Chapter 24: Network Issues

Learning Objectives

Students should learn to:

1. Find the optimal pricing strategy for a monopolist with a network externality in the demand for its product. The student will be able to explain the idea of low and high level equilibriums and the tendency for low level equilibriums to be unstable.
2. Discuss possible strategies for growing a network to critical mass.
3. Explain games involving the selection of a standard. The student will be able to explain what is meant by a network externality in such a game.
4. Explain the game called *tweedledum and tweedledee* and the various forms it can take. The game is one where the Nash equilibria do not lead to a common standard.
5. Explain the game called *battle of the sexes* where the Nash equilibria lead to a common standard.
6. Explain the game called *pesky little brother* where there are no Nash equilibria.
7. Discuss the difficulty of identifying anticompetitive behavior and appropriate remedies in the presence of network externalities.
8. Understand the nature of hedonic price regressions and the construction of an hedonic price index.

Suggested Lecture Outline:

Spend one fifty-minute long lecture on this chapter

Lecture 1:

Monopolies and network externalities in consumption

1. Critical mass and optimal pricing for the monopolist
2. Socially optimal size of the market
3. Problems raised by network externalities
   i) market failure
   ii) multiple equilibria
   iii) competition between rival systems
   compatible and incompatible technologies and technology standards
4. Excess inertia and excess momentum
5. Tweedledum and Tweedledee
   i) building on an early lead
   ii) attracting suppliers of complementary products
   iii) preannouncements
   iv) price commitments
   battle of the sexes
6. Pesky little brother
7. Public policy challenges
8. Review of Gandal (1994) study of network effects in early spreadsheet programs

Suggestions for the Instructor:

1. An example of a network externality is a school dance, where individuals want to go only if others are there.
2. Point out that the number of individuals in the population falls out of the first-order conditions for profit maximization for the network monopolist. It is the fraction that matters.
3. Other examples of network externalities and standardization include:
   a) Metric versus English tools and parts
   b) 5 1/4 versus 3 ½ inch floppy drives
   c) European versus English versus U.S. shoe sizes
   d) Shimano versus Campagnolo bicycle components
   e) Size of ball and receptacle on trailer hitches
   f) Format for attached e-mail files
   g) Actual width of planed lumber
   h) Frequency of radio or shortwave transmissions
4. In Battle of the Sexes, when the firms disagree on the choice of standard there are two possible equilibria, so an out of equilibrium outcome could arise in practice. Make sure to discuss the tactics firms could use to avoid this.
5. The standards games are a lot of fun to discuss. Be creative in allowing the students to suggest other games of this form. For example, the pesky little brother is like cat and mouse.

Solutions to End of the Chapter Problems

Problem 1

(a) Because of the network externality, the proposed merger is in the interest of the consumers.

(b) Most likely Bank 1 will not agree. It has a significantly larger number of ATM machines, so it has more likely to attract new customers.

Problem 2

(a) Let $\overline{w_i}$ be reservation value of the marginal consumer who is just indifferent buying the service and not buying it. The fraction *f* of consumers who subscribe to the service is given by

$$f = 1 - \frac{\overline{w_i}}{50}$$

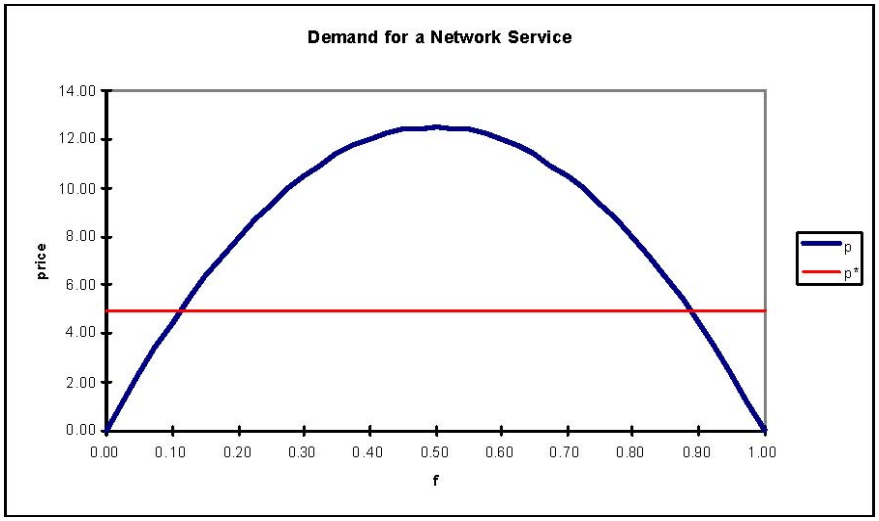
The marginal consumer's address is then given by

$$\overline{w_i} = 50(1 - f)$$

The quantity will be zero for $fw_i < p$, but will be one for each consumer who has $fw_i \geq p$. Substituting $\overline{w_i}$ in the demand equation when q_i^D is equal to one yields the inverse form as

$$p = f\overline{w} = f(50)(1 - f) = 50f(1 - f)$$

(b) Consider the graph below.



As the proportion subscribing rises, demand rises until $f = .5$. We can use the demand equation to solve for f low and f high by solving the aggregate demand equation for f, given p = 5. This is a quadratic in f. We can write it as follows

$$p = 50f(1-f) = 50f - 50f^2 \Rightarrow 5 = 50f - 50f^2 \Rightarrow 50f^2 - 50f + 5 = 0$$

It is straightforward to show that f = 0.887298 or 0.11270166

So if f is above 11.270166%, the market will move to the higher equilibrium at 88.7298% of the customers served.

(c) Profit as a function of f is given by

$$\pi = 50Nf^2 - 50Nf^3$$

Maximization of profit with respect to f yields $f = 0$ or $f = 2/3$. This implies that *price* = 11.11

Problem 3

(a) Solve A = 20 + (0.95) A. Get A = 20/(0.05) = 400.

(b) First determine A as a function of p.

$$A(p) = \frac{20-p}{0.05}$$

Therefore, for a price p, profit is $\pi = (p-2)\left(\frac{20-p}{0.05}\right)$

Maximization of profits yields $p = 11$.

As this price $A(11) = \frac{20-p}{0.05} = 180$ will attend the party**.**

Problem 4

(a) First consider the payoffs for firm 2. For there to be positive network externalities, it must be that the payoff when it chooses the old technology and the other firm chooses the old technology is higher than when it chooses the old technology and the other firm chooses the new technology. Similarly, if firm 2 chooses the new technology. Thus a > c and g > e. This ensures that when firm 2 will have higher payoffs when it chooses the same technology as firm 1. Now consider

firm 1. For there to be positive network externalities, it must be that b > f and h > d. For negative externalities, the opposite relationships hold. Summarizing:

	Positive Externalities	Negative Externalities
Firm 1	b > f h > d	f > b d > h
Firm 2	a > c g > e	c > a e > g

(b) 1. In this situation, each firm will prefer to be incompatible so the second column from the table applies. First consider the choices for firm 2. For firm 2 to always choose incompatibility, it must be that e > a and c > g. This ensures that firm 2 will have higher payoffs when it chooses a different technology than firm 1. Now consider firm 1. For firm 1 to prefer a different technology than firm 2, it must be that d > b and f > h. Summarizing: In this situation, both firms will prefer to adopt the same standard. First consider the choices for firm 2. For firm 2 to always choose compatibility, it must be that a > e and g > c. This ensures that firm 2 will have higher payoffs when it chooses the same technology as firm 1. Now consider firm 1. For firm 1 to prefer the same technology as firm 2, it must be that b > d and h > f. Summarizing:

c > a e > a

e > g d > b

f > b c > g

d > h f > h

2. The Battle of the Sexes,

a > c a > e
g > e b > d
b > f g > c
h > d h > f

3. The Pesky Little Brother.

In this situation, one firm prefers to be compatible and one firm prefers to be incompatible. First consider the choices for firm 2. For firm 2 to always choose incompatibility, it must be that e > a and c > g. This ensures that firm 2 will have higher payoffs when it chooses a different technology than firm 1. Now consider firm 1. For firm 1 to prefer the same technology as firm 2, it must be that b > d and h > f. We could also switch the roles and have firm 2 choose compatibility and firm 1 choose incompatibility. We have the following constraints:

	Firm 1 compatible Firm 2 incompatible	Firm 1 incompatible Firm 2 compatible
Firm that prefers compatible	b > d h > f	a > e g > c
Firm that prefers incompatible	e > a c > g	d > b f > h
Positive externality for firm that prefers compatibility	b > f h > d	a > c g > e
Negative externality for firm that prefers incompatibility	c > a e > g	f > b d > h