

# For-Profit and Nonprofit Hospital Models

University of Alabama

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## Last Class

- ▶ Self-Assessed Health (SAH)
- ▶ Data from the National Longitudinal Survey of Youth (NLSY) asking people “In general, how is your health?”
- ▶ People respond either excellent, very good, good, fair, or poor.
- ▶ Males tend to report better SAH than females, despite the fact the females tend to live longer.
- ▶ Hispanics have worse SAH, which is interesting as Hispanics have a higher life expectancy than blacks and whites.
- ▶ SAH is increasing in both income and education.

# Hospitals

- ▶ In 2016, there are over 5,600 hospitals with over 900,000 beds in the U.S.
- ▶ There is over \$800 billion spent at hospitals per year.
- ▶ Hospitals can be distinguished based on four criteria: length of stay, type, ownership, and size.
- ▶ Hospital types include teaching hospitals with residency programs, mental hospitals including those treating alcohol and drug addiction, and other hospitals specializing in specific treatments (maternity, orthopedic, rehabilitative, etc.).
- ▶ Hospital ownership can be either private (nonprofit or for-profit) or public (federal, state, county, or local).

# Hospital Data

	1980	1990	2000	2008
All hospitals	6,965 (1,365) <sup>a</sup>	6,649 (1,213)	5,810 (984)	5,815 (951)
Federal hospitals	359 (117)	337 (98)	245 (53)	213 (46)
Nonfederal hospitals	6,606 (1,248)	6,312 (1,113)	5,565 (931)	5,602 (905)
Community	5,830 (988)	5,384 (927)	4,915 (824)	5,010 (808)
Nonprofit	3,322 (692)	3,191 (657)	3,003 (583)	2,923 (557)
For-profit	730 (87)	749 (102)	749 (110)	982 (121)
State-local government	1,778 (209)	1,578 (169)	1,163 (131)	1,105 (131)
Psychiatric and other long-term	702 (256)	892 (183)	631 (105)	576 (95)
Community hospitals				
6–199 beds	4,120 (341)	3,730 (314)	3,489 (290)	3,605 (269)
200–499 beds	1,393 (430)	1,369 (417)	1,179 (358)	1,135 (348)
500 or more beds	317 (218)	285 (196)	247 (176)	270 (191)
Occupancy rate <sup>b</sup>	75	67	64	68
Admissions (per 1,000 pop.)	159	125	117	118
Average length of stay (days)	7.6	7.2	5.8	5.5
Outpatient visits (per 1,000 pop.)	890	1,207	1,852	2,053

<sup>a</sup>Numbers in parentheses are beds in thousands.

<sup>b</sup>Percent of beds occupied.

Sources: U.S. Department of Commerce, *Statistical Abstract of the United States* (2011 and earlier issues); and U.S. Department of Health and Human Services, *Health, United States* (2010 and earlier issues).

# Hospital Size

- ▶ Hospital size is generally measured by number of beds.
- ▶ The support services, types of equipment, and to some extent administrative staff, are related to the number of people that the hospital can house, i.e. the number of beds.
- ▶ About two-thirds of hospitals have more than 200 beds.
- ▶ The largest hospitals usually are affiliated with university medical schools and private tertiary care (complex care such as organ transplant surgery or open-heart procedures).
- ▶ The typical community hospital is limited to secondary care (non-complex, i.e. care consisting of the more common surgical and medical procedure)

# Hospital Spending

	1960	1970	1980	1990	2000	2008
National health care spending (\$ billions) <sup>a</sup>	27	73	246	696	1,353	2,339
Hospital care (\$ billions)	9.2	28	102	254	417	718
Percent of total health spending	34.1	38.4	39.2	36.5	30.8	30.7
Percent of hospital care paid by						
Out of pocket	20.8	9.1	5.2	4.4	3.3	3.2
Private health insurance and other private	37.0	36.0	40.5	42.4	39.8	39.9
Government	42.2	55.0	54.3	53.2	56.9	56.9
Medicare	—	19.4	26.0	26.7	29.3	29.4
Medicaid	—	9.6	10.4	10.9	17.3	17.1
Other government <sup>b</sup>	42.2	26.0	17.9	15.6	10.3	10.4
Average hospital cost (\$)						
Per day	—	—	245	687	1,149	1,782
Per stay	—	—	1,851	4,947	6,649	9,788
Nursing home care (\$ billions)	0.8	4.2	18	53	95	138
Percent of total health spending	3.2	5.8	7.1	7.6	7.0	5.9
Percent of nursing home paid by						
Out of pocket	77.9	53.6	40.0	37.5	30.1	26.7
Private health insurance and other private	6.3	5.1	5.7	13.3	13.1	11.1
Government	15.7	41.2	54.2	49.2	56.9	62.2
Medicare	—	3.4	1.7	3.2	10.6	18.6
Medicaid	—	22.3	50.2	43.9	44.1	40.6
Other government	15.7	15.5	2.3	2.1	2.2	3.0

<sup>a</sup>All monetary values are in nominal dollars.

<sup>b</sup>Includes the Department of Veterans Affairs, CHIP, and state and local spending.

Sources: U.S. Department of Health and Human Services, *Health, United States* (2010 and earlier issues); and U.S. Department of Commerce, *Statistical Abstract of the United States* (2011 and earlier issues).

# History of Hospitals

- ▶ Hospitals date back to ancient Egypt and Greece.
- ▶ Over time, hospitals (places of healing) were organized by various religious establishments. In older times, illness was closely associated with a lack of faith, and priests often administered care.
- ▶ Early hospitals in the U.S. were associated with the poor or with mental/infectious diseases, and medicine was practiced mainly at home.
- ▶ This changed in the latter half of the nineteenth century after the development of more effective surgical techniques and technology.
- ▶ At the turn of the twentieth century, the modern U.S. hospital emerged due to advances in antisepsis, i.e. the ability to fight off infections after a surgical procedure.

# History of Hospitals

Two nonscientific factors accelerated the growth in modern hospitals:

1. The rapid pace of urbanization resulting from industrialization.
  - ▶ Rural areas could not support sophisticated hospitals due to transportation problems and low population densities.
  - ▶ Urbanization also created more health problems such as outbreaks of infectious disease that were much less common in rural areas.
2. The rise of an urban middle class.
  - ▶ Early hospitals relied on philanthropic contributions or state and local government funds. These alone would not support the growing costs of the modern hospital.
  - ▶ Urbanization created wealth, which led to a greater ability to pay for medical services

The opening of The Johns Hopkins Hospital in Baltimore in 1885 was an important milestone and it became a model of the teaching and research hospital.

## For-Profit Hospital Models

Consider an example of a for-profit hospital. Assume that the hospital is a monopolist with complete control of the market. Is monopoly a reasonable assumption when it comes to many hospitals? Most hospital markets are highly concentrated (high HHI's).

We will consider two different models of for-profit hospitals:

1. A hospital that maximizes profits as a function of quantity produced
2. A hospital that maximizes profits as a function of not only quantity produced, but also quality of the good produced.

# Nonprofit Hospitals

- ▶ No single party or owner claims “profits.”
- ▶ Many tax benefits, including exemption from corporate income taxes, property and sales taxes, and donations to nonprofits are tax deductible.
- ▶ Nonprofits make up 5% of GDP, however are highly concentrated in the health care market treating about 70% of patients.
- ▶ Nonprofit firms exist due to market failure.

# Nonprofit Hospitals

- ▶ Asymmetric Information
  - ▶ It is difficult for consumers to judge “quality” of health institutions.
  - ▶ There is concern that hospitals that are for-profit will put profits ahead of everything else, including the overall health and well-being of the patients.
- ▶ Public goods
  - ▶ Many believe that nonprofits exist to provide a public good (nonrival and nonexcludable).
  - ▶ This public good creates a positive externality by providing health care benefits to the community.

# Profit Maximization of a Monopolist

Recall that like a competitive firm, a monopolist maximizes profits by producing quantity at a level such that  $MR=MC$ .

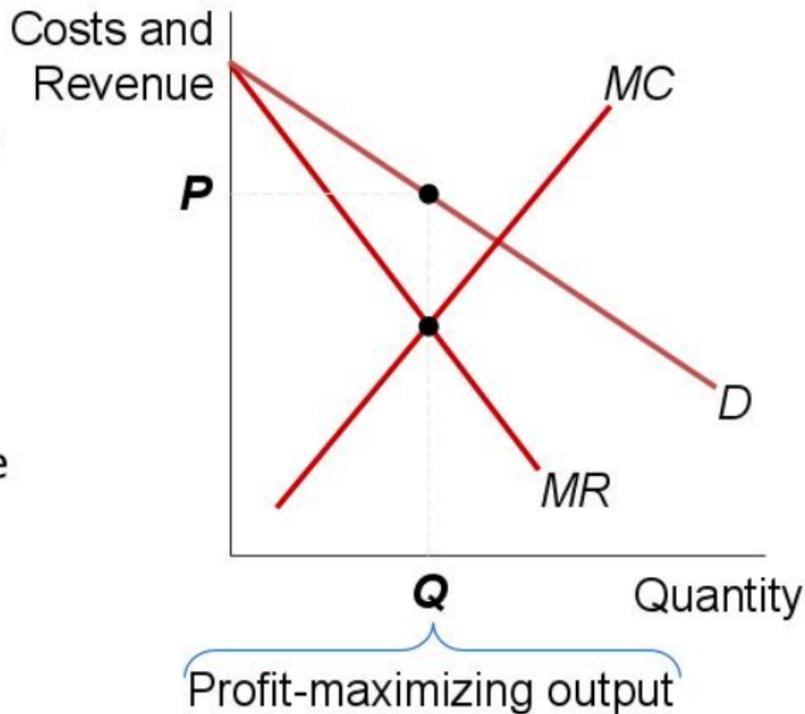
By choosing quantity produced, the monopolist implicitly chooses the price (as quantity and price are related through the demand curve). Note that unlike perfectly competitive firms, monopolists are not price takers, as they actually have some influence over the price.

Once the monopolist identifies that profit maximizing level of output, it sets the highest price that consumers are willing to pay for that quantity.

Recall that the marginal costs curve is upward sloping, and the marginal benefits curve is downward sloping.

# Profit Maximization of a Monopolist

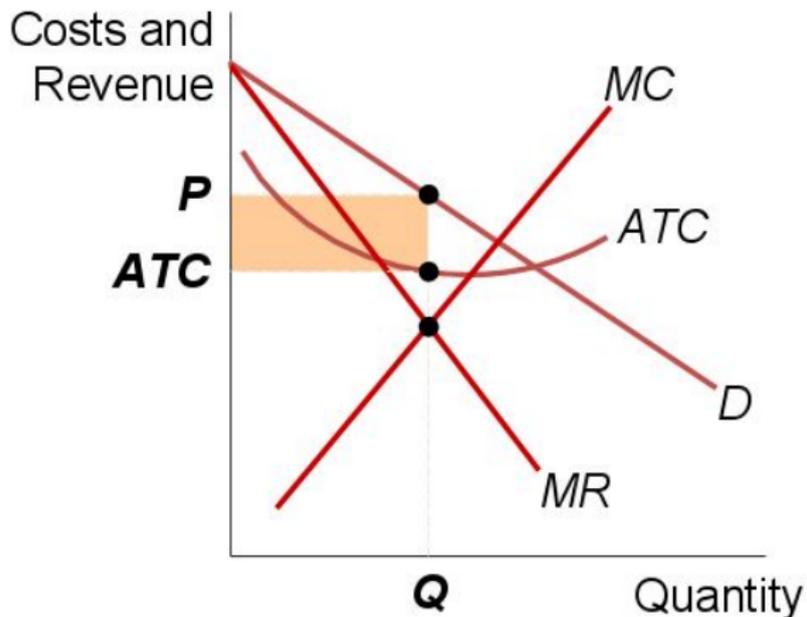
1. The profit-maximizing  $Q$  is where  $MR = MC$ .
2. Find  $P$  from the demand curve at this  $Q$ .



# Monopolist's Profits

As with a competitive firm, the monopolist's profit equals

$$(P - ATC) \times Q$$



# Welfare Loss of Monopoly

Competitive eq'm:

quantity =  $Q_C$

$P = MC$

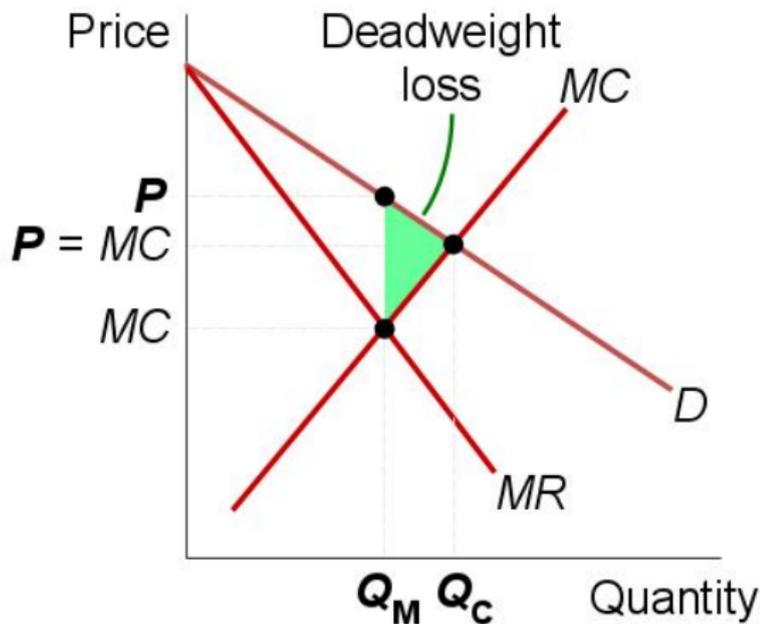
total surplus is maximized

Monopoly eq'm:

quantity =  $Q_M$

$P > MC$

deadweight loss



## Example

Consider an example in which a hospital is a monopolist, and profits are a function of only quantity produced.

Inverse demand is given by:

$$p = 404 - 2q$$

The hospital's total cost function is given by:

$$TC = 300 + 4q + 8q^2$$

1. Find the profit maximizing quantity and price for the hospital.
2. Find the hospital's total revenue, total cost, and profit.

## Example

$$p = 404 - 2q$$

$$TC = 300 + 4q + 8q^2$$

Step 1: Find the optimal quantity and price.

- ▶ The monopolist produces output at a level such that  $MR=MC$ .

$$\text{Total Revenue} = p * q = (404 - 2q) * q = 404q - 2q^2$$

$$\text{Marginal Revenue} = \frac{dTR}{dq} = 404 - 4q$$

$$\text{Total Cost} = 300 + 4q + 8q^2$$

$$\text{Marginal Cost} = \frac{dTC}{dq} = 4 + 16q$$

## Example

Setting  $MR=MC$ , we have:

$$404 - 4q = 4 + 16q$$

Solving for the equilibrium quantity:

$$20q = 400$$

$$q^* = 20$$

Now, we can find the equilibrium price by plugging the equilibrium quantity into the demand function:

$$p = 404 - 2q = 404 - 2 * 20$$

$$p^* = \$364$$

## Example

Step 2: Find revenue, cost, and profit. Note that revenue is also simply  $p \cdot q$ .

$$\textit{Total Revenue} = 404q - 2q^2 = 404(20) - 2(20)^2 = \$7,280$$

$$\textit{Total Cost} = 300 + 4q + 8q^2 = 300 + 4(20) + 8(20)^2 = \$3,580$$

Profits are revenues minus costs, so:

$$\textit{Profit} = \$7,280 - \$3,580 = \$3,700$$

## Example with Quality

Now suppose that the monopolist hospital maximizes profits by choosing not only some level of production, but also by choosing some level of quality.

Quality can enter into the demand function. Let's denote quality with the letter  $z$ .

Inverse demand is given by:

$$p(q, z) = 100 - 3q + 4z^{0.5}$$

Total costs are given by:

$$c(q, z) = 4q^2 + 10q + z$$

## Example with Quality

Just as before, to find the profit maximizing level of output for the monopolist, we must set  $MR=MC$ .

Total Revenue is given by:

$$TR = p * q = (100 - 3q + 4z^2) * q = 100q - 3q^2 + 4z^{0.5}q$$

Now, the hospital has two marginal revenue functions: one for quantity and one for quality.

Marginal Revenue associated with quantity is given by:

$$MR_q = \frac{\partial TR}{\partial q} = 100 - 6q + 4z^{0.5}$$

Marginal Revenue associated with quality is given by:

$$MR_z = \frac{\partial TR}{\partial z} = 0.5 * 4z^{-0.5}q = 2z^{-0.5}q$$

## Example with Quality

Total costs are given by:

$$c(q, z) = 4q^2 + 10q + z$$

Now, the hospital has two marginal cost functions: one for quantity and one for quality.

Marginal cost associated with quantity is given by:

$$MC_q = \frac{\partial TC}{\partial q} = 8q + 10$$

Marginal cost associated with quality is given by:

$$MC_z = \frac{\partial TC}{\partial z} = 1$$

## Example with Quality

Now, we must equate  $MR_q$  with  $MC_q$  and  $MR_z$  with  $MC_z$

$$MR_q = MC_q \implies 100 - 6q + 4z^{0.5} = 8q + 10$$

$$MR_z = MC_z \implies 2z^{-0.5}q = 1$$

This is a system of two equations and two unknowns ( $q$  and  $z$  are the unknowns).

We can isolate either variable in either equation and plug that variable into the other equation.

## Example with Quality

Let's solve for  $z$  in the second equation:

$$2z^{-0.5}q = 1$$
$$2q = z^{0.5} \implies z = 4q^2$$

Now, let's clean up the first equation, and plug the above expression for  $z$  in:

$$100 - 6q + 4z^{0.5} = 8q + 10$$

$$90 + 4z^{0.5} = 14q$$

$$90 + 4(4q^2)^{\frac{1}{2}} = 14q$$

$$90 + 8q = 14q$$

$$6q = 90$$

$$q^* = 15$$

## Example with Quality

Now we can plug  $q^* = 15$  into the expression for  $z$ , and find  $z^*$ :

$$z = 4q^2 = 4(15)^2 \implies z^* = 900$$

Given that we have solved for the equilibrium quantity and quality of the hospital, we can determine the equilibrium price from the demand curve:

$$p(q, z) = 100 - 3q + 4z^{0.5}$$
$$p(q^*, z^*) = 100 - 3(15) + 4(900)^{0.5} = \$175$$

## Example with Quality

Now, let's compute revenue, cost, and profit:

$$\begin{aligned} \text{Total Revenue} &= 100q - 3q^2 + 4z^{0.5}q \\ &= 100(15) - 3(15)^2 + 4(900)^{0.5}(15) \\ &= 1500 - 675 + 1800 = \$2,625 \end{aligned}$$

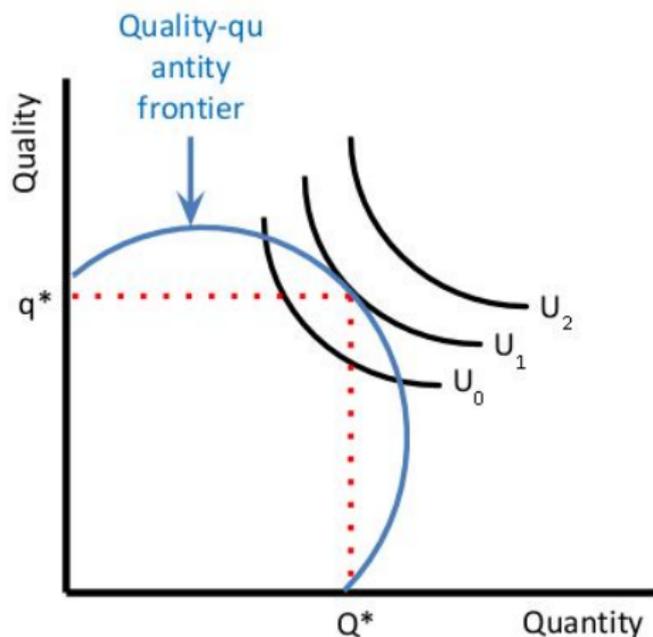
$$\begin{aligned} \text{Total Cost} &= 4q^2 + 10q + z \\ &= 4(15)^2 + 10(15) + 900 = \$1,950 \end{aligned}$$

So profit = revenue - cost = 2,625 - 1,950 = \$ 675

## Newhouse (1970)

- ▶ Proposed a model of nonprofit hospitals.
- ▶ The model involves utility maximization subject to some constraint. The hospital decision makers might be considered the board of trustees.
- ▶ Decision makers obtain utility as some function of quantity and quality, where quantity might be number of cases treated or the number of physicians hires and quality might be beauty of the hospital structure, prestige in the medical community, etc.
- ▶ Decision makers select a combination of quantity and quality that maximizes utility subject to some quantity-quality frontier.

## Newhouse (1970)



- Why does Quality/quantity frontier bow outward?
- Where would hospital produce if owners only cared about quality?
- Where would hospital produce if owners only cared about quantity?

## Newhouse (1970)

- ▶ The quantity-quality frontier bows-out from the origin, because at a level of zero quality  $Q^*$ , the hospital can achieve both a higher quality and a higher quantity by choosing a point to the northeast. This can occur if the higher quality attracts more customers but costs do not grow as rapidly.
- ▶ The frontier eventually bends backward, indicating that quality improvements no longer strongly attract customers but quality is increasingly costly.
- ▶ The utility maximizing combination of quantity and quality occurs at the point of tangency between the quantity-quality frontier and the hospital decision makers indifference curve. Decision makers want to be on the most “far out” indifference curve. The preferences of the decision makers (whether they care more about quantity or quality) will determine where this point of tangency occurs.

## Next Class

Externalities and the Health Economics of Bads (FGS Chapter 24)