The Welfare Effects of Mergers in the Hospital Industry

Paul S. Calem, Avi Dor, and John A. Rizzo

This paper presents a model of competition among hospitals, each of which competes in the provision of product quality. It examines whether mergers by hospitals enhance social welfare. The conclusion is that such mergers may be desirable, as they may mitigate the overutilization externality. Conditions determining the welfare impact of a merger are derived. We show that whether mergers are desirable depends on whether the hospitals maximize profits or output; on the welfare criterion used (consumers’ surplus, consumers’ plus insurers’ surplus, or total surplus); and on key parameters of the model such as the consumer co-payment rate. © 1999 Elsevier Science Inc.

Keywords: Hospitals; Mergers; Antitrust

JEL classification: I11, L41

I. Introduction

Since the mid-1980s, the hospital industry has undergone significant reorganization and consolidation, often in the form of horizontal (within-market) mergers. Between 1984 and 1989, there were at least 107 such mergers involving 220 hospitals [Dor and Friedman (1994)]. The number of hospitals notifying federal regulators of merger plans doubled from 1992 to 1993 [Rodat (1994)], and the American Hospital Association reported over 80 mergers per year, many of which were horizontal, between 1994 and 1996. These mergers raise concerns about potential anticompetitive effects, leading to more intense scrutiny by antitrust enforcement agencies [Bazzoli et al. (1995)].

Another form of mergers involves acquisition by large national chains (multi-hospital systems), the largest and most aggressive one being Columbia-HCA [Kuttner (1996)]. Such mergers tend to transcend market area borders, may increase efficiency and, therefore, do not raise many anticompetitive concerns. As a matter of policy, they are usually looked upon favorably by antitrust enforcement agencies [DOJ/FTC (1993)].
The economic evaluation of horizontal mergers typically hinges on the tradeoff between potential welfare losses from monopolization versus welfare gains from economies of scale. With constant returns to scale, the standard case is rather straightforward: monopoly results in prices which are above the competitive equilibrium, and output levels which are below it. Thus, mergers, which tend to create monopolies, lead to socially suboptimal outcomes. Several authors have extended the standard case to consider the tradeoffs between social welfare losses and efficiency gains when economies of scale are present [e.g., McAfee and Williams (1992); McAfee et al. (1992); Perry and Porter (1985)].

The hospital industry, and the health care industry more generally, are characterized by several features which set them apart from most other industries. The most obvious unique feature is the presence of private insurers and public third-party payers. Although recent growth in managed care has been accompanied by new pressures on health-care providers to limit costs, the design of many insurance contracts still contributes to a moral hazard problem (overconsumption of medical care), while providing incentives for hospitals to compete along the lines of resource-intensity or quality [Dor and Farley (1996)]. Because direct competition is costly, hospitals also have an incentive to differentiate their services [Calem and Rizzo (1995)]. Another aspect of the hospital industry is the preponderance of non-profit entities, with over half of all U.S. hospitals having this form of ownership. The standard merger literature does not account for such complexities; consequently, standard approaches may lead to erroneous conclusions about the welfare consequences of mergers in hospital markets.

We address this gap in the literature by developing a model of hospital competition and merger which incorporates these particular features of hospital markets. The moral hazard aspect of our problem requires us to examine the role of demand much more explicitly than has been attempted in previous research. As we shall see, a well-known general form of a utility function due to Shubik (1988) is particularly suited for this purpose; in addition to its treatment of product differentiation, it can be adapted to fit our context of quality competition and insurer-payer cost sharing.

It should be noted that although the courts have tended to base their judgements in merger cases on consumer surplus, economists typically argue that broader definitions of social surplus may provide more appropriate criteria for evaluating mergers. To accommodate these different perspectives, we will conduct our welfare analysis separately for consumer welfare and broader social welfare measures, and contrast the results. The broadest definition of social welfare takes into account surpluses accruing to consumers, the insurer and the hospitals. However, due to the ambiguous treatment by the courts of non-profit hospitals and their mission, we will also consider a version of welfare in which the hospital’s surplus is ignored, so that the welfare function incorporates costs borne by consumers and insurers only. We will analyze the welfare consequences of merger under each of these criteria.

---

2 The treatment of mergers involving non-profit hospitals has been a source of confusion in the courts. Two similar cases that had been considered at about the same time were the United States vs. Carrillion Health System in Virginia and the United States vs. Rockford Memorial Hospital in Illinois, in which the DOJ challenged local merger by non-profit hospitals in three-hospital towns. In the Roanoke case, the court ruled that the non-profit status of the hospitals “militates in favor of finding the combination reasonable”. In the Rockford case, however, the court sided with the government and ruled against the merger citing the Clayton Act. [Murphy (1990)].

3 We are grateful to Professor R. Preston McAfee for pointing this out to us.
Our approach is straightforward. Given consumer demand for hospital services, we will solve for the equilibrium levels of quality-adjusted prices and outputs in the pre- and post-merger states, substituting the respective solutions into a social welfare function. We then will comment on the welfare effects of mergers by comparing welfare levels in the pre-merger and post-merger states. We characterize the pre-merger case as a Cournot equilibrium, or more precisely, as a Cournot-Bertrand equilibrium in quality-adjusted prices; in the post-merger case, hospitals join to form a cartel or a multi-plant monopoly. We will show that the welfare effect of a merger depends on the welfare criterion used, on whether the hospitals are for-profit (profit maximizers) or non-profit (output maximizers), and on key parameters such as the consumer co-payment rate, which affects the extent of moral hazard. Under certain conditions, the duopoly (pre-merger) equilibrium yields too high a level of quality or quality-adjusted output relative to the social optimum, implying a welfare gain from a merger.

The remainder of the paper proceeds as follows: Section II presents the fundamental components of the model, namely, the basic utility function, derived demand equations, the hospital’s cost function, and alternative social welfare criteria used in the evaluation of mergers. Section III presents solutions for the pre-merger state (duopoly Cournot equilibrium), given that hospitals are profit-maximizers. Section IV presents solutions for the post-merger state (monopoly). Section V provides a comparison of social welfare in the pre-merger and the post-merger states, and is of particular interest from a policy perspective. To further examine the important issue of the treatment of not-for-profit hospitals in antitrust cases, Section VI briefly traces solutions for Cournot equilibrium and monopoly when the hospital’s objective is defined as output maximization, followed by a re-examination of the welfare consequences of hospital mergers. Section VII discusses the implications of the welfare analysis for antitrust policy.

II. Fundamentals of the Model

*The Consumer Utility Function*

Consumer welfare is evaluated in terms of the utility of a representative consumer. We will employ a modified version of the utility function in Shubik (1988). This function takes a simple quadratic form, which is sufficiently general for our purposes: 

\[ U(X_1, X_2) = av - 0.5bv^2 - 0.25ew^2, \]

where \( a, b, e \) are utility parameters, with \( 0 < e < 2b \); \( X_i \) represents services provided by hospital \( i \); and \( v \) and \( w \) are notational shorthand for product combinations: \( v = X_1 + X_2, \) \( w = X_1 - X_2. \)

Our formulation follows that of Shubik (1988), with two minor modifications. First, for simplicity, we assume that there are only two (rather than many) differentiated products. Second, following the broader health economics literature [e.g., Rogerson (1994); Dor and Farley (1996)], we describe the product of a hospital as the flow measure, \( X_i = A_iY_i \), where \( Y_i \) is the quantity of services provided by the hospital, and \( A_i \) is its corresponding level of quality. Thus, higher quality treatment services yield more benefit per unit of service. For example, surgery provided by a less experienced surgical team would require a longer stay to produce the same result as surgery by a more experienced team.

The demand for hospital services is identified below with demand functions derived from this utility function. A natural interpretation of this representative consumer framework is that of a physician acting in the best interest of his/her patients.
The posited utility relationship implies that the two hospitals are differentiated providers of substitute services. Although each hospital may provide a full range of medical services, the hospitals are not viewed as perfect substitutes by the representative consumer (as \( e > 0 \)). As shown below, this implies positive demand for each hospital’s services. Although the hospitals are substitutes for one another, consumers tend to prefer some services at hospital 1 and others at hospital 2. For example, each hospital might provide both routine care and tertiary care, but hospital 1 is perceived to specialize in routine care while hospital 2 is perceived to specialize in tertiary care. (This service mix differentiation should not be confused with our notion of quality, which applies to the overall level of service provided by a hospital.)

The parameter restriction, \( 0 < e < 2b \), ensures that the hospital services are gross substitutes, i.e., \( \partial^2 U / \partial Y_1 \partial Y_2 < 0 \). As shown below, this condition guarantees that if a hospital lowers its quality-adjusted price, demand for the other hospital’s services will decline. This ensures that the analysis will be relevant to the evaluation of mergers: antitrust enforcement is intended to focus explicitly on mergers between firms providing services that are sufficiently close substitutes as to threaten competition. In contrast, mergers involving services that are complementary (e.g., vertical integration) are generally viewed favorably by enforcement agencies, particularly in health care [DOJ-FTC (1994)].

**Demand Functions**

Expressions for consumer demand are derived from the representative consumer’s utility maximization problem. The consumer chooses \( Y_i, i = 1, 2 \), to maximize:

\[
U(A_1 Y_1, A_2 Y_2) - s P_1 Y_1 - s P_2 Y_2, \tag{1}
\]

where \( P_i \) denotes the price of services at hospital \( i \), and \( 0 < s < 1 \) is the copayment rate, namely, the share of spending on hospital services borne directly by the consumer. Because the consumer decides how much to consume, but shares only part of the payment (if \( s < 1 \)), an element of moral hazard is introduced, namely, potential overutilization of hospital services.

Utility maximization yields a corner solution, \( Y = 0 \) if \( MU_i < s P_i \) at \( Y_i = 0 \). Otherwise, the solution, \( Y, i = 1, 2 \), satisfies the first-order condition:

\[
MU_i - s P_i = 0. \tag{2}
\]

Let \( \Theta_i \) denote “quality-adjusted price”:

\[
\Theta_i = P/A_i.
\]

Then, equation (2) may be written:

---

4 It should be noted that hospital care is a complex service which may involve diverse specialties such as cardiology, oncology, orthopedics, obstetrics, and more. Although some hospitals may have unique capabilities (e.g., performing organ transplants), hospitals generally compete over similar clusters of services. Antitrust enforcement in hospital care generally is concerned with such clusters of services. Mergers involving inpatient facilities offering highly-specialized services are more likely to be viewed as vertical mergers.

5 Marginal utility of good \( Y_i \) is given by \( MU_i = a A_i - b v A_i + .5 e w A_i \cdot (-1)^i \). Note that equation (2) merely states that consumers will pick medical care such that the marginal utility of care is equal to the consumers’ out-of-pocket share of the price of a unit of medical care.
\[ bv + 0.5ew = a - s\Theta_i; \]  
(3-i)  
\[ bv - 0.5ew = a - s\Theta_2. \]  
(3-ii)

Note that if \( \Theta_i > \Theta_j \), then the solution converges to \( Y_i = 0 \) and \( Y_j = (a - s\Theta_j)/2b \) as \( e \) goes to zero, as the hospitals then become perfect substitutes. Also, \( Y_i = 0 \) occurs if \( \Theta_i \geq a/s \). Otherwise, a pure interior solution is obtained, provided the price differential, \( \Theta_i - \Theta_j \), is not too large. We derive this formally as follows. Let \( \mu_i = a - s\Theta_i \). Summing equations (3-i) and (3-ii) yields:

\[ A_1Y_1 + A_2Y_2 = (\mu_1 + \mu_2)/2b, \]  
(4-i)

while subtracting equation (3-ii) from equation (3-i) yields:

\[ A_1Y_1 - A_2Y_2 = (\mu_1 - \mu_2)/e. \]  
(4-ii)

Solving equations (4-i) and (4-ii) for \( Y \) and \( Y \) yields:

\[ Y = \left(\frac{(\mu_1 + \mu_2)/2b - (-1)^i(\mu_1 - \mu_2)/e}{2A_i}; i = 1, 2. \right \}  
(5)

Expression (5) may be rewritten:

\[ Y = \left(\frac{(a/b) - (s/2b) \cdot (\Theta_1 + \Theta_2) + (-1)^i(s/e) \cdot (\Theta_1 - \Theta_2)}{2A_i} \right) / 2A_i. \]  
(6)

Equivalently:

\[ Y = (1/2A_i)\{(a/b) - x\Theta_1 + y\Theta_2\}; \quad Y = (1/2A_i)\{(a/b) - x\Theta_2 + y\Theta_1\}. \]  
(7)

where we define:

\[ x = (s/2b) + (s/e); \quad y = (s/e) - (s/2b). \]  
(8)

The demand functions, \( Y \), exhibit several notable properties:

1. Quality-adjusted demand, \( A_iY_i \), is a linear function of quality-adjusted prices.
2. Holding \( \Theta_1 - \Theta_2 \) constant, demand for either hospital’s services declines with the sum of quality-adjusted prices, \( \Theta_1 + \Theta_2 \), where the rate of decline is determined by \( s/2b \). Thus, for smaller \( s \), demand is less influenced by \( \Theta_1 + \Theta_2 \), consistent with more severe moral hazard.
3. Demand is also influenced by the difference in quality-adjusted prices, \( \Theta_1 - \Theta_2 \), consistent with hospitals being substitutes. Demand is more sensitive to this price differential for smaller \( e \) (the hospitals are closer substitutes). Note that the net cross-price effect \( (dY/d\Theta_i) \) is positive, as \( e < 2b \).

**The Hospital’s Cost Function**

A hospital’s objective is either profit maximization or output maximization. Further development of hospital objectives and solutions are left for Sections III, IV, and VI. Regardless of the objectives of the hospital, costs are assumed to be proportional to
quality-adjusted output: Cost, \( cA_iY_i \). This assumption is particularly appropriate for the hospital industry.\(^6\)

The cost parameter is assumed to satisfy:

\[ a > sc. \]

As we shall see, this second parameter restriction ensures non-zero demand under either monopoly or Cournot equilibrium.\(^7\)

**Welfare Criteria**

To evaluate the impact of mergers, we shall consider three forms of the net social welfare function, distinguished by who bears the costs. For convenience, we shall refer to these as consumer surplus, which takes into account only the costs borne directly by patients; net social surplus, by which we mean the sum of consumers’ and insurers’ surplus; and gross social surplus, which takes into account the additional surplus accruing to hospitals. Given \( Y_i = Y_i, i = 1, 2 \), these welfare measures are functions of the quality-adjusted prices, \( \Theta_i \), described as follows.

**Consumers’ Surplus**

Consumers’ surplus equals \( U(A_1Y_1, A_2Y_2) - sP(Y_1 + Y_2) \), which may be written:

\[ CS = av - .5bv^2 - .25ew^2 - s\Theta_1A_1Y_1 - s\Theta_2A_2Y_2. \]  

(9)

A necessary condition for consumer surplus to be maximized is that \( w = 0 (A_1 = A_2) \). Further, note that if \( w = 0 \) and \( Y_i = Y_i \geq 0 \), then \( \Theta_1 = \Theta_2 = \Theta \) and \( A_1Y_1 = A_2Y_2 \), in which case equation (9) reduces to:

\[ CS = (a - s\Theta)^2/2b. \]  

(10)

Thus, \( CS \) is maximized at \( \Theta = 0 \) (infinite quality).\(^8\) This result is a consequence of the demand relationship (7). As quality increases, the quality-adjusted flow of services \( A_iY_i \) increases (to the limiting value, \( a/2b \)) while quantity \( Y_i \) and, hence, the consumers out-of-pocket expenditure, declines. Therefore, total consumers’ surplus increases with quality.

**Net Social Surplus (Consumers’ Plus Insurers’ Surplus)**

Net social surplus equals \( U(A_1Y_1, A_2Y_2) - P(Y_1 + Y_2) \), which may be written:

\[ NS = av - .5bv^2 - .25ew^2 - \Theta_1A_1Y_1 - \Theta_2A_2Y_2. \]  

(11)

---

\(^6\) The evidence on the direction of economies of scale in hospitals is mixed. In recent studies of multiproduct hospital cost functions, Vita (1990) found slight diseconomies of scale, whereas Fournier and Mitchell (1992) found economies of scale for select hospital services such as obstetrics and emergency care, which were not statistically significant. These studies are difficult to reconcile because they relied on samples from different states (California versus Florida), employed somewhat different specifications, and used different classifications to divide patients into broad hospital multiproducts. Together with numerous studies carried out earlier, these studies suggest that hospitals operate within a narrow range of diseconomies and economies of scale. Thus, for modeling purposes, an assumption of constant economies of scale is a reasonable approximation.

\(^7\) Recall the first parameter restriction on \( e \), the gross substitutability parameter.

\(^8\) We use \( v = (a - s\Theta)/b \), from equation (3-i).
Welfare Effects of Mergers in Hospital Industry

Although this measure omits hospital surplus, it may be viewed as appropriate when the benefits accruing to hospitals are not a focus of concern. As with consumer surplus, a necessary condition for net surplus to be maximized is that \( w = 0 \). Further, note that when \( w = 0 \) and \( Y_i = Y \geq 0 \), \( \Theta_1 = \Theta_2 = \Theta \) and \( A_1Y_1 = A_2Y_2 \), so that equation (11) reduces to:

\[
NS = \{(a - s\Theta)/b\} \cdot (5a - t\Theta),
\]

where we let \( t = 1 - .5s \). It follows immediately that \( NS \) is maximized at \( \Theta = 0 \) (infinite quality), as in the case of consumers’ surplus.

Also, it is easy to show that equation (12) is minimized at \( \Theta = a/2t \). In fact, over the range, \( 0 < \Theta \leq a/2t \), equation (12) is strictly decreasing and non-negative; over \( a/2t < \Theta < a/2ts \), equation (12) is strictly decreasing and negative; and over \( a/2ts < \Theta < a/s \), equation (12) is strictly increasing and negative.\(^9\) Intuitively, when \( \Theta \approx a/2ts \), an increase in \( \Theta \) (reduction in quality) reduces insurer costs (through a reduction in the quantity of services demanded) more than it diminishes consumers’ surplus.\(^10\) Henceforth, we refer to \( \Theta = a/2ts \) as the value of \( \Theta \) which minimizes net social surplus.\(^11\)

**Gross Social Surplus (Consumers’ Plus Insurers’ Plus Hospital Surplus)**

Gross social surplus equals \( U(A_1Y_1, A_2Y_2) - cA_1Y_1 - cA_2Y_2 \), which may be written:

\[
GS = av - .5bv^2 - .25ew^2 - cv.
\]

As with the other welfare criteria, a necessary condition for gross surplus to be maximized is that \( w = 0 \). Further, note that when \( w = 0 \) and \( Y_i = Y \geq 0 \), \( \Theta_1 = \Theta_2 = \Theta \) and \( A_1Y_1 = A_2Y_2 \), whereby equation (13) reduces to:

\[
GS = \{(a - s\Theta)/b\} \cdot \{a - c + (a - s\Theta)/2\}.
\]

It is easy to show that if \( a \geq c \), then \( GS \) is maximized at \( \Theta = c/s \). This is the quality-adjusted price such that a hospital’s marginal cost, \( cA_\i \), equals a consumer’s marginal utility (as \( MU_i = sP_i \)). If \( a < c \), then \( GS \) is maximized at \( \Theta = a/s \); that is, with demand driven to zero and \( GS = 0 \).\(^12\)

**III. Cournot Equilibrium**

**Cournot Equilibrium Solution under Profit-Maximization**

From equation (6), it follows that hospital revenues, \( P_iY_i \), and hospital costs, \( cA_\iY_i \), may be expressed as functions of quality-adjusted prices, \( \Theta_i \). We posit a static model where the quality-adjusted price is a hospital’s choice variable. The hospital may be viewed as choosing quality with prices fixed or, alternatively, as choosing prices with quality fixed.

---

\(^9\) We use the fact that \( \partial NS/\partial \Theta = [(a - s\Theta)/b] \cdot (-t) - (a/b) \cdot (5a - t\Theta) = (2a\Theta/b) - (ati/b) - (a/2t) \). Note that net surplus goes to zero as \( \Theta \) approaches \( a/s \), because demand goes to zero.

\(^10\) The insurer’s expenditure equals \( (1 - s)\Theta (a - s\Theta)/b \), which is decreasing in \( \Theta \) for \( \Theta \approx a/s \). The derivative with respect to \( \Theta \) is \( (1 - s)\Theta (a - 2s\Theta)/b \), which exceeds \( s\Theta^2/b \) in absolute value for \( \Theta \approx a/2ts \).

\(^11\) Strictly speaking, \( \Theta = a/2ts \) is welfare-minimizing, subject to \( w = 0 \).

\(^12\) In other words, an interior solution exists if and only if \( a \geq c \); otherwise, gross surplus is maximized with demand driven to zero. As discussed below, the weaker condition, \( a > sc \), suffices for non-zero demand and Cournot equilibrium. Thus, moral hazard (\( s < 1 \)) creates the possibility of positive demand for socially inefficient services.
Due to the rigidity of health-insurance contracts in the short run, we favor the first interpretation.\textsuperscript{13} Thus, each hospital chooses a quality-adjusted price, $Q_i$, to maximize its profit, $PY_i^* - cA_iY_i^*$, generating a Bertrand equilibrium in such prices. Using equation (7), hospital 1’s maximization problem can be written:

$$\max_{\theta_1} \left[ \left( \frac{1}{2} \right) (\Theta_1 - c) \left( \frac{(alb)}{2} - x \Theta_1 + y \Theta_2 \right) \right],$$

while hospital 2 solves:

$$\max_{\theta_2} \left[ \left( \frac{1}{2} \right) (\Theta_2 - c) \left( \frac{(alb)}{2} - x \Theta_2 + y \Theta_1 \right) \right].$$

The first-order conditions are:

$$(alb) - x \Theta_1 + y \Theta_2 - x(\Theta_1 - c) = 0;$$

$$(alb) - x \Theta_2 + y \Theta_1 - x(\Theta_2 - c) = 0,$$

which yield the equilibrium solution:

$$\Theta_1 = \Theta_2 = \left( \frac{(alb) + xc}{2x - y} \right) = \Theta^E.$$

To evaluate the welfare levels that correspond to the Cournot equilibrium, we simply substitute $Q^E$ into the welfare function of interest: equation (10), (12), or (14). Before proceeding with the welfare analysis, several technical issues pertaining to the Cournot equilibrium solution should be noted:

1. **Positive demand and profits:** By equation (6), quality-adjusted output, $A_iY_i^*$, in the Cournot equilibrium is given by $(a - s\Theta^E)/2b$, as $\Theta_1 = \Theta_2 = \Theta^E$. It follows that output will be positive if and only if $\Theta^E < als$, i.e., if and only if $s(alb) + xsc < (2x - y)a$. As $x - y = s/b$, this condition reduces to $sc < a$. Thus, our parameter restriction, $a > sc$, guarantees positive demand in the Cournot equilibrium. Similarly, it is easily verified that this parameter restriction implies $\Theta^E > c$. Thus, hospitals earn positive profits in the Cournot equilibrium.

2. **Existence of an equilibrium:** if $e$ is small, a restriction on hospitals’ strategic choices is required to ensure existence of an equilibrium. Specifically, a hospital is assumed to have the foresight to avoid trying to drive its rival’s market share to zero by means of a quality-adjusted price cut (i.e., a quality increase). Such an assumption is commonly employed to guarantee existence of an equilibrium in Bertrand-type models.

3. **Relation to parameters:** Straightforward calculation yields $\partial \Theta^E/\partial a > 0$; $\partial \Theta^E/\partial c > 0$; $\partial \Theta^E/\partial \theta > 0$; $\partial \Theta^E/\partial e > 0$; and $\partial \Theta^E/\partial b < 0$.

The above relationships between the parameters of the model and the Cournot equilibrium price are relevant to the welfare analysis below, and they have intuitive interpretations. Smaller $s$ or larger $a$ entails increased demand for hospital services, leading to a higher

---

\textsuperscript{13} Although contracts between hospitals and managed care organizations are subject to periodic (typically annual) negotiations, payments for a given set of medical conditions remain fixed during the tenure of the contract. Thus, in the short run, transaction prices are always rigid. In this view, prices, $P_i$, are the outcome of a first-stage bargaining game between a hospital and third-party payer.
Cournot equilibrium quality-adjusted price. When the cost parameter, $c$, is large, or when $e$ is close to $2b$ (the hospitals are highly differentiated), quality competition is more restrained, leading to a comparatively high Cournot equilibrium quality-adjusted price.

Next, we evaluate Cournot equilibrium performance under each of the welfare criteria. Later, to evaluate mergers, Cournot equilibrium performance will be compared with the welfare level under monopoly.

Equilibrium Price and Welfare under Competition

The welfare impact of a merger will depend, in part, on the slope of the welfare function evaluated at equilibrium quality-adjusted price. Therefore, to facilitate our later discussion of the welfare impact of a merger, we now consider the relationship between welfare and equilibrium price under each of our three welfare criteria.

Consumers’ Surplus. Given $Q_1 = Q_2 = Q$, consumers’ surplus is strictly decreasing in $Q$, from equation (10). Hence, the higher the Cournot equilibrium quality-adjusted price, the lower the surplus. It follows that consumers’ surplus is increasing in $a$, $c$, and $e$, and decreasing in $s$ and $b$.

Net Social Surplus. The Cournot equilibrium quality-adjusted price will exceed the price that minimizes net social surplus ($\Theta^E = a/(2ts)$) if and only if:

$$ (2 - s)sx \geq a \{1 - (1 - s)[2e/(e + 2b)]\}. \quad (17) $$

Equivalently, net social surplus is increasing in $\Theta$ at $\Theta^E$ when equation (17) holds, and decreasing otherwise.

Condition (17) is more apt to hold for larger $e$, smaller $b$, larger $c$ and smaller $a$, reflecting the impact of these parameters on the equilibrium quality-adjusted price. It does not hold in the limit as $s$ approaches 1, nor as $s$ approaches 0.

Gross Social Surplus. The Cournot equilibrium quality-adjusted price exceeds the price that maximizes gross social surplus if and only if $a \geq c$ and $\Theta^E > cls$. After straightforward calculation, this condition reduces to:

$$ \{2e/(e + 2b)\}(a - c) > (1 - s)c. \quad (18) $$

Thus, hospitals underproduce quality (or quality-adjusted output) if equation (18) holds, and overproduce if the reverse inequality holds.

It follows that hospitals underproduce quality or quality-adjusted output in the limit as $s$ approaches 1, if $a \geq c$, but may overproduce if $s$ is sufficiently small. The result that hospitals underproduce quality-adjusted output when $s = 1$ is analogous to the standard result that oligopolists raise prices and restrict output relative to perfect competition. The potential to overproduce when $s < 1$ is a consequence of moral hazard, which increases

---

14 Using $x = y = ab$ and $t = 1 - .5s$, the condition $\Theta^E \geq a/(2ts)$ reduces to $(1 - s)(a(ab + xsc)) \geq x(a - sc)$. Dividing through by $x$, and using $sxs = 2be(e + 2b)$, this reduces to equation (17).

15 Using $x = y = ab$, the condition, $\Theta^E \geq cls$, reduces to $(ab) + xc > (xcls) + (cls)$. Multiplying through by $sxs = 2be(e + 2b)$, we obtain equation (18).

16 In particular, hospitals overproduce when $sc < a < c$, in which case the optimal level of quality-adjusted output is zero, but the Cournot equilibrium level is positive.
the demand for hospital services. This may cause equilibrium quality or quality-adjusted 
output to exceed the socially optimal level. Note that the potential to overproduce when 
s is small is enhanced if e is small; that is, if hospitals are close substitutes. This effect is 
a consequence of enhanced quality competition when hospitals are close substitutes. The 
potential to overproduce is also enhanced when the marginal cost parameter, c, is large 
relative to a.

IV. Monopoly

Monopoly under Profit Maximization

If the two hospitals are under joint ownership and/or maximize joint profits, then their 
optimization problem yields the first order conditions:

\[(alb) - 2x\Theta_1 + 2y\Theta_2 - cs/b = 0;\]
\[(alb) - 2x\Theta_2 + 2y\Theta_1 - cs/b = 0.\]  

Solving equation (19) for the monopoly solution yields: 17

\[\Theta_1 = \Theta_2 = (c/2) + \{a/2s\} = \Theta^M.\]  

Note that \(\partial\Theta^M/\partial s < 0; \partial\Theta^M/\partial a > 0; \) and \(\partial\Theta^M/\partial c > 0.\) Smaller s or larger a entails 
increased demand for hospital services, leading to a higher monopoly quality-adjusted 
price. A higher cost of quality c also leads to a higher quality-adjusted price.

Monopoly Solution Compared to the Cournot Equilibrium

A merger results in a strictly higher quality-adjusted price. This can be seen by comparing 
equation (20) to equation (16). This comparison implies that \(\Theta^M\) exceeds \(\Theta^E\) if and only 
if:

\[y(a - sc) > 0.\]  

As \(a > sc\) and \(e < 2b,\) equation (21) is satisfied. Thus, the quality-adjusted price is lower 
and quality-adjusted output is greater in the Cournot equilibrium as compared to the 
monopoly outcome.

Equilibrium Price and Welfare under Monopoly

The welfare impact of a merger depends in part on the slope of the welfare function 
evaluated at the monopoly price. As we have seen, the monopoly price strictly exceeds the 
equilibrium price under competition. In order to facilitate our later discussion of the 
welfare effects of merger, we now consider the relationship between welfare and monop-

17 Note that \(a > sc\) guarantees positive demand and profits. Also note that \(\Theta^E\) converges to \(\Theta^M\) as \(e\) 
approaches \(2b,\) or \(a\) approaches \(sc.\)
Consumers’ Surplus. The higher the Cournot equilibrium quality-adjusted price, the lower the consumers’ surplus, by equation (10). It follows that consumers’ surplus is increasing in $a$ and $c$, and decreasing in $s$.

Net Social Surplus. The monopoly quality-adjusted price will exceed the price that minimizes net social welfare ($\Theta^M > a/2st$) if and only if:

$$ (2 - s)c > a. \quad (22) $$

Equivalently, net social surplus is increasing in $\Theta$ at $\Theta^M$ when equation (22) holds, and decreasing otherwise. In the limit, as $s$ approaches 1, equation (22) does not hold. For smaller $s$, equation (22) will hold so long as $a$ is not too much larger than $c$.

Gross Social Surplus. Monopoly will underproduce quality or quality-adjusted output relative to the level that maximizes gross social surplus if and only if $a < c$ and $\Theta^M > cls$. It follows that a monopoly underproduces if:

$$ a - c > c(1 - s), \quad (23) $$

and overproduces if the reverse inequality holds. Hence, a monopoly will underproduce quality or quality-adjusted output in the limit as $s$ approaches 1, if $a \geq c$, but may overproduce if $s$ is sufficiently small.\(^{18}\) The result that hospitals underproduce quality-adjusted output when $s = 1$ is analogous to the standard result that a monopolist raises price and restricts output relative to perfect competition. The potential to overproduce is a consequence of moral hazard, which increases the demand for hospital services. Note that the potential to overproduce when $s$ is small is enhanced when $c$ is large relative to $a$; that is, when costs are high.

V. The Welfare Impact of a Merger

The welfare consequences of a merger appear to be different, depending on which welfare criterion is applied. Below, we provide an evaluation of the impact of hospital mergers separately for each of the three alternative welfare measures previously described.

Merger and Consumers’ Surplus
Given $\Theta_1 = \Theta_2 = \Theta < als$, consumers’ surplus is represented by equation (10), which is decreasing in $\Theta$. As $\Theta^E < \Theta^M$, a merger unambiguously reduces consumers’ surplus.

Merger and Net Social Surplus

From equation (12), a merger increases net social surplus if and only if:

$$ (a - s\Theta^M)(.5a - t\Theta^E) - (a - s\Theta^E)(.5a - t\Theta^E) > 0. \quad (24) $$

Condition (24) may be rewritten:

$$ (a - s\Theta^M)(t\Theta^E - t\Theta^M) + (.5a - t\Theta^E)(s\Theta^E - s\Theta^M) > 0, \quad (25) $$

\(^{18}\) As in the case of Cournot equilibrium, hospitals overproduce when $sc < a < c$. 

Welfare Effects of Mergers in Hospital Industry 207
which reduces to:

\[ t(a - s\Theta^M) + s(.5a - t\Theta^E) < 0. \]  \hspace{1cm} (26)

Using \( t = 1 - .5s \), equation (26) reduces to:

\[ \Theta^M - (a/2st) > (a/2st) - \Theta^E. \]  \hspace{1cm} (27)

Hence, a merger is welfare-enhancing if and only if equation (27) holds. Three possible cases can now be identified with respect to the impact of a merger on net social surplus:

1. Since \( \Theta^E < \Theta^M \), a merger is welfare-enhancing if the pre-merger quality-adjusted price, \( \Theta^E \), exceeds the welfare minimizing price, \( a/2st \). This is a consequence of the fact that net social surplus is increasing in Θ over the range \( \Theta > a/2st \). It follows that equation (17) is a sufficient condition for a merger to increase net social surplus.

2. A merger is welfare-reducing if the post-merger quality-adjusted price, \( \Theta^M \), is lower than the welfare minimizing price, \( a/2st \). This is a consequence of the fact that net social surplus is decreasing in \( \Theta \) over the range \( \Theta < a/2st \). It follows that the reverse of inequality (21) is a sufficient condition for a merger to reduce net social surplus.

3. The impact of a merger is ambiguous when \( \Theta^E, a/2st, \Theta^M \).

Based on this and our previous discussion, we conclude that a merger will tend to be welfare-enhancing when the hospitals are highly differentiated (\( e \) is close to \( 2b \)) or the marginal cost of quality-adjusted services is comparatively high (\( c \) is large relative to \( a \)). Intuitively, larger \( e \) or \( c \) increases pre-merger quality-adjusted price and closes the gap between the pre- and post-merger prices, implying a smaller loss of consumers’ surplus, which would tend to be offset by lower insurer expenditures post-merger. On the other hand, a merger will be welfare-reducing in markets where patients generally are uninsured (\( s \) is close to 1).

**Merger and Gross Social Surplus**

From equation (14), a merger increases gross social surplus if and only if:

\[ (a - s\Theta^M)(.5a - c + .5s\Theta^M) - (a - s\Theta^E)(.5a - c + .5s\Theta^E) > 0. \]  \hspace{1cm} (28)

Condition (28) may be rewritten:

\[ .5s(a - s\Theta^M)(\Theta^M - \Theta^E) + s(.5a - c + .5s\Theta^E)(\Theta^M - \Theta^E) > 0, \]  \hspace{1cm} (29)

which reduces to:

\[ \Theta^M - (c/s) < (c/s) - \Theta^E. \]  \hspace{1cm} (30)

Hence, a merger is welfare-enhancing if and only if equation (30) holds. Again, three possible cases can be identified with respect to the welfare impact of a merger:

1. As \( \Theta^E < \Theta^M \), a merger is welfare-enhancing if the post-merger (quality-adjusted) price, \( \Theta^M \), is less than the welfare-maximizing price, \( c/s \). This is a consequence of the fact that gross social surplus is increasing in Θ over the range \( \Theta < c/s \). In other words, when \( \Theta^M < c/s \), the (post-merger) monopoly overproduces quality-adjusted output, but to a lesser degree than the (pre-merger) duopoly. It follows that the
reverse of inequality (23) is a sufficient condition for a merger to increase gross social surplus.

2. A merger is welfare-reducing if the pre-merger (quality-adjusted) price, $Q_E$, exceeds the welfare-minimizing price, $c/s$. This is a consequence of the fact that Cournot equilibrium underproduces quality when $c/s \leq \Theta^E$, so that monopoly underproduces quality to an even greater degree. It follows that equation (18) is a sufficient condition for a merger to increase gross social surplus.

3. The impact of a merger is ambiguous when $\Theta^E < c/s < \Theta^M$.

Thus a merger will tend to be welfare-enhancing when the marginal cost of quality-adjusted services is comparatively high ($c$ is large relative to $a$), and in markets where patients have low copayment rates ($s$ is small). Under either of these conditions, the (pre-merger) duopoly tends to overproduce quality-adjusted output. In contrast to the case of net social surplus, a merger will tend to be welfare-reducing when hospitals are highly differentiated ($e$ is close to $2b$). The reason for this divergence is that the gross surplus criterion includes gains to hospitals as well as to consumers. Intuitively, the cost savings to merging hospitals from elimination of quality competition is greater for hospitals that provide similar (or closely substitutable) services. On balance, under the gross social welfare criterion, a greater degree of service mix differentiation has a negative impact on post-merger welfare.

VI. The Case of Output-Maximizing Hospitals

Characterizing a hospital’s objective as profit maximization is not necessarily appropriate in the case of not-for-profit hospitals. An alternative approach employed in modeling not-for-profit institutions is to assume that they maximize output subject to a resource constraint [Dranove (1988)]. In this section, we develop the duopoly and monopoly solutions of our model, and analyze the implied effects of a merger, under the assumption that hospitals are output maximizers.

**Duopoly Equilibrium**

Consider the case of a duopoly with each hospital choosing $A_i$ to maximize its output, $PY = \Theta_i A_i Y$, subject to the constraint that total hospital revenues must exceed total costs:

$$c A_i Y \leq \Theta_i A_i Y.$$  \hspace{2cm} (31)

Note that constraint (31) is non-binding if and only if the solution to the unconstrained maximization problem satisfies $\Theta_i > c$.

Consider first the case that equation (31) is non-binding in the duopoly equilibrium. In this case, the Cournot equilibrium solution is obtained by setting $c = 0$ in equation (16):

$$\Theta_1 = \Theta_2 = \Theta^E = ab(2x - y).$$  \hspace{2cm} (32)

It follows that the resource constraint (31) is non-binding in the duopoly equilibrium if and only if $a \geq x[(3/2) + (b/e)]$. Otherwise, equation (31) is binding, and $\Theta_1 = \Theta_2 = \Theta^E = c$ in the duopoly equilibrium.
Thus, output maximization yields a lower Cournot equilibrium quality-adjusted price than profit maximization (whether or not the resource constraint is binding). Therefore, output-maximizing duopolists are more apt to overproduce quality or quality-adjusted output as compared to profit-maximizing duopolists, under the gross social surplus criterion.

Monopoly Solution
Now consider the case of a monopoly maximizing output subject to the resource constraint:

\[ c(A_1 Y + A_2 Y) \leq \Theta_1 A_1 Y + \Theta_2 A_2 Y. \]  (33)

This constraint is non-binding if and only if the solution to the unconstrained maximization problem satisfies \( \Theta_i > c \). In this case, the solution is obtained by setting \( c = 0 \) in equation (20):

\[ \Theta_1 = \Theta_2 = \Theta^M = a/2s. \]  (34)

It follows that the resource constraint (33) is non-binding if and only if \( a \geq 2sc \). Otherwise, it is binding, and \( \Theta_1 = \Theta_2 = \Theta^M = c \).

Again, output maximization yields a lower quality-adjusted price than profit maximization. Therefore, an output-maximizing monopolist is more apt to overproduce quality or quality-adjusted output as compared to a profit-maximizing monopolist, under the gross social surplus criterion.

Welfare Effects of a Merger
Note that if \( a < 2sc \), the resource constraint is binding both in the duopoly equilibrium and in the monopoly resulting from a merger. In this case, \( \Theta^M = \Theta^E \) and a merger has no welfare implications. From here on, we focus on the more interesting case that \( a \geq 2sc \). In this case, the resource constraint (33) is non-binding on the post-merger monopoly. This case is apt to be representative of some hospital markets. Casual observation suggests that many not-for-profit hospitals operate with a substantial funding surplus; it seems reasonable to presume that resource constraints are not binding in such cases.

It readily verified that \( \Theta^M > \Theta^E \) whenever the resource constraint (33) is non-binding on the post-merger monopoly. It immediately follows that a merger reduces consumers’ surplus (equation (10)). Further, condition (27) still governs whether a merger will increase or reduce net social surplus. As \( t < 1 \), \( \Theta^M = a/2s < a/2ts \); thus, a merger unambiguously reduces net social surplus.

---

19 When the resource constraint is binding under output maximization, this result follows from the fact that the equilibrium quality-adjusted price under profit maximization strictly exceeds \( c \). Otherwise, it follows immediately from comparison of equation (32) to equation (16).

20 Output-maximizing hospitals underproduce quality in the Cournot equilibrium relative to the social optimum if and only if \( a > c((3/2) + (b/e)) \). In contrast to the case of profit-maximization, whether the hospitals overproduce quality is independent of \( s \).

21 An output-maximizing monopolist underproduces quality relative to the social optimum if and only if \( a > 2c \). In contrast to the case of profit-maximization, whether the monopolist overproduces quality is independent of \( s \).

22 This follows from the fact that \( b(2x - y) = s((3/2) + (b/e)) > 2s \).
surplus (in contrast to the case of profit maximization, for which the impact of a merger was found to be ambiguous).

Likewise, condition (30) still governs whether a merger will increase or reduce gross social surplus. Since output maximization yields lower quality-adjusted prices, $\Theta^E$ and $\Theta^M$, than profit maximization, we can conclude that a merger is more apt to be welfare-enhancing in the case of output maximization, under the gross social surplus criterion.

If the resource constraint (31) is binding in the duopoly equilibrium, then equation (30) reduces to:

$$a < 2c(1 - s).$$

(35-i)

Otherwise, equation (30) reduces to:

$$\left[\frac{4a}{3 + 2(b/e)}\right] + a < 4c.$$

(35-ii)

Thus, again, a merger will tend to be welfare-enhancing when the marginal cost of quality-adjusted services is comparatively high. Further, a merger will tend to be welfare-enhancing when patient copayment rates are low (if the resource constraint is binding). On the other hand, a merger will tend to be welfare reducing when hospitals are highly differentiated (if the resource constraint is non-binding).²³

VII. Implications

This paper has examined the welfare consequences of hospital mergers. We have cast our analysis in terms of a static model where hospitals compete in quality-adjusted prices. A comparison of the duopoly Cournot equilibrium with monopoly in this setting mirrors the standard case: quality (or quality-adjusted output) is lower under monopoly, and quality-adjusted prices are higher, reducing consumer surplus.

Although concerns of the courts in antitrust cases are most closely approximated by consumer surplus, other welfare criteria merit attention. Here, we have taken a broader perspective of social welfare, and considered the impact of mergers on surplus accrued to insurers and consumers (net social surplus), and the surplus accrued to hospitals in addition to consumers and insurers (gross social surplus). Mergers unambiguously lead to a loss of consumer surplus, but can lead to welfare gains under the alternative measures.

Analysis of the impact of certain parameters on the net social welfare and gross social welfare gains (or losses) from a merger yielded several insights. A reduction in the consumer cost-sharing rate (smaller $s$) tends to increase the gross social welfare gain from a merger. This result has a certain intuitive appeal. Because of limited cost sharing imposed on the consumer, health care markets are characterized by a degree of moral hazard (potential over-consumption of quality) which typically does not exist in other industries. Thus, despite their anticompetitive effects, mergers may provide a social benefit to the extent that they mitigate welfare losses resulting from moral hazard. More specifically, moral hazard and the associated expansion of demand for hospital services may entail overproduction of quality. Elimination of quality competition through a merger may then yield a welfare gain.

²³ If the resource constraint (31) is non-binding, then the welfare effect of a merger will be independent of $s$, and if it is binding, then the welfare effect will be independent of $e$. 
An increase in the marginal cost of quality-adjusted services (larger \( c \)) tends to increase the welfare gain from a merger, under both the net and gross social welfare criteria. This, in turn, implies a higher pre-merger quality-adjusted price and closer convergence between the pre- and post-merger prices. Thus, larger \( c \) entails a smaller loss of consumers’ surplus which may be offset by lower insurer expenditures subsequent to the merger, leading to a gain in net surplus. Moreover, an increase in \( c \) entails a greater reduction in hospital costs from elimination of quality competition through a merger, implying a larger increase in gross surplus.

Turning to the notion of hospital differentiation, increased specialization and service mix differentiation among hospitals (larger \( e \)) yield opposite effects, depending on which social welfare criterion is used. An increase in \( e \) tends to raise the welfare gain from merger under the net criteria, while it tends to lower the welfare gain from merger under the gross criteria. From the point of view of consumers of hospital services, mergers are less harmful the greater the degree of differentiation, due to closer convergence between the monopoly and Cournot equilibrium outcomes. On the other hand, the cost savings to merging hospitals from elimination of quality competition is greater for hospitals which provide similar (or closely substitutable) services. On balance, under the gross social welfare criterion, a greater degree of service mix differentiation has a negative impact on post-merger welfare.

It is also worth noting that when hospitals are assumed to maximize output rather than profit, mergers unambiguously result in lower net social surplus. Gross social surplus could potentially increase, however. Moreover, under the gross social welfare criterion, output-maximizing hospitals are more apt to overproduce quality than are profit-maximizing hospitals, and mergers of output-maximizing hospitals are more apt to increase gross social welfare than are mergers of profit-maximizing hospitals.

Although the emphasis in litigation (as well as in previous literature) has been placed on consumer surplus, the public goods aspect of hospital services suggests that, in some cases, considering insurers’ and hospitals’ surplus is not without merit. In public policy debates, proponents have argued that preserving community access to care in marginal hospitals is a legitimate goal, effectively blurring the distinction between consumer surplus and producer surplus. In certain cases, the legalistic analogy would be to invoke the failing-firm defense. Ultimately, it is up to the courts to decide whether narrow or broad definitions of social welfare are most appropriate for the hospital industry. Again, our analysis demonstrates that the implications for the evaluations of mergers would vary significantly depending upon the criteria chosen.

An earlier version of this paper was presented at the 1996 meetings of the American Economic Association. We thank Martin Gaynor, R. Preston McAfee, Robert Taggart, Dennis Yee, and an anonymous reviewer for helpful comments and suggestions.

References


