



THE UNIVERSITY  
OF AUCKLAND

BUSINESS SCHOOL

Department of Economics

# 04 Network Effects 1

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ECON 204 2008

Reading: *Cabral*, Ch 17

# Introduction

- In this topic we will study markets for a particular type of goods and services for which the demand exhibits 'network effects'.
- **Objectives of this lecture:** Understand the definition and nature of network effects, what causes them, and some examples of markets where they occur.

# 'Supply-side' vs 'Demand-side' Networks

- Economic research has focused on two types of 'network':
- **Supply-side networks:** A good or service that is created by combining several separate components, that may be supplied by different firms.
  - Example: Electricity generation and distribution.
- **Demand-side networks:** Goods or services that become more valuable to consumers as more people consume them.
  - Example: Fax machines.
- In this topic we focus on **demand-side** networks only.

# Demand-side Network Effects

- The demand for a good exhibits **network effects** or **network externalities** if consumers value it more highly the more other consumers who consume the same good.
- This is an externality because the decision of one consumer to consume a good positively affects the utility that other consumers derive from the same good.
- For such a good, the relevant network is the consumers that can be “accessed” by using that good in the appropriate way
  - E.g. For gtalk the relevant network is other gtalk users.

# Examples

- Telephones
- Fax machines
- Microsoft Word
- Microsoft Windows
- Instant messaging software
- Auction websites
- Online games
- Job search / dating websites
- Social networking sites
- Game consoles (PS3, Wii etc)
- Standards (e.g. HTML, CSS, SSL, etc)

# Formal Definition

- A **network good** is:

*A good for which each individual consumer's utility from consuming the good increases as the number of other consumers who consume the same good increases, everything else equal.*

# Direct and Indirect Network Effects

- Two types of network externality:
  1. **Direct**
  2. **Indirect**
- A good can have one or both types of externality.
- Whether network externalities are direct or indirect depends on the characteristics of the good and on how consumers use the good interact with each other.

# Direct Network Effects

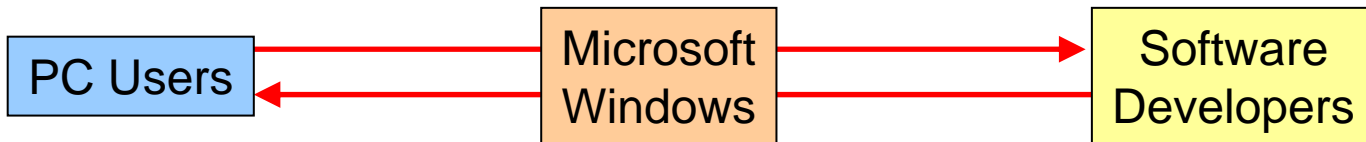
- *Direct* network effects occur when some or all of the utility that consumers get from a good comes from the way the good allows them to connect or interact with other consumers.
- Example: Instant Messaging
  - The value to you of having an instant messaging program is directly proportional to the number of other consumers you can communicate with via it.
  - Your utility from using the product depends **directly** on the size of the network.

# Indirect Network Effects

- *Indirect* network externalities arise when consumers don't get utility from the number of other consumers on the network directly, but benefit indirectly because of an increase in the number of complementary goods and services.
- Example: Microsoft Windows
  - A computer operating system, doesn't do much by itself but lets you run programs and organise your files.
  - Not much direct benefit from other people also having Microsoft Windows.
  - However, the more people that have Windows, the more software will be developed for it.
  - Hence consumers benefit indirectly from the size of the Microsoft Windows network through the increased software that is available.
  - Software developers also benefit if more consumers have Windows on their computers.

# Indirect Network Effects / Two-Sided Markets

- Indirect network externalities result in what is known as a *two-sided market*.
  - We will study these later.



↔ Network effects

**Indirect network effects  
operate *across* the 'platform'.**

# Intrinsic Utility

- It is not necessarily the case that consumers get *all* of their utility from consuming a good from the network effects.
- Goods may also provide some utility that is *independent* of the size of the relevant network.
  - May be related to *quality* or *brand preference*.
- This utility is called *intrinsic utility*.
- Example 1: Microsoft Word
  - Has network effects: If more people use Word, you can share your files with more people.
  - Has intrinsic utility: Independent of whether anyone else uses Word, you can still use it to type up and print out your assignment.
- Example 2: gtalk
  - Has network effects: If more people use it, you can communicate with more people.
  - Doesn't have intrinsic utility: It is not useful for anything except communicating with others.

# Examples Again

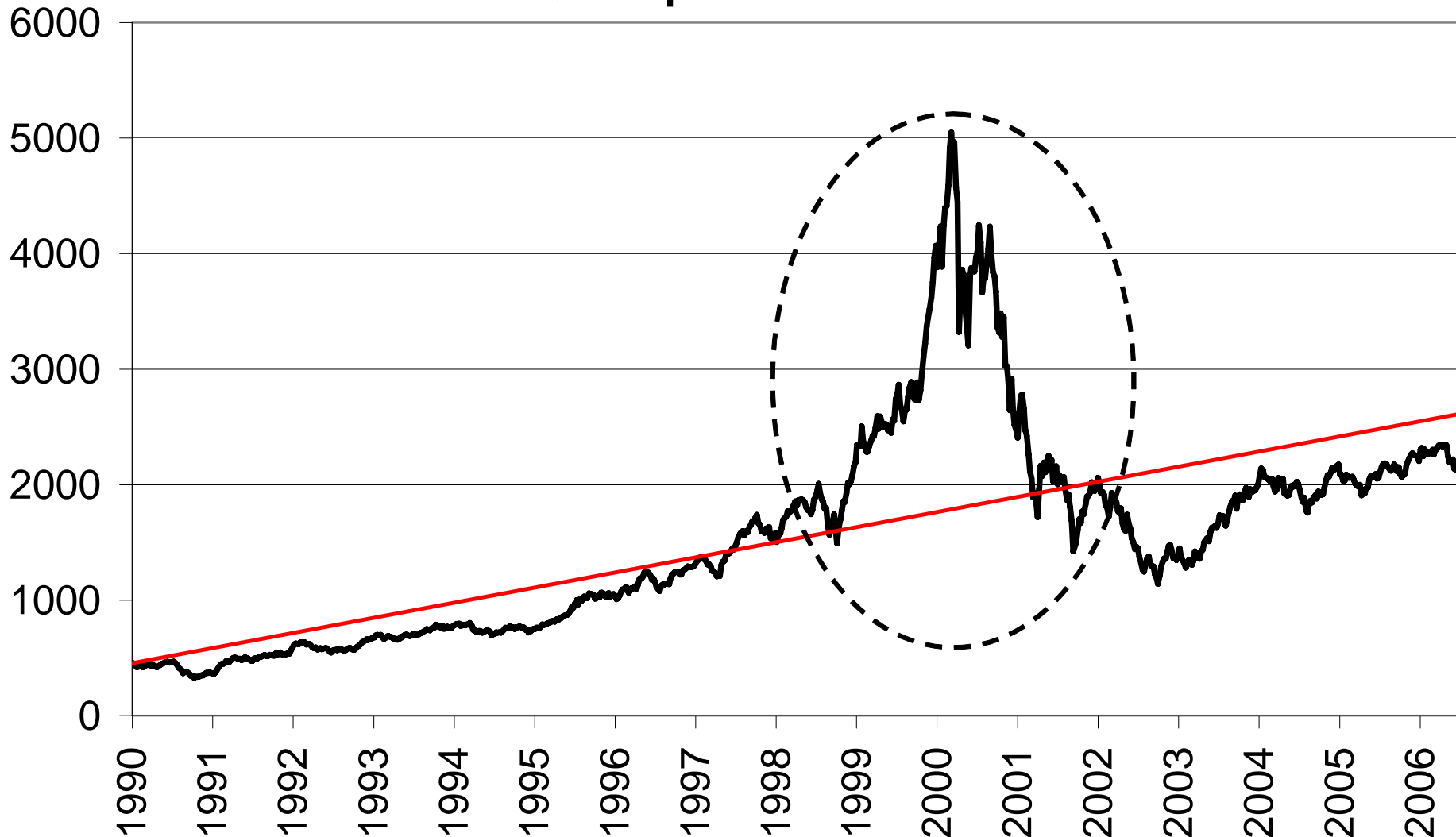
| <b>Example</b>          | <b>Direct or Indirect?</b> | <b>Intrinsic Utility?</b> |
|-------------------------|----------------------------|---------------------------|
| Telephones              | Direct                     | None                      |
| Fax machines            | Direct                     | Small                     |
| Microsoft Word          | Direct                     | Big                       |
| Microsoft Windows       | Indirect                   | Small                     |
| Instant messaging       | Direct                     | None                      |
| Auction websites        | Indirect                   | None                      |
| Job search websites     | Indirect                   | None                      |
| Social networking sites | Direct                     | None                      |
| Playstation             | Indirect                   | Small                     |
| Standards               | Direct                     | ?                         |

# Some Features of Network Markets

- Network markets are often characterised by a dominant firm (though which firm is dominant may change over time).
- New entry may be difficult.
- Market shares can be unstable and 'tippy' in early stages.
- Network goods that are technically inferior may maintain market share even in the face of competition from superior goods.
- The first firm to enter the market may have some advantage over rivals who enter later.
- New networks often set low prices to build market share.
- New networks sometimes try to make their network compatible with existing networks.

# The Dotcom Bubble

NASDAQ Composite Index 1990-2006



# The Dotcom Bubble

- One of the possible causes of the dotcom bubble was the mistaken belief that most or all Internet-related markets are characterised by network effects.
- In a network market, it may be a good strategy for a firm to try to increase its network size rapidly by offering low prices initially, even if this means making losses.
  - Once the network is established, it will be more difficult for other firms to compete, and prices can be increased.
- Many dotcom firms applied this type of strategy, and lost a lot of money.
- However, not all Internet-related markets have network effects.

# The Dotcom Bubble

- For example, selling pizzas online does not make pizzas a network good.
- Whether or not a good is a network good depends on the determinants of consumers' utility, NOT how the good is sold.
- Just because the good is sold on a network does not make it a 'network good'!
- Many high-profile dotcoms such as pets.com and boo.com (fashion) followed a strategy of spending large amounts on advertising and rushed their services out before they were well developed and tested.
- When network effects failed to materialise, it became clear that these dotcom firms did not have a superior business model to traditional retailers, and were unable to make profit.

# Metcalfe's Law

- Why exactly does a network become more valuable to its users as it gets bigger?
- Metcalfe's Law provides one possible explanation: Increasing the size of the network leads to a disproportionate increase in the number of possible 'connections' between network members.
- The number of potential connections exhibits *increasing returns to scale*.

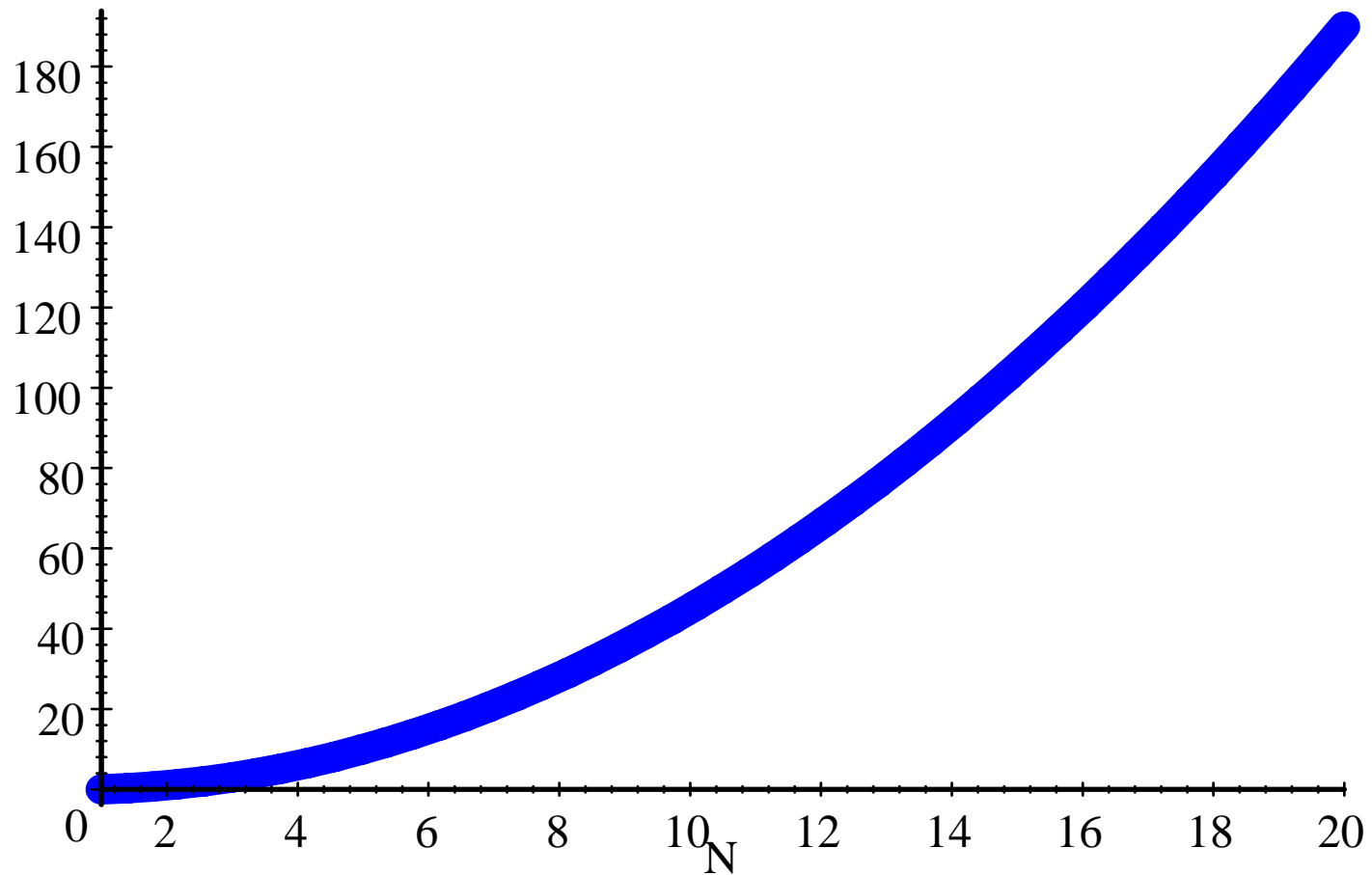
# Metcalfe's Law

| <b>Network Size</b> | <b>No. of potential connections</b> |
|---------------------|-------------------------------------|
| 2                   | 1                                   |
| 3                   | 3                                   |
| 4                   | 6                                   |
| 5                   | 10                                  |
| 6                   | 15                                  |
| $X$                 | $\frac{1}{2}X(X - 1)$               |

# Metcalfe's Law

- If  $X$  is the network size then there are  $\frac{1}{2}X(X - 1)$  possible connections.
- If each connection is equally valuable, for large  $X$ , the value of the network is proportional to  $X^2$ , i.e. increasing returns to scale.
- This relationship is known as *Metcalfe's Law*.

# Metcalfe's Law



# Metcalfe's Law

- Metcalfe's law effectively tells us how the social value of a network is related to its size *assuming that all connections are equally valuable and all consumers are identical.*
- If  $X$  is large, the total value that the network creates will be proportional to  $X^2$  *assuming that all connections are equally valuable and all consumers are identical.*
- Thus Metcalfe's Law predicts *increasing returns* on the demand-side for network goods.
  - Should be able to charge a higher price the larger is the network, everything else equal.

# Metcalfe's Law

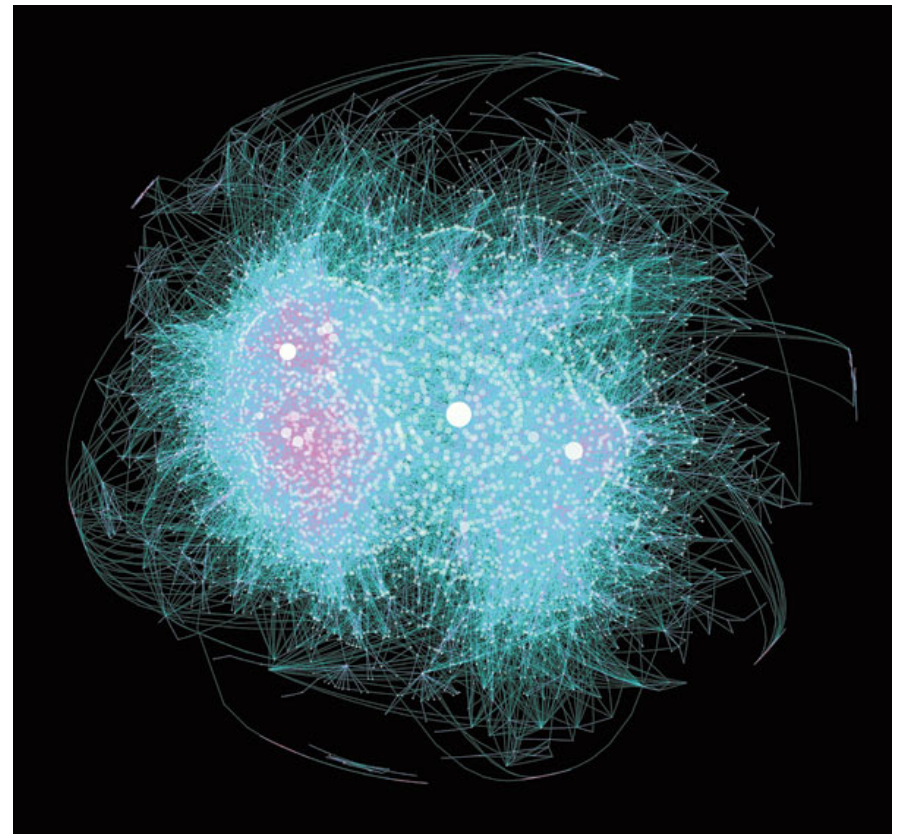
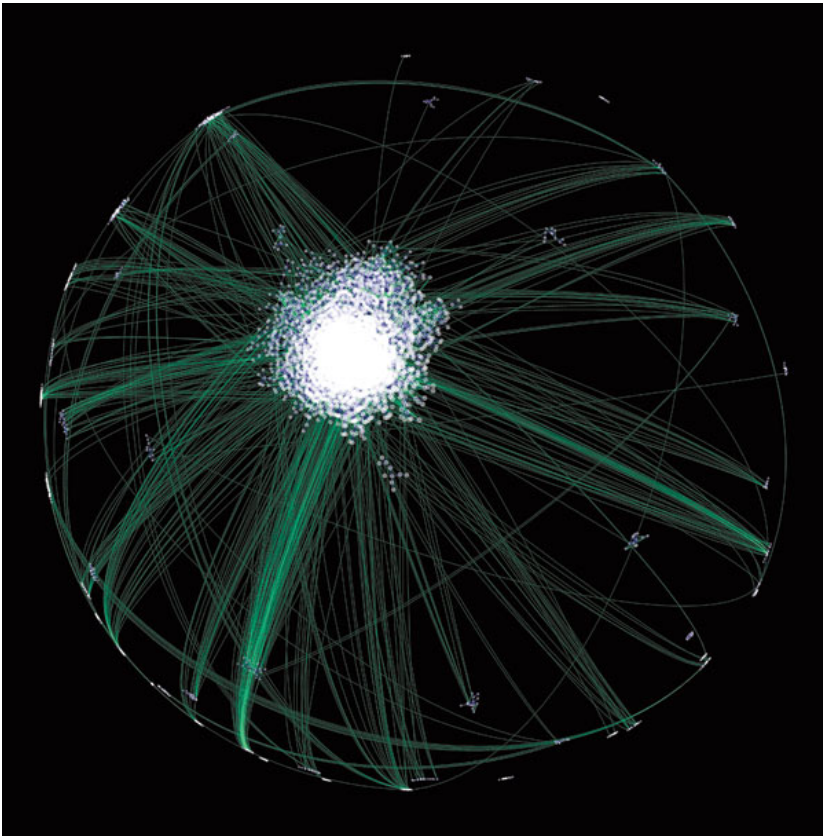
- From the point of view of a firm that operates the network, the total value that they can extract from consumers who belong to the network will also be proportional to  $X^2$ .
  - In practice this will be limited by firms not having complete market power, i.e. not being able to extract all consumer surplus.
  - The profit-maximising size of the network will also depend on the *costs* of operating the network.
  - Although there are increasing returns on the demand side, there might be diminishing returns on the cost side.
- In practice, the network won't be so valuable:
  - Not all connections are equally valuable.
  - Ignores the costs of constructing the network.

# Metcalfe's Law

- Metcalfe's Law values each connection equally.
- In reality, people value connections with some people more highly than others.
- Everyone doesn't always 'connect' with everyone else in online networks.
  - Although, the possibility of connecting with people may be valuable.

# Visualising Networks

- Links between blogs:



# Visualising Networks

- Last.fm friends network (random sample):

