



THE UNIVERSITY  
OF AUCKLAND

BUSINESS SCHOOL

Department of Economics

# 06 Network Effects 3

Aaron Schiff

ECON 204 2008

Reading: *Cabral*, Ch 17

# Introduction

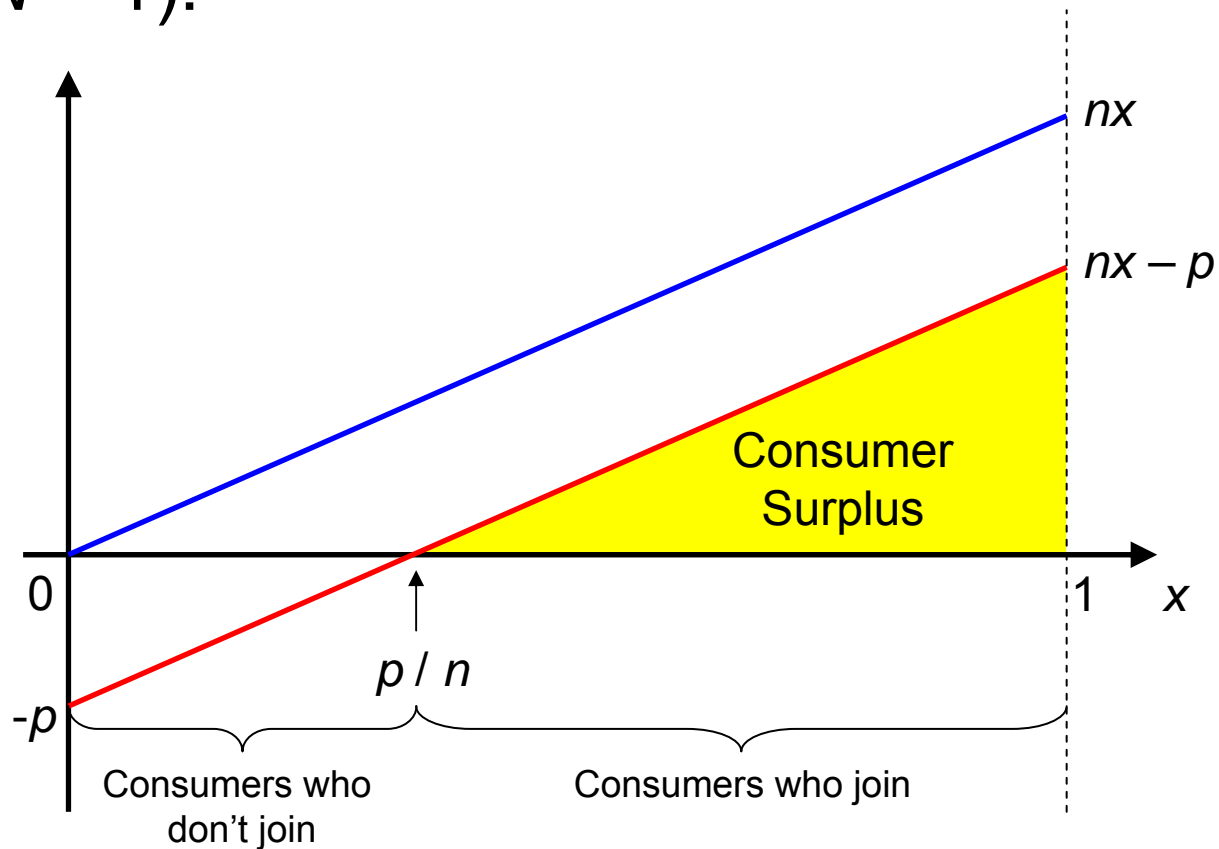
- **Objectives of this lecture:** Use the model of demand from the previous lecture to understand how to value networks and analyse a monopoly network. Discuss strategies for getting a new network off the ground.

# Consumer Surplus

- In our model of demand, suppose that  $N = 1$  for simplicity.
- For a given price and network size, we can calculate consumer surplus by ‘adding up’ the net utilities of all those consumers who do join the network.
- Recall that a consumer’s net utility from joining a network of size  $n$  at price  $p$  is given by  $nx - p$ , and consumers join the network if  $x \geq p / n$ .

# Consumer Surplus

- Finding consumer surplus for a given  $n$  and  $p$  (with  $N = 1$ ):



# Example 1

- Suppose  $N = 1$  in our model of demand.
- Questions:
  - What will be the market price if the network size is  $n = \frac{3}{4}$ ?
  - Calculate consumer surplus at this price and network size.

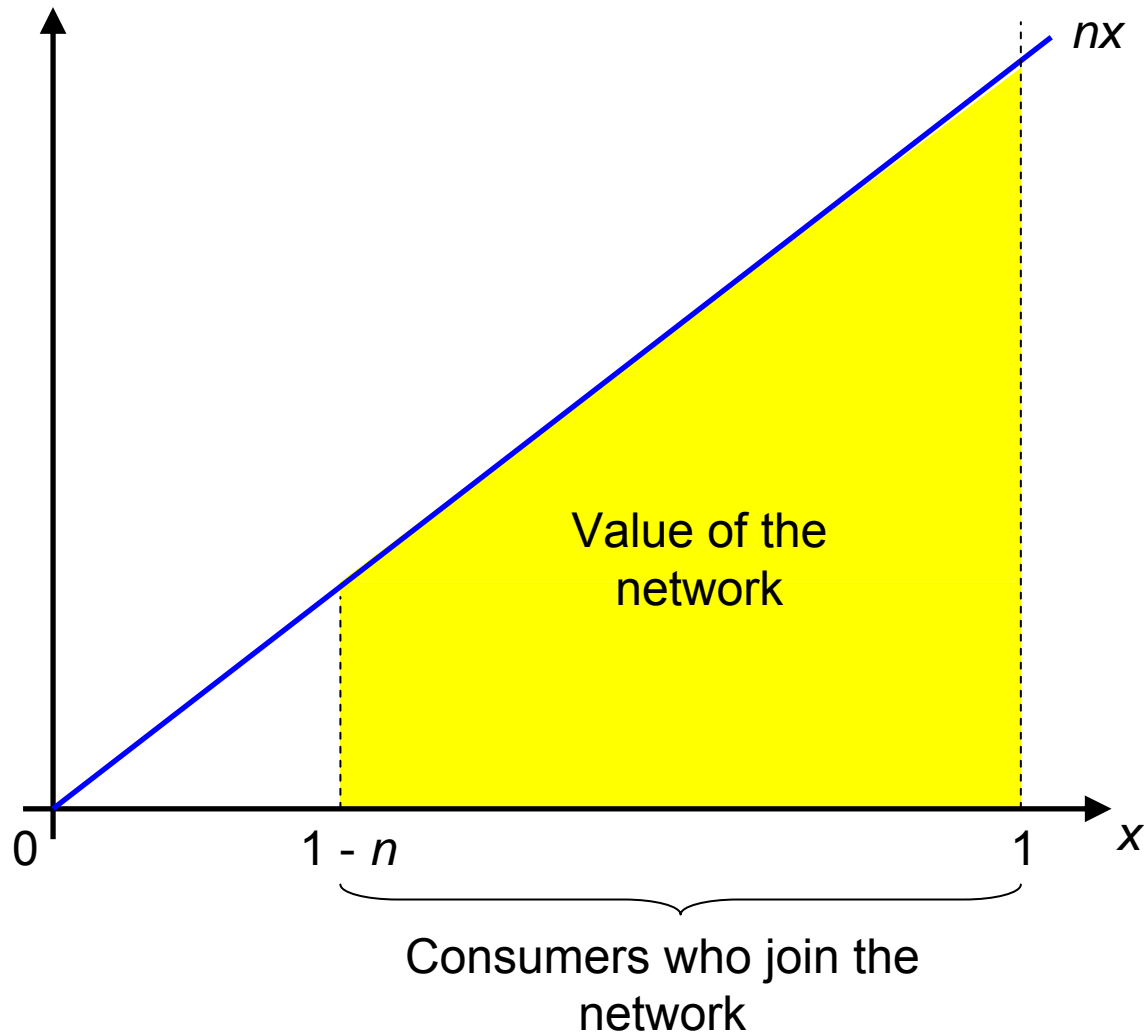
# Value of a Network

- The total economic ‘value’ or ‘welfare’ of the good or service sold in any market is the total value (utility) to consumers from the quantity consumed, minus the costs of producing that quantity.
  - The market price determines how the total welfare is split between consumers and producers.
- Recall that Metcalfe’s Law says that the total value of a network is proportional to the square of the network size.
  - Assuming each connection is equally valuable and no cost of creating the network.

# Value of a Network

- In our model, assuming no costs of creating the network, the total value of the network is just the total gross utility of all consumers who do join the network.
- Suppose  $n$  consumers join the network.
- The value to each consumer who joins is  $nx$  where  $x$  is between 0 and 1.
- If  $n$  consumers join, it must be those with the highest values of  $x$ .

# Value of a Network



If  $n$  consumers join the network, the total value created is given by:

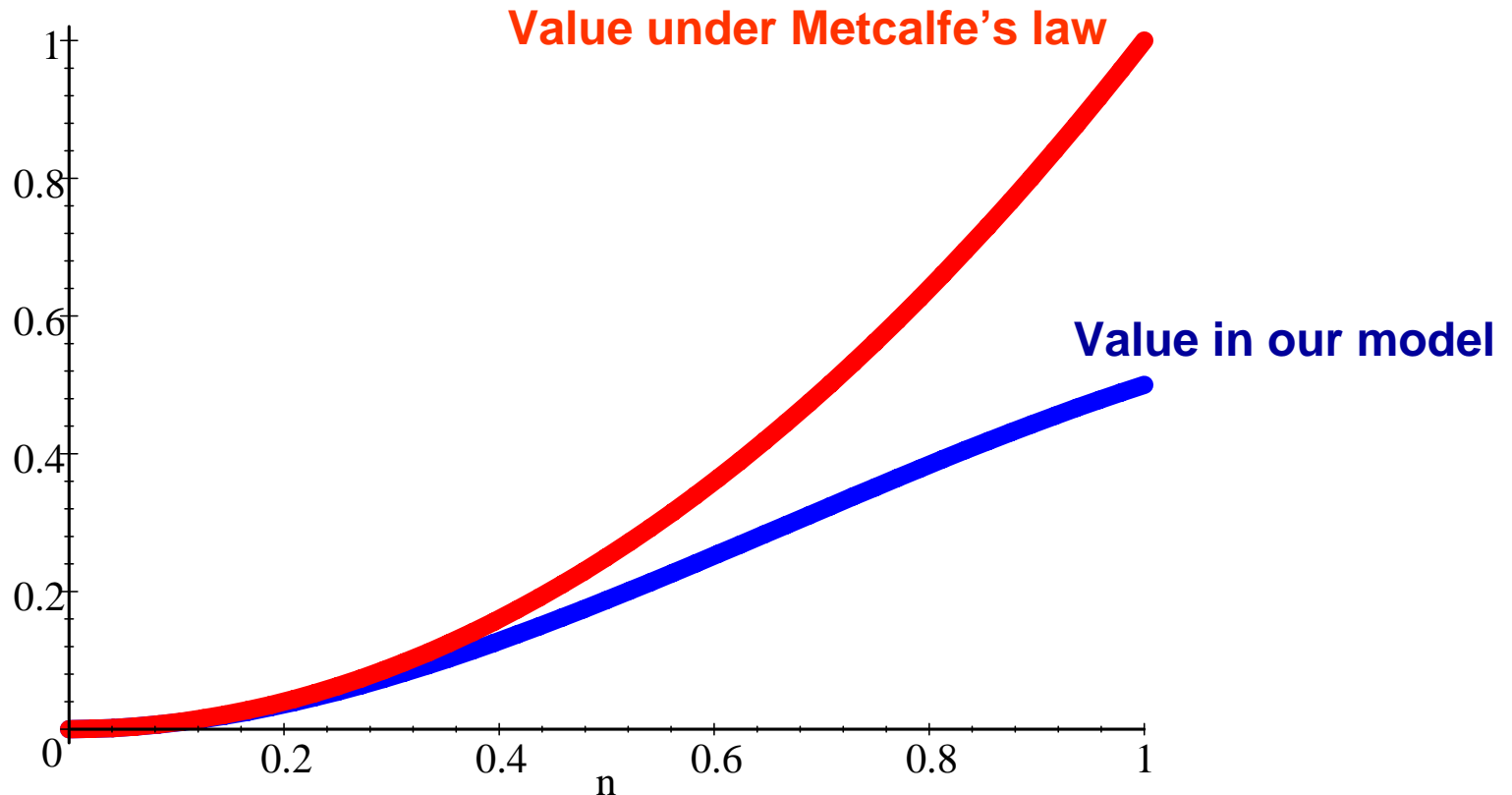
$$V(n) = n^2 - \frac{1}{2}n^3$$

# Example 2

- In our model of demand, suppose  $N = 1$  for simplicity.
- Calculate and illustrate the total value of the network at a network size of  $n = \frac{1}{2}$ , assuming no costs to create the network.

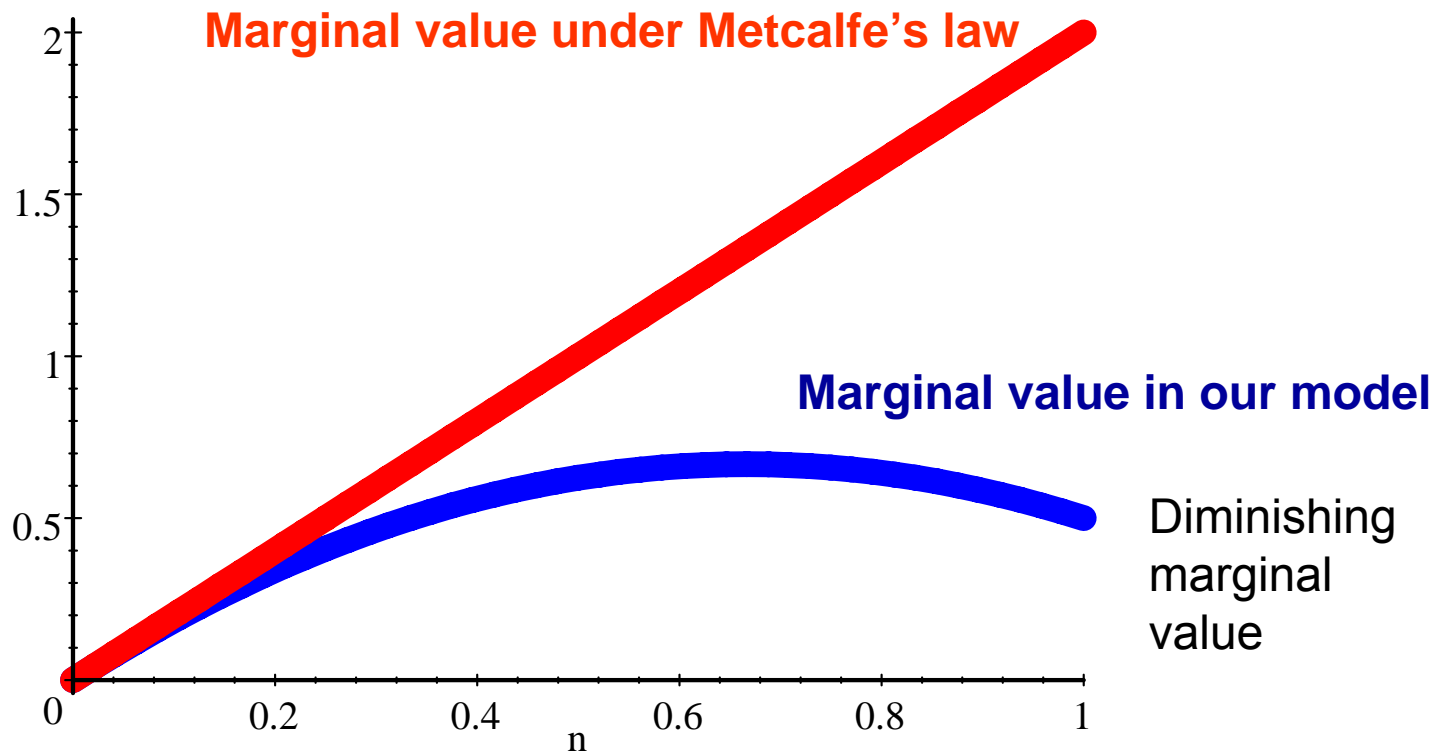
# Value of a Network

- Metcalfe's law overestimates the value of the network compared to our model.



# Value of a Network

- Under Metcalfe's law, the value of an additional consumer on the network is  $2n$
- In our model it is  $2n - \frac{3}{2}n^2$



# Value of a Network

- Because Metcalfe's Law assumes each network connection is equally valuable, it generates increasing returns.
- In our model, additional connections are less valuable.
- In our model there is initially increasing returns, followed by diminishing returns.

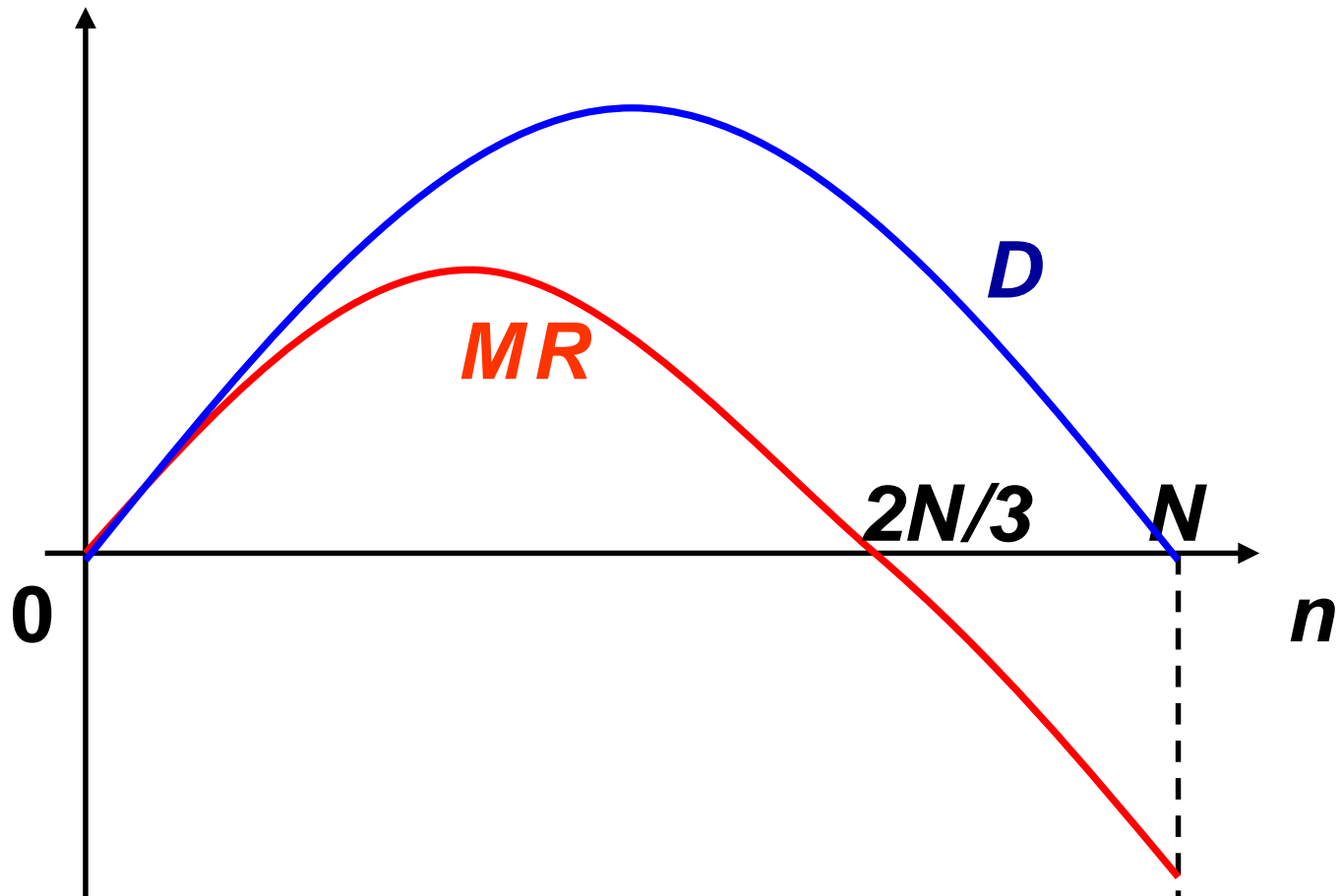
# Monopoly Network

- Suppose the network good/service is provided by a monopolist.
- Assume there are no costs to keep things simple.
  - The monopolist just maximises total revenue
- The monopolist faces the network good demand function that we have derived from our demand model:

$$p(n) = n \left( \frac{N - n}{N} \right)$$

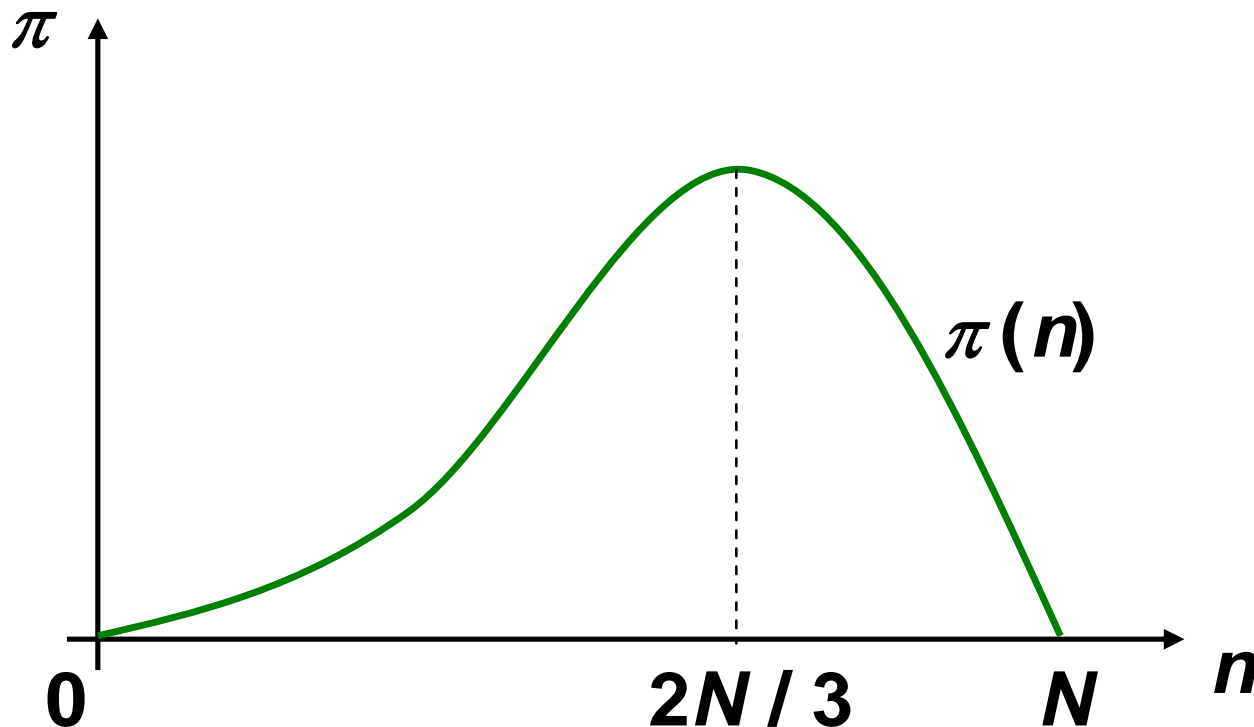
# Monopoly Network

- Marginal revenue is a quadratic function.
- Remember profits are maximised where  $MR = MC$ .



# Monopoly Network

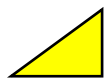
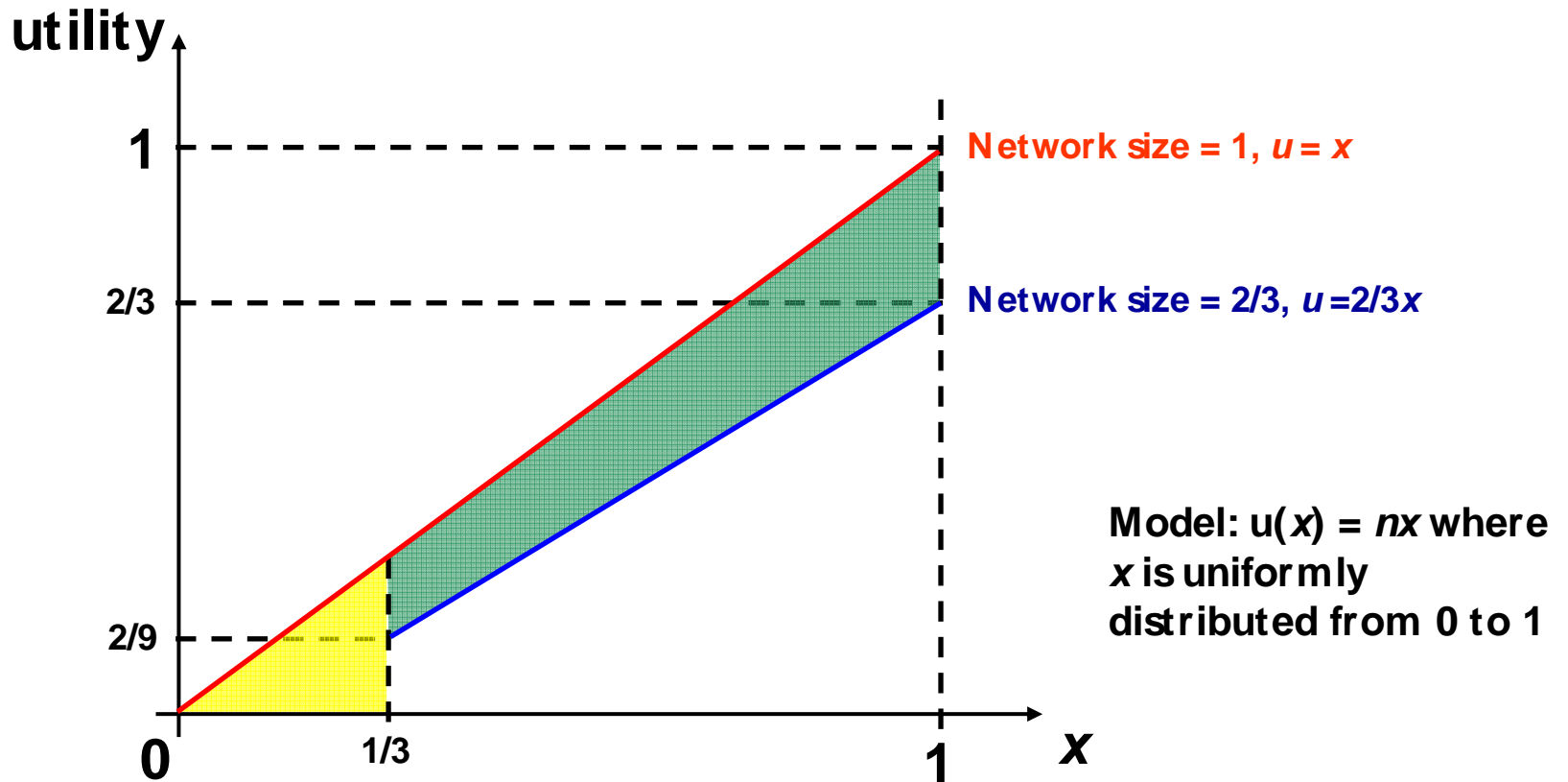
- Since  $MC = 0$  by assumption, we have  $MR = MC$  when
$$n = 2N / 3$$
- Monopoly's profit is maximised at this network size



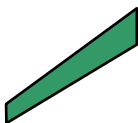
# Deadweight Loss of Monopoly

- Since there are no costs to connect consumers to the network and all consumers are better off if the network is larger, the socially optimal network size (that maximises the total value of the network) is  $n = N$ , i.e. all consumers connected to the network.
- The monopolist sets  $n < N$  so as usual the monopolist restricts quantity and welfare is lower than what it could be (there is **deadweight loss**).

# Two Sources of Deadweight Loss



DW L due to consumers who cannot join the network



DW L due to reduced network size