ELZINGA-HOGARTY TESTS AND ALTERNATIVE APPROACHES FOR MARKET SHARE CALCULATIONS IN HOSPITAL MARKETS

H.E. Frech III
James Langenfeld
R. Forrest McCluer*

I. INTRODUCTION

Between 1993 and 2000, there were more than 1000 hospital mergers and acquisitions.[1] For all this activity, the antitrust enforcement agencies have challenged only a handful of cases. Their challenges in recent years have been remarkably unsuccessful; they have not prevailed on any of the six actions they have brought since 1992.[2] In contrast, before 1992 the agencies prevailed in all but one case. One of the main reasons behind this U-turn in court decisions is not difficult to identify. The courts' approach to geographic market definition has changed dramatically, and has led to lower market shares and concentration measures.[3]

---

* H.E. Frech III is Professor of Economics, University of California, Santa Barbara, California. James Langenfeld is a Director, LECG, LLC, and Adjunct Professor, Loyola University Chicago School of Law. R. Forrest McCluer is a Senior Managing Economist, LECG, LLC. The authors wish to thank Roger Blair and Jill Herndon for very helpful comments. Dr. Langenfeld was engaged by the plaintiffs in the *Sutter/Summit* merger discussed below; the opinions expressed in this article, however, are those only of the authors.

[1] *See* Cory S. Capps et al., *Antitrust Policy and Hospital Mergers: Recommendations for a New Approach*, 70 Antitrust Bull. 677, 677 (2002) (citing Irving Levin Assocs.).

[2] The vast majority of merger cases are brought by the enforcement agencies. The only exception we know of is *Santa Cruz Medical Clinic v. Dominican Santa Cruz Hospital*, 1995-2 Trade Cas. (CCH) ¶ 71,254 (N.D. Cal 1995) (allowing some of plaintiff's claims to survive summary judgment). Similarly, the State of California lost the only merger case it has pursued. *See* California v. Sutter Health Sys., 130 F. Supp. 2d 1109 (N.D. Cal. 2002).

[3] A few of the government losses were for reasons other than market definition. One challenged merger was allowed to proceed due to anticipated efficiencies and promised conduct. *See* FTC v. Butterworth Health Corp., 946 F. Supp. 1285 (W.D. Mich. 1996), *aff'd per curiam*, No. 96-2440 (6th Cir. July 8, 1997) (unpublished). A second merger was permitted based on a failing-firm defense, in addition to geographic market definition concerns. *See* California v. Sutter, 130 F. Supp. 2d. 1109 (N.D. Cal. 2002).

Other issues include the media and political backlash against managed care, a belief that nonprofit monopolies will be benign, and occasionally, an anti-federal feeling. *See*

Historically, courts found relatively small geographic markets. In what turned out to be one of the last cases to find a local hospital market, *United States v. Rockford Memorial*, the Seventh Circuit affirmed a decision to enjoin a merger of the two largest hospitals in Rockford, Illinois. Writing for a panel of four judges, Richard Posner stated that, "for the most part, hospital services are local. People want to be hospitalized near their families and homes, in hospitals in which their own—local—doctors have hospital privileges.[4] The court upheld the Department of Justice's finding that the geographic market was a three-county area, with a radius of about thirty miles.

Economic research literature on hospital competition tends to support this type of market definition.[5] In analyzing hospital competition, researchers often use fairly small pre-defined areas, such as counties or "SMSAs," which are small metropolitan statistical areas used by the U.S. Census Bureau. Sometimes, they have used pure distance measures from the merging hospitals, with radiuses in the 10 to 20 mile range.[6]

Despite the research, court decisions issued in the last several years have found much larger geographic markets. For example, a three-judge panel of the Eighth Circuit in *FTC v. Freeman Hospital* included hospitals as far away from Joplin, Missouri, as fifty-four miles (Springfield, Mo.) in a seventeen-county area.[7] Based on this larger market definition, the court permitted the merger of the larger two of Joplin's three hospitals. In *United States v. Mercy Health Services*, District Judge Michael J. Malloy

---

Thomas L. Greaney, *Night Landings on an Aircraft Carrier: Hospital Mergers and Antitrust Law*, 23 AM. J.L. & MED. 191 (1997).

[4] United States v. Rockford Mem'l Corp., 898 F.2d 1278, 1285 (7th Cir. 1990).

[5] *See* Capps et al., *supra* note 1; Robert Town & Gregory Vistnes, *Hospital Competition in HMO Networks*, 20 J. HEALTH ECON. 733 (2001). Both of these papers use a multinomial logit approach, which allows them to simulate mergers. They find that mergers, even within the metropolitan areas of Los Angeles and San Diego, can create enough market power to generate price increases well over 5%, suggesting that a hypothetical merger of all competitors in these areas would lead to price increases exceeding the 5% of the DOJ/FTC Horizontal Merger Guidelines. *See also* Cory S. Capps et al., *Designing Hospital Antitrust Policy to Promote Social Welfare*, *in* 2 FRONTIERS IN HEALTH POLICY RESEARCH 53 (Alan Garber ed., 1999) (suggesting a logit-based approach to market definition).

[6] For papers focused on distance traveled, see Lee Rivers Mobley & H.E. Frech III, *Managed Care, Distance Traveled, and Hospital Market Definition*, 37 INQUIRY 91 (Spring 2000), or, more briefly, Lee Rivers Mobley & H.E. Frech III, *The Impact on Distance Traveled by Hospital Patients*, ANTITRUST REP. 2, 3 (Apr. 1999). For earlier work that differentiated according to diagnosis, see Will White & Michael Morrisey, *Are Patients Traveling Further?*, 5 INT'L J. ECON. BUS. 203 (1998). For similar results (short distances traveled) with a different approach, see Town & Vistnes, *supra* note 5, at 746, 747.

[7] FTC v. Freeman Hosp., 69 F.3d 260 (8th Cir. 1995).

accepted a market definition that expanded the market around Dubuque, Iowa, to include major hospitals 70 to 100 miles away.[8] This decision would have allowed the only two hospitals in Dubuque to merge, except that the hospitals abandoned the merger after the decision and before an appeal could be heard. In the *FTC v. Tenet Health Care* case, the FTC challenged a merger of the two largest hospitals in Poplar Bluff, Missouri. After a favorable ruling for the FTC by the district court, the circuit court reversed the district court and found hospitals as far as Cape Girardeux in the relevant market—a distance of sixty miles from Poplar Bluff.[9]

In this article, we analyze the primary causes for the expanse of geographic markets and the resulting low market shares. In particular, we focus in detail on the Elzinga-Hogarty (E-H) and related tests, which have been used to define geographic markets based on patient admissions and discharges, commonly referred to as patient "flow" data. After a review of several reasons courts have turned to these approaches, and a description of the tests, we use a case study based on the facts presented by *California v. Sutter* to examine six different but economically reasonable implementations of the E-H test. Our comparison shows that geographic markets defined using patient flow data are sensitive to choices in methodology, and even to details in the analysis.[10] We find some of the approaches can suggest economically plausible geographic markets and others do not.

Although our case study confirms that patient flow data and E-H tests can be useful in helping to define geographic markets, one must carefully evaluate how the data and tests are being implemented and include other economic analyses. If done too simplistically, analyses based on patient discharge data can be misleading. We reject the frequently used "bright line" E-H test of 90 percent because it makes no economic sense. Moreover, our case study shows that even after a geographic market is determined, the decision as to which alternative method for calculating market share is used can also have a significant impact in evaluating market power.

---

[8] United States v. Mercy Health Servs., 902 F. Supp. 968 (N.D. Iowa 1995).

[9] FTC v. Tenet Health Care Corp., 186 F.3d 1045 (8th Cir. 1999).

[10] For related retrospective analyses of hospital mergers, see John Simpson, *Geographic Markets in Hospital Mergers: A Case Study*, 10 INT'L J. ECON. BUS. 291 (2003), and Michael Vita & Seth Sacher, *The Competitive Effects of Not-for-Profit Hospital Mergers: A Case Study*, 49 J. INDUS. ECON. 63 (2001).

II. GEOGRAPHIC MARKET DEFINITIONS APPLIED TO HOSPITAL SERVICES

The DOJ/FTC Merger Guidelines' approach market definition from the perspective of a "hypothetical monopolist,"[11] where the analysis in effect assumes that all of the producers of a given product within a geographic area collude and make pricing decisions. The relevant geographic market is defined to be the "smallest geographic area," in which this hypothetical monopolist would be able to implement a small and non-transitory price increase that would be profitable.[12]

A number of aspects of the hospital industry create challenges for product and geographic market analyses under the Merger Guidelines' approach. Hospital markets are typically defined as a cluster of hospital services. Many of these services are not substitutes in demand, though they may be substitutes in supply.[13] This service heterogeneity can affect geographic market definition analyses. For example, consumers needing high-tech services that are only offered in a few major hospitals will travel longer distances for these services.[14]

The multiplicity of services also makes analyzing pricing extremely complex. In receiving hospital care, consumers receive a bundle of many services (e.g., basic hospital services, tests and other specialized procedures, drugs, devices, operating theater rentals). The definitions of these services are not necessarily the same across hospitals. A typical hospital will have at least tens and possibly hundreds of prices for each of its services for different buyers (e.g., each managed care plan will have different prices, as well as different prices for Medicare, Medicaid, and local indigent care programs).[15]

---

[11] U.S. Dep't of Justice and Federal Trade Commission Horizontal Merger Guidelines (1992, revised 1997), *reprinted in* 4 Trade Reg. Rep. (CCH) ¶ 13,104 [hereinafter Merger Guidelines].

[12] For a detailed discussion of the application of the Merger Guidelines' test, see James Langenfeld, *The Merger Guidelines as Applied, in* THE ECONOMICS OF THE ANTITRUST PROCESS (Malcolm Coate & Andrew Kleit eds., 1996), and Gregory J. Werden, *The 1982 Merger Guidelines and the Ascent of the Hypothetical Monopolist Paradigm*, 71 ANTITRUST L.J. 253 (2003).

[13] For an early discussion, see H.E. Frech III, *Comments on Antitrust Issues*, 7 ADV. IN HEALTH ECON. & HEALTH SERVS. RES. 266, 267 (1987).

[14] *See* White & Morrisey, *supra* note 6, at 216. White and Morrisey find average distance varies according to DRG, ranging from 9.24 miles for hernia repair, to 15.77 miles for back and neck surgery, to 38.90 miles for kidney transplants. Note a problem with the DRG definitions. They are not pure diagnoses, but rather a mixture of diagnosis and treatment. Further, even within a DRG, patients travel farther for relatively more severe conditions.

[15] The differences between these prices are often huge. *See* Lucette Lagnado, *One Critical Appendectomy Later, Young Woman Has a $19,000 Debt.*, WALL ST. J., Mar. 17, 2003, at A1.

The bases of service prices also differ. Few payers pay list fee-for-service prices, as most receive discounts off list prices. Medicare and some private payers pay a dollar amount per admission, depending on diagnosis (the DRG system), but also adjust payment upward to account for the unusual costs of the most expensive patients. These adjustments, called outlier payments, are based partly on hospital charges.[16] On the other hand, many payers pay on a per diem (hospital days) or capitation basis. Each of these methods provides different incentives and allocate risks differently. In addition, because the costs of treatment for capitation or per diem payers depend on the exact makeup of the consumers in the group,[17] comparing pricing even within a category of payer can be complex. This is not to say pricing analyses in hospitals would be impossible, but they are difficult and have seldom been done.

Managed care may also make defining hospital markets difficult, for reasons beyond pricing. Before the growth of managed care, consumers selected their hospitals with little pressure from indemnity plans. In contrast, managed care plans often attempt to steer their members to particular hospital networks. The forcefulness of these efforts depends on the type of plan. In HMOs, the steering is strong because consumers often receive no benefits for using out-of-plan hospitals. In PPOs and point-of-service HMOs (POSs), consumers typically get reduced benefits (greater cost-sharing) if they use out-of-plan hospitals.

Under managed care, therefore, there are two stages of choice. First, the plan chooses which hospitals to put into its network. Second, the consumer chooses which hospital to use. Bifurcation of choice in managed care affects market definition in several ways. A focus on competition at the first stage—which hospitals are included in the network—is likely to lead to smaller market areas than a focus on second-stage competition.[18] Also, patient flow data are frequently analyzed with data from a single year, but changes in the hospitals included in a network

[16] This adjustment is a bit of an anachronism that may be changed soon. The best-known example of Medicare outlier payments comes from Tenet Hospital Corp. Tenet increased its Medicare outlier payments greatly by raising its charges, but ultimately reduced them under public pressure. *See* Ronald D. White, *Tenet Profit Up but Forecast Dims: Hospital Chain Cuts Fiscal 2003 Earnings as It Reduces the Amount It Charges Medicare*, L.A. TIMES, Jan. 14, 2003, at C1.

[17] For example, if payer A were to have healthier members than payer B, payer A would pay higher prices for services even if the per diem prices were identical.

[18] For a thorough discussion of the two levels of competition, see Gregory Vistnes, *Hospital Mergers and Two-Stage Competition*, 67 ANTITRUST L.J. 671 (2000). In discussing differences in market areas for the two stages of competition, Vistnes argues that because plans must appeal to diverse groups, they are not willing to exclude hospitals that are important to vocal minorities of members. *Id.* at 686. For a related analysis in terms of option value, see Capps et al., *supra* note 1.

occur over a longer interval.[19] Thus, patient flow analyses, including variations of E-H to be discussed below, tend to reflect migration related to consumer choice of hospitals (second-stage competition).

A related problem is whether managed care causes consumers to be willing to travel farther than they would otherwise. When managed care first emerged, researchers suggested that the growth of managed care would make consumers more willing to travel in response to small price differences than in the days of indemnity insurance. Empirical research on distance traveled, however, has shown this to be a dubious argument. Actual distance traveled has changed little with the growth of managed care, and managed care consumers travel almost the same distance as other consumers.[20]

III. DEVELOPMENT OF THE ELZINGA-HOGARTY TESTS AND CRITICAL LOSS ANALYSIS

Despite the complexities of hospital markets, the hospital industry offers analysts a wealth of reliable, publicly available data, which generally do not exist for other industries. For most states, it is relatively easy to obtain data regarding the residential zip codes of the patients admitted to and discharged from each hospital. These data allow analysts (and ultimately courts) to study the geographic areas in which the patients of a hospital live. Before testing the sensitivity of alternative approaches to analyzing patient flow data and E-H analyses, we briefly discuss how some of the courts have used the E-H tests and critical loss analysis.

A. The Elzinga-Hogarty Test as Conventionally Implemented

Based on the loose idea that a geographic market would usually be more or less self-contained, the E-H approach has come to be taken rather literally and mechanically by some economists and courts. The E-H method usually starts with two measurements. First, an analyst determines the geographic area responsible for a percentage of the sales of the hospital or hospitals in question.[21] Elzinga and Hogarty originally

---

[19] *See* Town & Vistnes, *supra* note 5, at 743. Over a three-year period in the early 1990s, a Los Angeles HMO with an average of 51 hospitals added two and dropped one from its network. Another Los Angeles HMO with an average of 34 hospitals added four and dropped two. *Id.*

[20] *See* Mobley & Frech III, *supra* note 6; White & Morrisey, *supra* note 6; Jack Zwanziger & Glenn Melnick, *Effect of Competition on the Hospital Industry: Evidence from California*, Competitive Approaches to Health Care Reform (R. Arnould et al. eds., 1993).

[21] As we discuss below, there is ambiguity even as to the starting set of hospitals. In a merger context, should it be one or both of the merging hospitals or should it include all hospitals that are obviously close competitors?

suggested an area responsible for 75 percent of sales, and then later suggested 90 percent for a "strong market" and 75 percent for a "weak market."[22] This area is sometimes called the service area, the draw area, or the catchment area. In the context of health care markets in particular, and in the markets for services more generally, the measure of the service area is referred to as the Little In From Outside (LIFO) measure.[23] Put simply, this means that the hospitals service few patients from outside the service area. The second measurement is the percentage of residents in the service area who obtain their care from hospitals within the area. This is called the Little Out From Inside (LOFI) measure. Again, in the simplest terms, this means that few patients from the service area obtain care outside of the area. The economic presumption is that these static measures are inversely proportional to the number of patients who would switch to hospitals outside the service area in the face of a post-merger price increase. That is, the larger the percentage of patients who leave the proposed market, the larger the number of patients that would switch to hospitals outside the market.

The courts recently have strictly applied the 90 percent "strong" test. In *California v. Sutter*, Judge Maxine Chesney was very clear in stating that "The Court finds a service area based on the 90 percent level of significance . . . to be more appropriate than one based on an 85 percent threshold as proposed by plaintiff. Courts have generally acknowledged the 90 percent level of significance."[24]

However, no one has articulated an economic rationale for 90 percent, 75 percent, or any other percentage. Indeed, there are significant problems with relying on this type of "bright-line" interpretation of patient flows. Flows of patients measured by some arbitrary and static level of migration in or out of any area do not necessarily imply that consumers who are not migrating would change their behavior and become migrants in response to a small price increase.[25] Some migration among hospitals

---

[22] Kenneth G. Elzinga & Thomas F. Hogarty, *The Problem of Geographical Market Delineation in Antimerger Suits*, 18 ANTITRUST BULL. 45 (1973); Kenneth L. Elzinga & Thomas F. Hogarty, *The Problem of Geographical Market Delineation Revisited: The Case of Coal*, 23 ANTITRUST BULL. 1, 2 (1978).

[23] The terminology can be confusing. Our definition is based on the flows of patients, not flows of services or products. The usual application in other industries focuses on flows of products, so it would reverse our definitions.

[24] California v. Sutter, 130 F Supp. 2d. 1109 (N.D. Cal. 2002).

[25] *See* Gregory J. Werden, *On the Use and Misuse of Shipments Data in Defining Geographic Markets*, 26 ANTITRUST BULL. 719 (1981) (providing a general discussion). For a specific application to hospital markets, see Gregory J. Werden, *The Limited Relevance of Patient Migration Data in Market Delineation for Hospital Merger Cases*, 8 J. HEALTH ECON. 363 (1990). For the argument that the contestable zip code approach implicitly assumes that consumers have identical preferences, see Vistnes, *supra* note 18, at 689–90. But this assumption of

is for reasons other than price sensitivity. Consumers migrate from small towns to larger cities for higher perceived quality or more sophisticated services. They also migrate because they have family, friends, or business relations near the hospitals. This type of migration does not indicate that the distant hospitals constrain each other's price and quality.[26]

Nonetheless, experts and courts use patient flow data to build geographic markets. The first step of the conventional approaches is to determine the merging hospitals' service area by "ranking" relevant zip codes. The zip codes are usually "ranked" in three ways: (1) by location or proximate distance from the hospitals, (2) by the greatest total number of patients from the zip code who use the hospitals, or (3) by the largest hospital share of business within the zip code. For example, if one uses the 75 or 90 percent threshold, the highest ranked zip codes are collected until the accumulated zip codes account for 75 or 90 percent of the hospitals' business. The share of business can be counted by patient discharges, patient days, or revenue. While revenue is perhaps the most appealing from an economic viewpoint, data limitations usually result in the analysis being done with patient discharges. After the service area is determined based on ranking, it is tested to see if it meets the LIFO and LOFI tests at the selected percentage, 75 or 90 percent.[27] If the initial service area does not pass the LIFO/LOFI test, it is expanded.

Each approach to ranking has its own advantages and disadvantages. The first method, distance to the hospitals, is relatively simple but has economic content only to the extent that it approximates transportation time to the hospitals and patients prefer less travel time. The second method, which ranks zip codes according to the largest number of patients, is based on the notion that it will include the zip codes that contribute most to the hospitals' profitability. However, a large but distant zip code may be included in the service area even if a small fraction of its patients went to the merging hospitals. The third method, which ranks zip codes based on the hospitals' market shares, identifies the area where the merger hospitals are more likely to have market power. It

identical preferences creates other problems. If consumers have identical preferences, why do some migrate and some do not? It can hardly be random behavior because the percentage migrating is stable over time and rationally related to distance.

[26] For a formal theoretical analysis, *see* Werden, *The Limited Relevance of Patient Migration, supra* note 25. For an empirical demonstration that mergers within large metropolitan areas can reduce competition and raise prices, see CAPPS ET AL., THE SILENT MAJORITY FALLACY OF THE ELZINGA-HOGARTY CRITERIA: A CRITIQUE AND NEW APPROACH TO ANALYZING HOSPITAL MERGERS (Working Paper No. 8216, National Bureau of Economic Research, Apr. 2000).

[27] Note that the LIFO percentage is not generally identical to the service area threshold because often the service area includes additional hospitals. The LIFO percentage is the percent of care received from all hospitals in the area, not the hospitals in the initial service area.

also eliminates the problems of zip codes of different sizes potentially extending the service area just because they are large.

Although there are strong economic arguments for using zip codes ranked by share, two district courts have endorsed the second method of ranking by simple numbers of patients. In *California v. Sutter*, Judge Chesney explained that the "method of ordering zip codes by the actual numbers of patients . . . more accurately reflects the importance of a zip code to the area from which a hospital draws its patients, and is also the manner in which hospitals determine their own service areas."[28]

When the E-H method must account for multiple hospitals in the same initial service area, a second important choice must be made. One must decide how to rank zip codes of the different hospitals in putting together what we will call an E-H market. There are two typical choices. First, rank each hospital's zip codes separately, and then combine each of these different areas into a tentative geographic market. Second, combine the hospitals' patient flow data that are in a hypothetical market, and then use the combined patient flows to form a single ranking. While this choice has gotten little attention, it turns out that it often greatly affects the ultimate results of the E-H method.

More specifically, the "rank, then combine" method first ranks zip codes of each of the merging hospitals separately, then includes all zip codes that are in the service area of either hospital. If that "union" of the service areas includes any additional hospitals, the service area of each of those additional hospitals is calculated separately at the same threshold. The preliminary market area includes all the zip codes that are in the service areas of any one of these hospitals.

Figures 1–4 illustrate the application of these approaches. Figure 1 shows the 75 percent service area around H, the Hospital of interest, which also includes two other hospitals, Hospitals A and B. Figure 2 shows the service areas of Hospitals A and B, illustrating the overlap between those areas and that of Hospital H.

Figure 3 depicts the analysis based on the "rank, then combine" method. If LIFO/LOFI statistics on H's service market alone fail to pass the test at the 75 percent threshold level, then one expands the size of the potential market to include the discharges from Hospitals A and B. Next, one calculates the 75 percent service area of Hospitals A and B, and combines the three service areas, including all zip codes that are in the service area of any hospital. This generates the preliminary market area shown in Figure 3.

---

[28] California v. Sutter, 130 F. Supp. 2d at 1122; *see also* FTC v. Freeman Hosp., 69 F.3d 260 (8th Cir. 1995).

At this point, one calculates the LIFO and LOFI for all hospitals located in this larger preliminary market area. If the calculation meets the threshold minimum for LIFO and LOFI, then the preliminary market area is the E-H market for that threshold. If not, one identifies all of the additional hospitals included in A's and B's 75 percent service areas, locates their 75 percent service areas, and calculates the LIFO and LOFI. This approach usually leads to hospitals progressively further away being included in the market, even if there is only minimal or no overlap between the "new" service areas and that of Hospital H.[29]

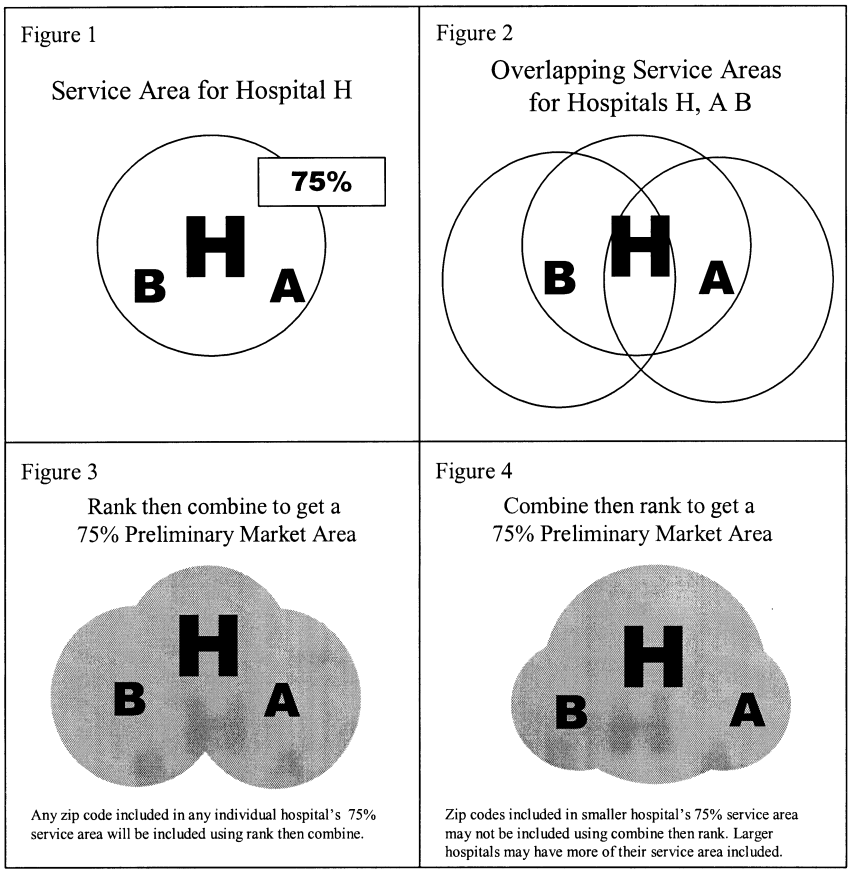
In the "combine, then rank" method, which is illustrated by Figure 4, the starting point is the same: the initial service area of Hospital H. If the LIFO/LOFI statistics based on this service area do not surpass the selected threshold level, then the "combine, then rank" method expands the market area by hospitals A and B, as before. However, in contrast to the "rank, then combine" approach, the discharges from all three hospitals are grouped together and ranked without regard to the originating hospital to calculate their combined service area. The service area of the combined hospitals is the preliminary market area, as shown in Figure 4. The "combine, then rank" method results in the inclusion of more zip codes from the service areas of larger hospitals, and fewer zip codes from the service areas of smaller hospitals. The method tends to lead to smaller market areas, and makes it less likely that more-distant hospitals will be included in the relevant market.

As with the "rank, then combine" approach, the next step is to check the LIFO and LOFI numbers to see if the desired threshold (presumably 75 or 90 percent) has been met or surpassed. If not, one can iterate by redoing the same method, adding more hospitals as indicated. If no additional hospitals are identified and the LIFO/LOFI statistics still fall below the threshold—for example, 75 percent—then this method would have failed to obtain a 75 percent LIFO/LOFI market area. The process can then be repeated with a higher or lower service area threshold. A higher threshold will lead to a larger initial service area, possibly including more hospitals. A lower threshold will lead to the opposite result.

A number of complications may arise with these conventional approaches to ranking. First, the ranking may result in noncontiguous areas. Although arbitrarily adding or dropping zip codes to fill in holes or removing outlying areas can address this problem, such a solution is

---

[29] The defendants' expert in *California v. Sutter* used a similar approach when she presented a series of 90% service area circles. She used these circles to argue that hospitals that did not directly compete with the merging hospitals (no overlap in service areas) should be included in the same geographic market. *California v. Sutter*, 130 F. Supp. 2d at 1125–26.



Figures 1–4. Expanding Market Areas with Overlapping Service Areas

subjective and can easily be criticized. Second, the threshold criteria for selecting the service area does not assure that the resulting LIFO and LOFI statistics will satisfy the initial threshold criteria. For example, a 75 percent service area may have LIFO and LOFI percentages well below 75 percent. This can be addressed by an iterative process of adding hospitals, as is discussed above. However, the process can continue indefinitely, expanding in area at each step.[30] Each time the service area expands, it picks up new hospitals that serve some patients outside of the area, leading to new expansions. Logically, the process must

[30] The "combined, then rank" approach may lead to zip codes originally included dropping out of subsequent iterations. In our work, we stop if the LIFO/LOFI criterion is not met in six iterations.

eventually stop. Until we have either people or hospitals in outer space, the LIFO and LOFI for the entire world as a geographic market must be 100 percent. This possibility of having no plausible E-H market is no mere theoretical oddity. Defendant's expert in *FTC v. Tenet* found no plausible E-H market at either the 75 percent or the 90 percent threshold in the Poplar Bluff, Missouri, area. Indeed, even when he included all the data from the entire state of Missouri, he still found no E-H market.[31] This result does not make economic sense. The relatively small Poplar Bluff hospitals in all likelihood compete in a geographic market smaller than the entire state.

B. The Elzinga-Hogarty Test—Alternative Approaches

Some of the weaknesses of the conventional ranking methods are avoided with expanding radius and contiguous-search approaches. Both approaches simultaneously evaluate the ultimate E-H criteria, LIFO and LOFI, when determining whether a geographic market surpasses a given threshold criteria. Additionally, for contiguous land masses they ensure contiguous areas during the process.

1. *Expanding Radius Approach*

This approach begins at a geographic point, selects a distance radius, and includes all of the zip codes within that radius.[32] One then calculates the LIFO and LOFI statistics. The radius is then expanded in increments, and the LIFO and LOFI statistics are recomputed. This approach expands the radius until the LIFO/LOFI statistics surpass a given threshold. This method addresses two of the problems with conventional E-H ranking methods. It assures that the selected area will be contiguous, and its expansion is based directly on the LIFO and LOFI criteria of interest.

However, there is one major drawback. The market is forced into a circular shape, ignoring key geographic features that affect markets, such as highways, mountain, rivers, and lakes. For this reason, the expanding radius approach can be difficult to justify, and we give more attention to the contiguous search method discussed below.

2. *Contiguous Search Approach*

While the expanding radius approach described above did take advantage of geographic information to some extent, one can do better than

---

[31] Expert Report of Barry Harris at 26, *FTC v. Tenet Health Care Corp.*, 186 F.3d 1045 (8th Cir. 1999) (undated).

[32] For an example of the radius approach in research literature, see James Robinson & Hal Luft, *The Impact of Hospital Market Structure on Patient Volume, Average Length of Stay, and the Cost of Care*, 4 J. Health Econ. 333 (1985).

imposing circles on the geography. With the contiguous search approach, we start with a small area and then expand the area one zip code at a time.[33] One does this by adding the zip code that contributes most to higher LIFO and LOFI statistics—that is, the most strongly connected zip code.

Expanding the area in this manner gives additional insights into patterns of patient migration. One is able to surmise which areas are "core" and which are "secondary." The "core" areas are picked up in the early iterations because they contribute more to the LIFO and LOFI criteria. This approach provides an economically rational and intuitive way to examine geographic markets characterized as a continuous gradient, and not a clear dichotomous distinction of being "In" or "Out."[34] The starting point economizes on information, much like the expanding radius approach. One only need specify one small region to start. Further, the exact search procedure can be modified to avoid rigidly locking in the starting region.

There are three parameter settings that one needs to consider when implementing this algorithm: threshold criteria, search criteria, and search direction. Much of the literature and case law focuses on just two values for the threshold criteria, the 75 percent "weak" and the 90 percent "strong." Because no rigid threshold is necessarily related to the DOJ/FTC Merger Guidelines' methodology for market definition or the basic economics, we use several threshold values in our case study. The search criterion is the minimum of the LIFO and LOFI numbers, which is consistent with using E-H to assist in geographic market definition. The search direction determines the order in which zip codes are added. The simplest approach, which we employ, is called "ADD 1."[35]

C. Critical Loss Analysis, "Contestable Zip Codes," and Overlapping Patient Draw Areas

Along with the E-H method, courts and analysts have turned to "Critical Loss Analysis" in an effort to directly address the DOJ/FTC Merger

---

[33] For a detailed discussion of the contiguous-search approach, see R. Forrest McCluer, A Contiguous-Search Approach to Elzinga-Hogarty Analysis of Geographic Markets (2003) (unpublished paper on file with author).

[34] The conventional methods can analyze different points on the continuum of LIFO and LOFI measures only by varying the thresholds.

[35] This ADD 1 approach is rigid in that once a region is added to the preliminary market area, the region will also be in the final geographic market area. This can be relaxed. For example, one can choose an ADD 2/DROP 1 approach, where one adds zip codes, just as before, but on the third step the region associated with the worst LIFO/LOFI statistics is dropped. One could run the search in the opposite direction, starting with a very large

Guidelines' market definition question of whether a given price increase would be profitable for a hypothetical monopolist. First proposed by Barry Harris and Joseph Simons in 1989, critical loss analysis is now commonly used to help create or critique market definitions.[36]

The critical sales loss is defined as the decrease in sales resulting from a hypothetical price increase that is just large enough to make the price increase unprofitable. The critical loss is then compared to the loss expected from the price increase. If the expected actual sales loss exceeds the critical loss, it follows that the price increase would be unprofitable. If the hypothetical price increase would be unprofitable, then the market has been defined too narrowly.[37] This approach can produce relatively large market areas, particularly if it does not take certain appropriate adjustments into consideration.[38]

A predicted actual loss due to a price increase must be generated to compare to the critical loss. An increasingly common approach is to predict willingness to respond to price from market shares within an area. This is the concept of the "contestable zip code" or overlapping service areas, and courts have accepted this approach.

In *FTC v. Tenet Health Care Corp.*, the defendant's economic expert showed that in 25 of the 31 zip codes of the 90 percent service area of the merging hospitals, at least 20 percent of the patients went to some other out-of-town hospital. He called these "contestable zip codes" and maintained that consumers living in these zip codes were willing to travel to other hospitals in response to small price increases, and this potential migration would defeat any attempt of the merged entities to raise price.[39]

In *California v. Sutter*, district court judge Maxine Chesney followed a somewhat different logic, but similarly decided that the potential loss due to a price increase would be larger than the critical loss. In particular,

---

region, perhaps an entire MSA, and then use a DROP 1 or DROP 2/ADD 1 search direction to shrink the region.

[36] Barry C. Harris & Joseph J. Simons, *Focusing Market Definition: How Much Substitution Is Enough*, 12 RES. L. & ECON. 207 (Richard O. Zerbe Jr. ed., 1989).

[37] For a fuller explanation, see Barry Harris, *The Economics of the Dubuque Hospital Decision*, ECONOMISTS INK (Newsletter of Economists Inc.) (Spring/Summer 1996).

[38] *See* Kenneth L. Danger & H.E. Frech III, *Critical Thinking About "Critical Loss,"* 46 ANTITRUST BULL. 339 (2001); James Langenfeld & Wenquing Li, *Critical Loss Analysis in Evaluating Mergers*, 46 ANTITRUST BULL. 299 (2001); Gregory J. Werden, Beyond Critical Loss: Tailoring Applications of the Hypothetical Monopolist Paradigm (unpublished paper, Antitrust Division, U.S. Dept. of Justice, July 22, 2002) (on file with author).

[39] FTC v. Tenet Health Care Corp., 186 F.3d 1045, 1053 (8th Cir. 1999). More detailed, and more skeptical, commentary on Harris's analysis is contained in the district court decision, *FTC v. Tenet Healthcare Corp.*, 17 F. Supp. 2d 937, 942, 944–45 (E.D. Mo. 1998). *See also* Harris Expert Report, *supra* note 31, at 27–30.

she noted that the 90 percent service area of the merging hospital overlapped with the 90 percent service areas of several other hospitals, and in effect that the 90 percent service areas of those other hospitals overlapped the service areas of more distant hospitals. She concluded that such overlaps implied that consumers could, in practice, turn to these distant hospitals in case of an anticompetitive price increase.[40]

While this point has not been much appreciated, the "contestable zip code" approach is closely related to the E-H analysis. As applied by the courts, both are based on the assumption that current patient flows indicate that consumers would switch to more distant hospitals in response to a small price increase. Thus, with both of these approaches, to complete the analysis, one must estimate how many patients would actually switch in the face of a price increase.

IV. MARKET SHARE AND HHI CALCULATIONS

Once the geographic market is defined, the next step in antitrust analysis is typically calculating the hospital market shares. There are two economically reasonable approaches to assessing a hospital's market share: the "supply-side" (hospital-based) and "demand-side" (patient-based) approaches. In hospital cases, the antitrust agencies have traditionally used the supply-side approach, basing calculations on the patient discharges or capacity of the hospitals in the geographic market. An alternative approach is to base the calculation on the discharges of consumers who live in the geographic market. The demand-side approach has been presented to the antitrust agencies by private parties in recent years, and was considered by the judge in the *Summit/Sutter* merger.

From a consumer choice perspective, hospital market shares are computed based either on where the consumer lives or where he or she consumes hospital services. Consider a product market analogy. The supply-side approach includes exports but excludes imports. The demand-side approach is just the opposite.

Both approaches have conceptual and methodological shortcomings and advantages. The supply-side approach presumes that market power is better measured by the capacity of the local hospitals, that there is no geographic price discrimination, and that the services offered by hospitals outside the geographic market are not good substitutes for the services offered by the hospitals inside the market. This approach may suffer from "sample selection" bias. That is, the denominator is calculated

[40] *California v. Sutter*, 130 F. Supp. 2d at 1125–26.

based on consumers who have already made the choice to go to a hospital in the area.

The demand-side approach more closely follows the FTC/DOJ Merger Guidelines' methodology by focusing initially on consumer choice. It is most appropriate where there is geographic price discrimination and where the services of hospitals outside the market are good substitutes for the services of hospitals inside the market. However, price discrimination based on geographic location typically has not been found in hospital markets. The demand-side approach also ignores out-of-town consumers and may suffer from measurement problems because the data on out-of-state services are not readily available.[41] In addition, because the hospitals themselves often are the source of data, the supply-side data is easier for them to obtain. These problems may have contributed to the more common use of the supply-side approach.

V. CASE STUDY: APPLICATION OF DIFFERENT APPROACHES TO E-H ANALYSES AND MARKET SHARE CALCULATIONS IN THE *SUMMIT/SUTTER* MERGER

To illustrate the effects of different approaches to analyzing patient flow data, we apply them to data taken from the most recently litigated hospital merger, *California v. Sutter*. We are able to use public data available from the State of California, to which we apply six E-H methodological approaches. We examine four variations of the conventional zip code ranking approach: the two ranking methods and the two methods expanding the service area when additional iterations are needed. In addition, we examine the radius approach and the contiguous-search approach.

All six approaches require choices (e.g., initial thresholds, radius, rounds, criteria, ranking procedures, etc.) that directly influence the LIFO/LOFI statistics. We examine how some of these choices influence the geographic market results and the corresponding market share calculations.

A. Background: The *Sutter/Summit* Merger

In 1997, two hospitals located in the vicinity of Oakland, California—Summit Medical Center and Alta Bates Medical Center—gave notice that they planned to merge. The State of California challenged their merger. The state hypothesized an "inner East Bay" geographic market

[41] However, some contiguous states have reciprocal data sharing and reporting agreements. For example, the Department of Health in Missouri is able to report the number of Missouri residents who were treated in Kansas hospitals and vice versa.

based on geographic considerations (mountains, the Bay, etc.), company documents, and testimony from payers. It then tested that market using an 85 percent E-H test and critical loss analyses. The state's definition of the product and geographic market provided a post-merger market share of almost 50 percent based on supply-side market share calculations.

The defendants argued that the relevant geographic market was much larger than the state's, based on a set of overlapping service areas which they claimed linked the more-distant hospitals with the merging hospitals. The defendants also presented their own critical loss analysis. They argued that the relevant geographic market extended throughout the Bay area and beyond (including San Francisco, San Jose, and counties across the mountains east and south of Oakland), never defining the limits of their geographic market. The defendants' market share calculations were based on the 90 percent service area of the merging hospitals and on demand-side market share calculations, which resulted in a much lower estimate of the post-merger market share of the merging hospitals. The court ultimately ruled in favor of the merging parties.

B. Data and Preliminary Choices

For our analysis we use 1997 inpatient hospital discharge data from the California Office of Statewide Health Planning and Development, which were available at the time of the merger. We define the product market as acute-care inpatient hospital services, including special as well as general hospitals. We exclude DRGs associated with rehabilitation, drug dependencies, psychological evaluations, and newborns,[42] which leaves about 83 percent of all discharges. This "cluster" product market of inpatient services is the approach commonly used in hospital merger product market definition, and is consistent with the product market used in the merger litigation in *Summit/Sutter* and the other recent merger challenges.

As has become common, we use data at the zip code level,[43] and drop discharges of people who live outside the United States. We did however, include out-of-state discharges. "Point zip codes," most frequently used for large buildings, were assigned to the enclosing zip code. We encountered a few hospitals in the discharge data whose own zip codes could

[42] Thus, the following DRGs were excluded: 391, 462, and 424–437 inclusive. Newborns are excluded to avoid double counting.

[43] Although zip code data give more geographic precision, there is a disadvantage. The numbers of discharges can be small enough to generate statistical noise, especially if one looks at only a single diagnosis, and zip codes can vary greatly in the population they represent.

not be determined. The corresponding discharges were dropped, about 1 percent of the total. We also excluded observations if they could not be geographically located. After these corrections, the resulting dataset consisted of 2,998,602 discharges from 1997, 81 percent of the total original observations.

A number of methodological choices must be made prior to conducting this comparative analysis of geographic market definition criteria. For example, we must decide how to weigh LIFO and LOFI, as they do not necessarily move together. In the *Rockford* case, the two statistics were averaged. Though there is no obvious rationale for the choice, it has been conventional to use the lower of the two statistics as the criteria. We follow that convention. We also follow the common approach of using patient discharges rather than patient days or revenue as our measure for ranking.

C. Evaluation of Approaches: Empirical Results

To evaluate the six methodologies, we apply each to our data. In the case of the four conventional ranking approaches, we run each method with a range of initial minimum threshold "service area" values for each of the merging hospitals (rank, then combine) and for the combined merging hospitals (combine, then rank). These service areas are defined by first ranking zip codes from highest to lowest, based on either the absolute number of patients going to the merging hospitals or the percent of each zip code that go to the merging hospitals. Given these rankings, the service area then takes the highest zip codes and includes them in the service area until they add up to a given level of the merging hospitals' patients.

For the "number of patient" and the "percent" approaches, we start by calculating service areas that account for 50 percent of the merging hospitals and add increments up to 90 percent at 1 percent steps, resulting in 40 evaluation points. For the radius approach, we start with a radius of 1 mile and add 1 mile increments up to a radius of 60 miles. For the contiguous-search approach we use the ADD 1 search-direction and added up to 150 zip codes. We refer to these increments as the "step variables." For ease of interpretation, we present the results graphically in charts and maps.

1. *Comparison of LIFO/LOFI and Post-Merger HHI*

Chart 1 shows the relationship between the step values for each approach and the resulting LIFO/LOFI statistics. For the conventional ranking methods, shown in panels A through D, the horizontal axes show minimum service area thresholds. These charts can be read from

the lowest minimum service area threshold of 50 percent on the left to 90 percent on the right. The vertical axis plots the LIFO and LOFI figures that correspond to each additional increase in the minimum percent service area threshold. Panels A through D illustrate the differences in the patterns between ranking by count and ranking by market shares (A and C by count, B and D by share). These panels also show the differences between the "rank, then combine" (A and B) and "combine, then rank" (C and D) for both the count and share approaches.

All four of these charts show that it is virtually impossible to obtain a 90 percent E-H market, regardless of the approach used. Even when the service area threshold is 90 percent, none of these approaches yields a 90 percent LOFI, though in some versions there is a 90 percent LIFO. That is, even after enlarging the area to account for the service areas of the extra hospitals included, more than 10 percent of the consumers obtain care from hospitals outside of the area. Note the jump in LIFO at about the 76–78 percent level for the "rank, then combine" approach (A and B). This reflects a noticeable increase in the size of the area, as we discuss below.

Interpreting the LIFO/LOFI statistics for the radius and contiguous approaches shown in Panels E and F approaches is simpler. On the radius method, Panel E, the horizontal axis is the mileage radius itself. Panel E shows that the 70 percent E-H market occurs at a 10-mile radius, while the 90 percent E-H market fails to exist, even at a 60-mile radius. At 60 miles, the LIFO is about 94 percent, but the LOFI is only about 85 percent. The radical changes between five and ten miles show the effects of including San Francisco when the radius extends across the Bay.

On the contiguous search method, the horizontal axis is the "round," which corresponds to the number of zip codes in the preliminary market. The contiguous search approach, Panel F, generates a 70 percent E-H market at about 30 rounds (30 zip codes). Like all the other methods, it cannot generate a 90 percent E-H market, even with 150 rounds (zip codes), although it does come close.

None of the methods are monotonic, in that raising the service area does not always raise the ultimate LIFO or LOFI. Adding areas can drive LIFO and LOFI down.[44]

---

[44] Accordingly, one might think that the contiguous search method would be monotonic, since it adds the best possible zip code at each iteration. But, as panel F shows, this is not so. Both LIFO and LOFI often decline with further iterations, especially between 50 and 90 rounds. Adding the best zip code may not raise the LIFO or LOFI when surrounding zip codes have patient in-migration or out-migration patterns that differ significantly from the ones already in the preliminary area. This tendency is mitigated by using the ADD 2/DROP 1 or DROP 1 approach. *See* McCluer, *supra* note 33.

Chart 1
Comparison of Geographic Market Methodologies, 1997
Elzinga-Hogarty LIFO/LOFI Statistics

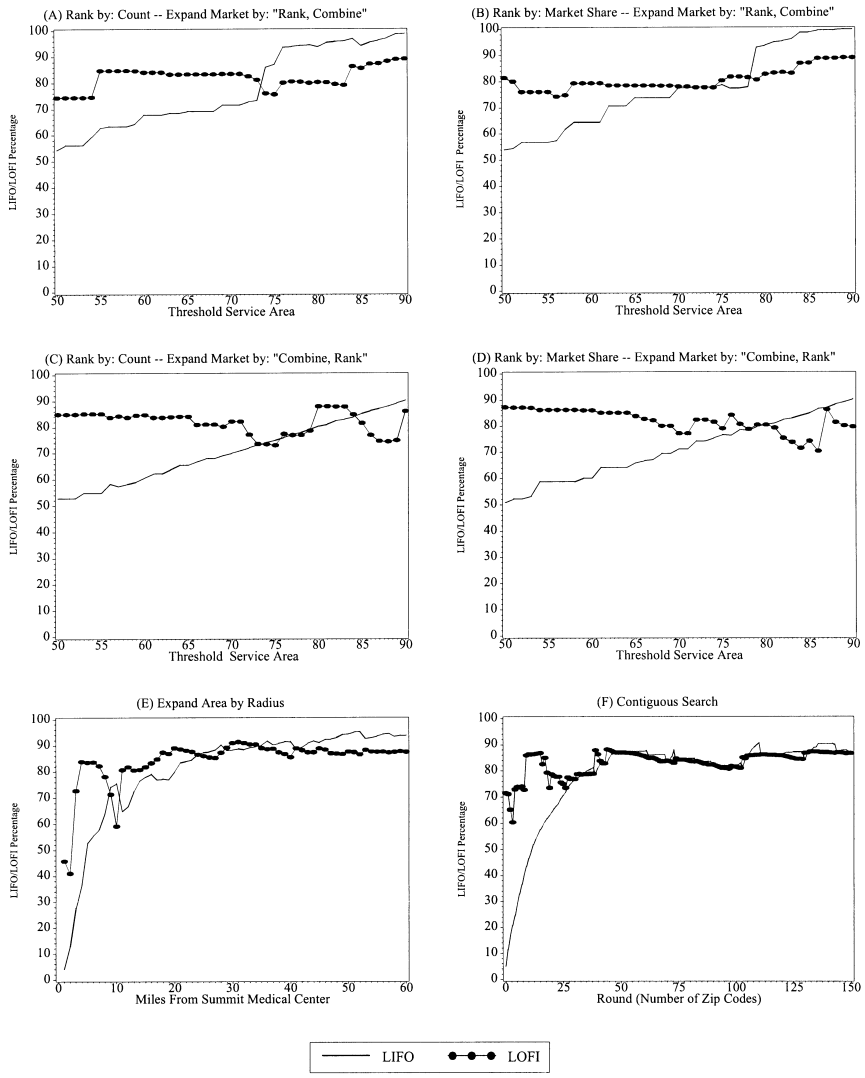


Chart 2 has the same horizontal axes for each of the E-H methods, but shows the post-merger HHI values as the vertical axes. Each panel compares HHIs calculated using the supply-side (hospital-based) and demand-side (patient-based) approaches. For reference, a line is drawn on each panel at the HHI of 1800, the level that can trigger antitrust concern under the FTC/DOJ Merger Guidelines.

Of particular interest are the different results that come with relying upon patient-based versus hospital-based analyses. The difference is most apparent with higher HHIs. For example, Panel D shows that at the 85 percent threshold, the demand-side HHI is below 1500, while the supply-side HHI is much higher at about 2600.

Within the conventional ranking methodology, the "rank, then combine" approach using either the number of patients or the zip code share precipitously drops under the 1800 level for a supply side (hospital-based) HHI at threshold service area values between 70 and 80 percent. The "rank, then combine" approach resulted in demand-side (patient-based) HHIs that are usually lower up to the 75 to 80 percent service area thresholds. In Panel C, showing "rank, then combine" based on patient count, the supply-side HHI increases between the 75 and 80 percent service area calculations. This results from the addition of Eden's Hospital to the geographic market. This hospital is owned by Sutter, so its output is added to the market share of the merging hospitals, raising the HHI. As discussed above, this method creates more links between geographically distant hospitals, even when distant hospitals' service areas do not overlap in any significant way with the service area of the merging hospitals.

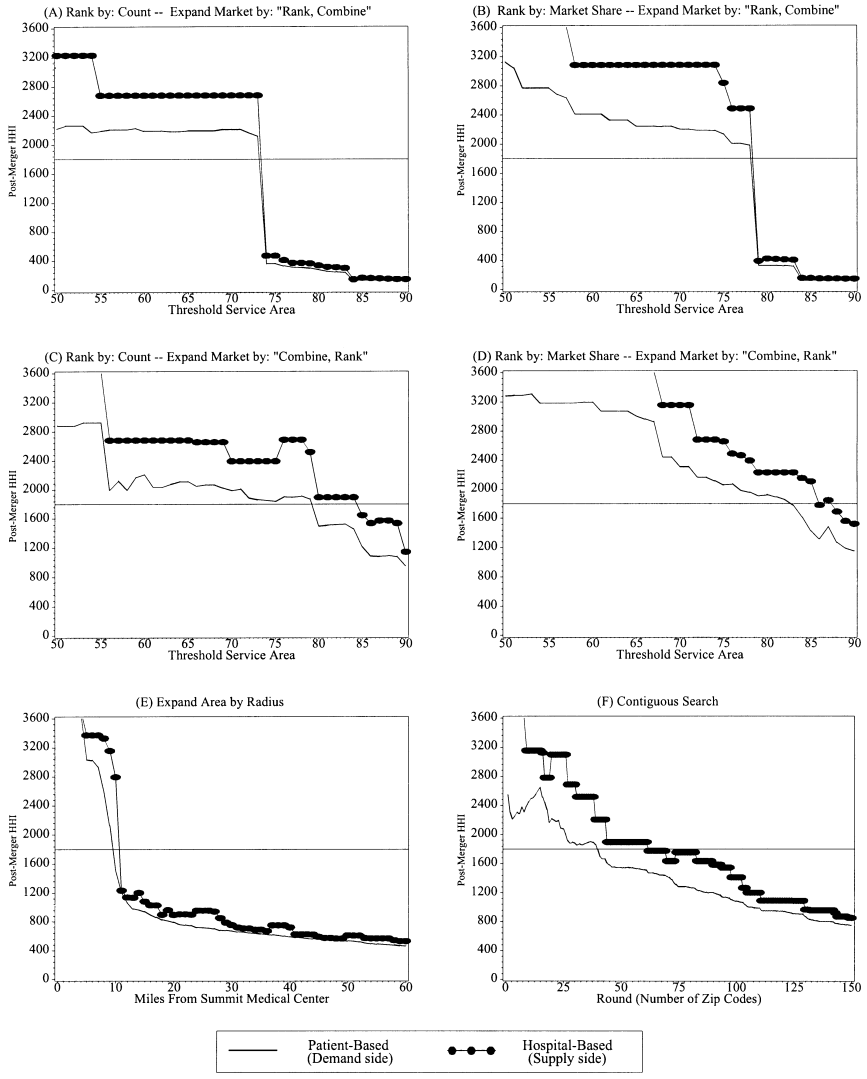
The "combine, then rank" approach does not drop to 1800 until in the vicinity of 80 percent or higher for supply-side HHI. The demand-side (patient-based) HHI is lower, approaching and then dipping below 1800 for somewhat lower threshold values.

The radius approach drops under the 1800 HHI level at a minimum LIFO/LOFI statistic in the 60–70 percent range at around ten miles for both the patient-based and hospital-based measures. The contiguous search approach drops below the 1800 HHI level with between twenty-five to thirty zip codes for demand-side HHI. However, the supply-side HHIs are much higher, and do not dip below 1800 until one includes sixty zip codes. The increase in the HHIs for additional rounds reflects the impact of Sutter's ownership of Eden's hospital.

2. *Maps of Elzinga-Hogarty Market Areas*

Charts 3 and 4 show the geographic markets based on each of these six approaches. In Chart 3, the markets meet the minimum (LIFO, LOFI)

Chart 2
Comparison of Geographic Market Methodologies, 1997
Post-Merger HHI - Hospital-Based versus Patient-Based



criteria of 75 percent.[45] Their areas differ quite a bit, illustrating why the approaches lead to very different supply-side HHI results, ranging from 474 to 2,836.[46] The "rank, then combine" based on patient count illustrated in panel A leads to the largest geographic area. This approach includes San Francisco, the most significant population area in Northern California, and has the lowest HHI.

None of the conventional ranking methods used for Panels A through D guarantee contiguity. Nonetheless, most of the zip codes are contiguous, with the exception of Panel A. If taken as if they were correct and other evidence ignored, the higher HHIs under the DOJ/FTC Merger Guidelines would suggest substantial antitrust concern, while the lower ones would suggest little concern. None of these geographic areas appear absurd with the exception of the "rank, then combine" based on patient count. As indicated above, this method is similar to the analysis presented by the defense in the litigation. Three of the charts (C, D, and F) show areas that are quite similar to the geographic market alleged by the plaintiffs in the merger.

In Chart 4, the markets shown meet the minimum LIFO/LOFI criteria of 80 percent, the highest limit at which all methods could produce an E-H market.[47] Panels A and B show that the conventional methods that "rank, then combine," are unstable within this range of thresholds. Going above 75 percent, these methods pick up large numbers of hospitals and large geographic areas, leading to E-H markets that are truly breathtaking; they are approximately 400 to 600 miles long and 200 miles wide. The corresponding HHI measures are strikingly low at 340 and 425. If taken as correct, these measures would suggest a highly unconcentrated

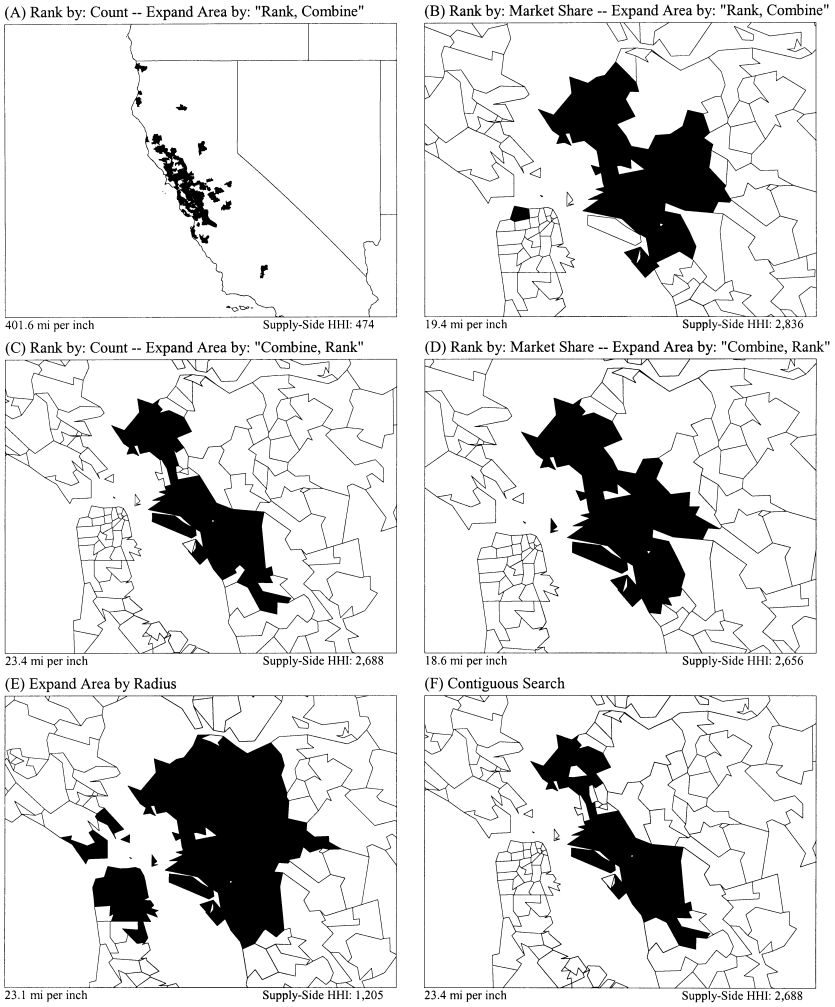
---

[45] Note the small gap in the middle of the conventional and radius methods. The gap corresponds to a zip code with no hospital discharges in 1997. These methods never add a zip code unless it has a least one discharge. The contiguous search method avoids the gap because it adds the best zip code at each stage. There are stages where any zip code with patients reduces the LIFO or LOFI, so the method would add a zip code with no discharges. While not important for our central point, this highlights the problem of statistical noise in discharges from low population zip codes.

[46] For simplicity, we present only supply-side HHIs in the text and on the maps. The demand-side HHIs are generally similar in four of the methods, though smaller when using the "combine, then rank" method to account for other hospitals. See Chart 2. Also note that at the time of the merger the plaintiffs calculated higher market shares for the merging hospitals based on evidence that Kaiser would be closing one of its major hospitals in the East Bay.

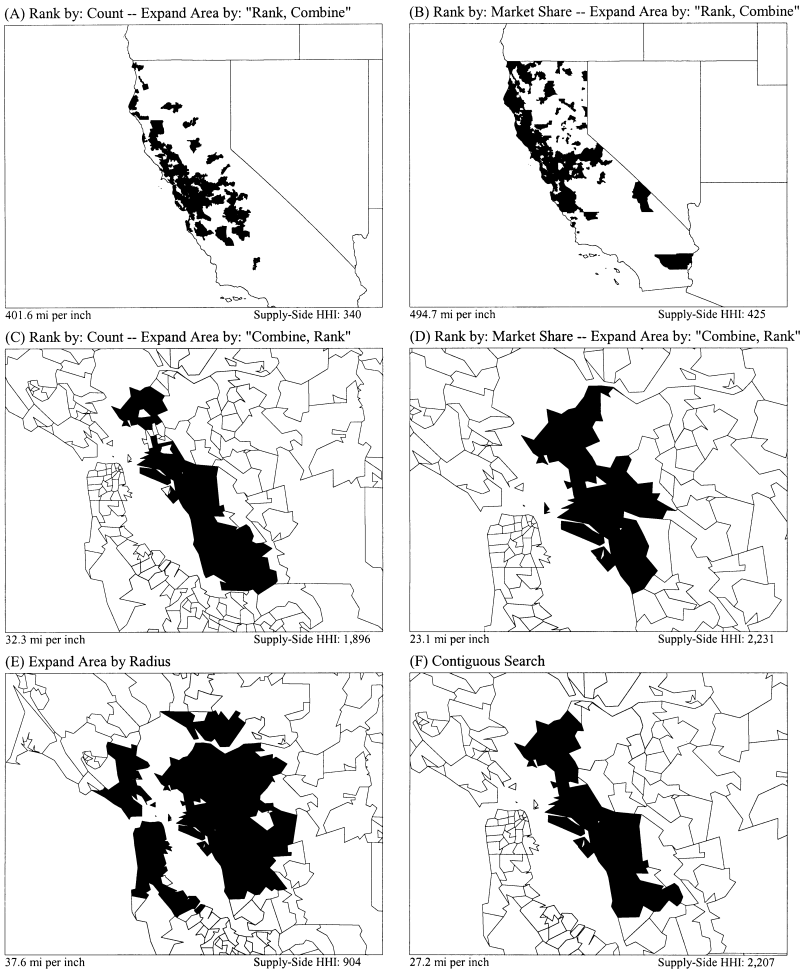
[47] At the 80% level and above, both "rank, then combine" methods (panels A and B) produced an E-H market area consisting of zip codes that spanned the entire state, while one of the "combine, then rank" methods failed to produce an E-H market area at all. This can occur in any of the conventional ranking methods when the initial service area does not meet the threshold and iterative expansions fail to introduce enough new hospitals to cause it to meet the threshold.

Chart 3
Geographic Markets for Alternative Methodologies, 1997
Criteria: Min(LIFO,LOFI) of 75%



market where almost nothing could cause a competitive problem. These results correspond to the defendant's expert in *Tenet* not finding any E-H supportable market less than or equal to the entire state of Missouri for the Poplar Bluff hospitals, discussed above. Further, these huge E-H market areas are not contiguous, and contain many gaps and holes. This

Chart 4
Geographic Markets for Alternative Methodologies, 1997
Criteria: Min(LIFO,LOFI) of 80%



"rank, then combine" approach clearly appears economically implausible because it includes hospitals in the same E-H market that have virtually no direct overlap with the merging hospitals and skips all around the state.

In contrast to the large and discontinuous jump in E-H market area generated by the "rank, then combine" methods, the other four methods

increase incrementally in reasonable-looking ways. However, the HHIs still differ, ranging from 904 to 2,207. The radius method is the only one of these four with an HHI below 1,800, because it includes much more of the San Francisco peninsula. It does not take into account the reluctance of patients to cross the often-congested Bay Bridge for inpatient hospital services that is shown in panels C, D, and F.

VI. CONCLUSIONS

Because of conceptual weaknesses and lack of robustness to specification, we recommend that the courts look at Elzinga-Hogarty analyses cautiously. Our empirical case study demonstrates that the geographic market one will build using an E-H analysis will depend on the choice of methodology. We found a high degree of sensitivity to alternative assumptions within the four conventional ranking approaches. These approaches are particularly sensitive to how other hospitals in the initial service area are handled in the analysis. In our case study, the approaches yielded very different geographic areas. For example, using an 80 percent threshold for LOFI and LIFO, the E-H market areas vary between roughly a twelve-by-three-mile section of the East Bay and a 600-by-200-mile area essentially encompassing almost all of the major population areas in Northern California. Further, the fact that the ranking methodologies can fail to find an E-H market even at a service area threshold of 80 percent illustrates some of the weaknesses of the approach.

Our case study also shows large differences in market share and resulting HHIs depending on whether a supply-side (hospital-based) or demand-side (patient-oriented) definition was used, with the supply-side typically yielding higher HHIs for any given geographic market. The HHIs vary from being so low as to suggest atomistic competition, to well over 1,800. Applying the FTC/DOJ Merger Guidelines to these HHIs, the inference is that the market is either very unconcentrated (suggesting little antitrust concern with mergers) or highly concentrated (suggesting a much greater degree of concern).

Our findings show that the conventional ranking method of the "rank, then combine" approach to adding additional zip codes is particularly unreliable in defining geographic markets. This approach adds hospitals across the entire State of California, when using LOFI/LIFO of 80 percent. Similarly, the radius approach in the *Sutter/Summit* merger appears unreliable because it adds parts of San Francisco without taking into account in any way the often-congested Bay Bridge. Moreover, there can be considerable variability in geographic market definitions resulting from slight changes in threshold assumptions in these approaches.

The other approaches—"combine, then rank" and contiguous search—provide more consistent and economically realistic geographic markets.

We believe these results are likely to apply to the other recently challenged hospital mergers, with some exceptions. The *Sutter/Summit* merger occurred in a major metropolitan area with some substantial constraints on patient flows, such as frequent congestion on the Bay Bridge and mountains that limited the number of roads patients can use. The other hospital mergers we discuss occurred in relatively isolated rural locations, without the geographic impediments to patient travel that exist in the East Bay. The main implication is that the radius-distance approach may present fewer problems for market definition in these rural areas than we find in *Sutter/Summit*. The major problems with the "rank, then combine" approach and the use of bright line standards still occur, as evidenced by the defendants' expert in *Tenet* being unable find a market based on a 75 or 90 percent LIFO/LOFI for even the entire state of Missouri.

Given these results, we suggest that the courts refrain from using a bright line rule of thumb for interpreting E-H results. We believe that arbitrary choices, such as 90 percent LIFO/LOFI tests, are particularly inappropriate. Analyzing patient flows as an approximation of where competition exists makes some sense. However, constructing an up-or-down test of market definition based on pre-ordained percentages of patient flow strikes us as an attempt to create a bright line where none exists. In our case study, using the 90 percent with the "rank then combine" method led to including zip codes from all over the State of California in the relevant market for a merger of two hospitals located a few miles away from each other. To the extent that courts and analysts use patient flows to generate an E-H market, the "combine, then rank" or contiguous search approaches make the most economic sense.

We suggest, however, that the courts use E-H analyses as one part of an analysis for geographic market definition, but not as near-dispositive up-or-down tests. In particular, patient flow data can be used to test a geographic market suggested by other factors. Hospital, industry, or payer documents may indicate that the merging hospitals compete with other hospitals in a given area. Similarly, geographic impediments, such as bodies of water, mountains, and excessive driving times due to congestion, may suggest a geographic market for acute inpatient care. One can use the combined E-H LIFO and LOFI numbers for the hospitals in such a proposed market to help test whether the patient flow data are consistent with most residents consuming hospital services locally, and local hospitals primarily competing with one another for patients in that area.