



RECITATION NOTES #4

Network Externalities and Demand Concepts

Friday - October 1, 2004

OUTLINE OF TODAY'S RECITATION

1. **Network externalities:** definition and graphic analysis
2. **Dynamic demand and elasticities:** definition
3. **Numeric Examples:** applying these concepts to exercises

1. NETWORK EXTERNALITIES

1.1 Definition and examples

1.2 Graphic explanation of positive network externality

1.1 Definition and examples

An industry faces Network Externalities if the quantity demanded in the market depends on the quantity already sold to other consumers.

- **Network externalities:** the more people already own a product in the market, the more the demand for that product will increase. In this case, we will face a so-called "**Bandwagon effect**", as every new consumer will demand more than he would have if there hadn't been a bandwagon to jump on to.
- **Snob effect:** the more people already own a product in the market, the more the demand for that product will decrease. In this case, we face a so-called "**Snob effect**", as every new consumer will now not be attracted to the good if too many people already have it.

Example of network externalities: My own demand function for the Microsoft Office suite depends directly on how many people in my office / my school use Office. The more people use it, the more I will want Office.

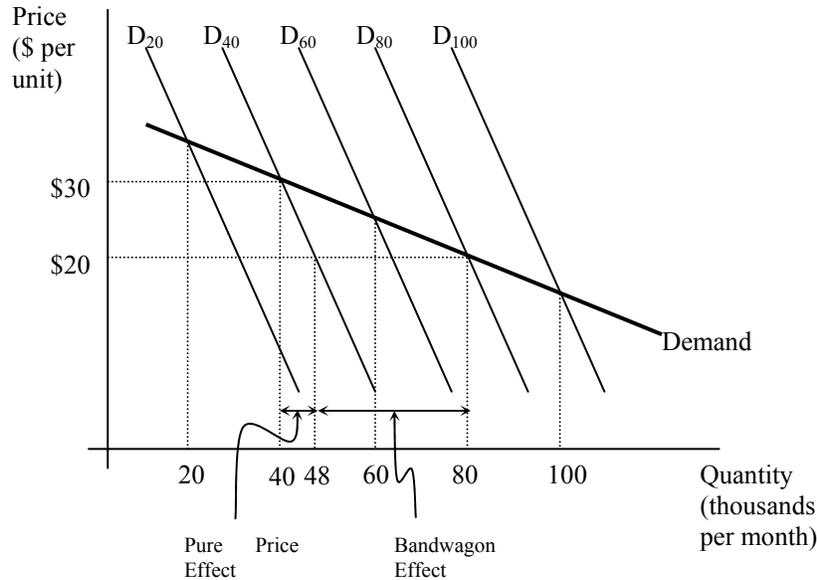
Example of snob effect: If too many people already own a Rolex Daytona 1987 Special, my demand for that watch will diminish as it is no longer "cool" to own one.

Network externalities can be direct or indirect:

- **Direct network externality:** the number of other consumers directly affects my demand. For example: telephone or instant messaging – if you are the only one with the technology it is not worth anything, and the value increases with the number of users
- **Indirect network externality:** the number of other users affects complimentary products that consumers care about. For example, the number of other Windows users has little

direct effect on my valuation, but the fact that software is programmed to be compatible with Windows directly effects my value of the product. The fact that many other people use Windows encourages more software applications. Another example: Nintendo Gameboy. It is not that others use a Gameboy that is important, but the fact that many games are created for Gameboy when many people use that technology.

1.2 Graphic explanation of a positive Network Externality



Quantity demanded depends on belief/knowledge about demand of others: $Q = f(P, I, Q_{\text{others}})$. For example, the D_{100} curve shows what demand would look like if consumers believed 100 other people will own the good. Because demand increases if a consumer believes many more people will demand the good, the thick line becomes the final demand curve in presence of network externalities.

2. DYNAMIC DEMAND AND ELASTICITY

2.1 Non-Durable Goods

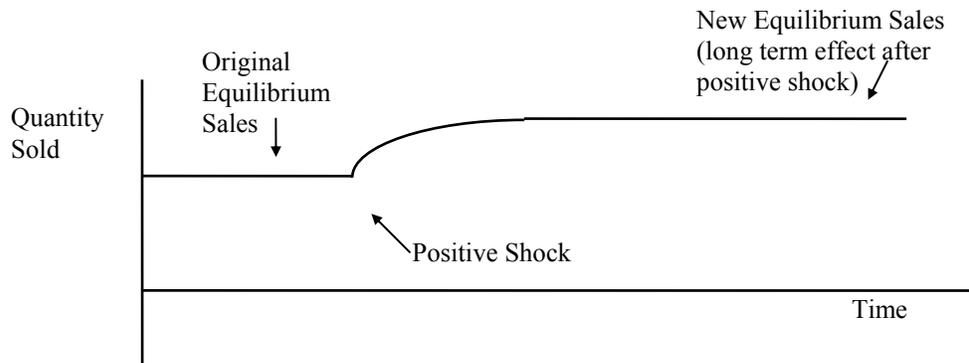
2.2 Durable Goods

2.1 Non-Durable Goods

Non-durable goods have a stickiness factor — the quantity bought today depends on the quantity bought last period. It can take time for habits to change to reflect a price shock or an income shock. As a result, the demand will vary less in the short run versus the long run. So for non-durable goods, typically:

Long term Elasticities > Short term Elasticities (*Absolute Value*)

- If the price goes down, or if income goes up, the result is a positive shock.:



A common example of elasticity differences in non-durable goods occurs with gasoline consumption. If the price of gasoline rises, consumers cannot do much in the short run to reduce consumption. It takes consumers a long time to alter their behavior to reduce consumption by either (a) purchasing a more fuel efficient automobile, or (b) moving closer to work to reduce commute distance.

2.2. Durable Goods

We think of durable goods in terms of the stock or the number of units that are in service in the economy. For example, if there are 100 million cars being used in the United States, the stock of cars in the US is 100mm. (Note this Stock is not the finished goods held by a supplier.)

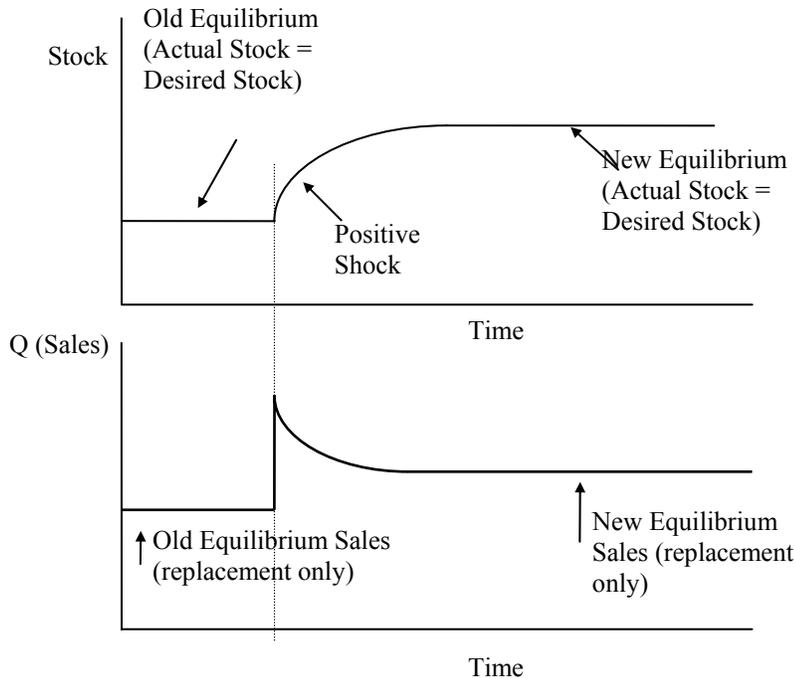
For durable goods, the long run stock of goods in the system is a function of income and price. At the long run equilibrium, the actual stock and desired stock are equal, and all sales (Q) are replacement sales for worn out units.

However, in the short run, in response to a price or income shock, the quantity demanded (Q) is equal to replacement sales for worn out units plus an adjustment (positive or negative) needed to move toward the new long term desired stock level.

The gap between actual stock and desired stock of durable goods is the largest right after a shock, so:

$$\text{Short Term Elasticities} > \text{Long Term Elasticities (Absolute Value)}$$

- If price of good goes down, or if income of consumers goes up, the result is a positive shock.



3. NUMERIC EXAMPLES

3.1 Example of Network Externality

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Using data from the graph in 1.2, calculate the demand curves for each level of total quantity (Q) in the market, as well as the final demand curve which incorporates the bandwagon effect.

a) Demand curve for each level of total quantity (Q) in the market is represented by:

$$q_x = a - b \cdot P + c \cdot Q$$

From the graph in 1.2:

For $P=20$, $D_{40}(P) = 48$

$D_{80}(P) = 80$

For $P=30$, $D_{40}(P) = 40$

Solve system of three equations:

(1) $48 = a - b \cdot 20 + c \cdot 40$

(2) $80 = a - b \cdot 20 + c \cdot 80$

(3) $40 = a - b \cdot 30 + c \cdot 40$

To calculate c , use equations (1) and (2):

$$80 - 48 = c*80 - c*40$$

$$32 = c*40$$

→ $c = 32/40$

→ $q_x = a - bP + (32/40)*Q$

Factor to correct for
bandwagon effect

To calculate a and b , use equations (1) and (3):

$$48 = a - b*20 + (32/40)*40$$

$$40 = a - b*30 + (32/40)*40$$

→ $b = 0.8$

$$a = 32$$

→ $q_x = 32 - 0.8P + 0.8Q$

Where q_x is the demand given a level of belief about the total number of products (Q) in the market.

Such that:

$$q_{40} = 32 - 0.8P + 0.8*(40) \rightarrow q_{40} = 64 - 0.8P$$

-and-

$$q_{100} = 32 - 0.8P + 0.8*(100) \rightarrow q_{100} = 112 - 0.8P$$

b) To solve for the equation for the final demand taking into account the bandwagon effect, calculate the slope from two points on the final demand curve to get b , and then plug in one of the points to solve for a :

Point 1: $P=30, Q=40$

Point 2: $P=20, Q=80$

$$\text{slope} = \Delta P / \Delta Q = (\$30 - \$20) / (40 - 80) = -1/4$$

$$Q = a - bP$$

$$-b = \Delta Q / \Delta P = 1/\text{slope} = -4$$

$$Q = a - 4P$$

Plug in \$20 and 80 for P and Q and solve for a :

$$80 = a - 4*(20)$$

$$a = 160$$

$$Q = 160 - 4P$$

Note that the elasticity for the demand without the bandwagon effect is given by:

$$E_d = -b*(P/Q) = -0.8*(30/40) = -0.6$$

and the elasticity for the final demand with the bandwagon effect is:

$$E_d = -b*(P/Q) = -4*(30/40) = -3$$