



THE UNIVERSITY
OF AUCKLAND

BUSINESS SCHOOL

Department of Economics

05 Network Effects 2

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ECON 204 2008

Reading: *Cabral*, Ch 17

Introduction

- **Objectives of this lecture:** Study in more detail the factors that affect demand for a network good, and some of the implications for businesses in these markets.

Coordination Problems

- The value that someone gets from using a network good depends in part on how many other people use the same good.
- Thus, joining a network confers an external benefit on *other* people (a positive externality).
- However, people won't take the effects on others into account when making their joining decision.
- This can result in *coordination problems* where individual choices do not lead to an efficient outcome.

Example 1

- Suppose two people, A and B, must simultaneously choose whether or not to join a network.
- If both join, both get a net payoff (benefits minus joining cost) of 4.
- If one joins but the other does not, the one who joined gets a payoff of -2.
- Anyone who does not join gets a payoff of zero.
- Questions:
 - Write down the payoff matrix of this game.
 - Find the Nash equilibria and interpret.

Example 2

- Now suppose A and B simultaneously choose between joining network 1 or network 2.
- Person A prefers network 1 and gets a payoff of $4 + x$ if B also joins network 1, while A gets only 4 if both join network 2.
- Person B has no preference and gets 4 if both join either network.
- Person A gets x from joining network 1 if B joins network 2, and zero from joining network 2 if B joins network 1.
- Person B gets zero from either network if A joins a different network.

Example 2 Cont

- Payoff matrix:

		Person B	
		Join 1	Join 2
Person A	Join 1	$4 + x, 4$	$x, 0$
	Join 2	$0, 0$	$4, 4$

- Questions:
 - Find the Nash equilibria depending on x .
 - Interpret.

Effects of a Lack of Coordination

- Consumers may be *confused* about whether or which network to join.
 - Multiple equilibria in our coordination games.
 - Difficult to predict the outcome.
- The market may *splinter* into several small competing networks.
 - Even though everyone may be better off in a single large network, it may be difficult to coordinate on that outcome.
- Consumers may *wait and see* what other consumers do before joining a network.
 - Retards/delays network growth.
 - Example: HD-DVD vs Blu-ray.

Demand for a Network Good

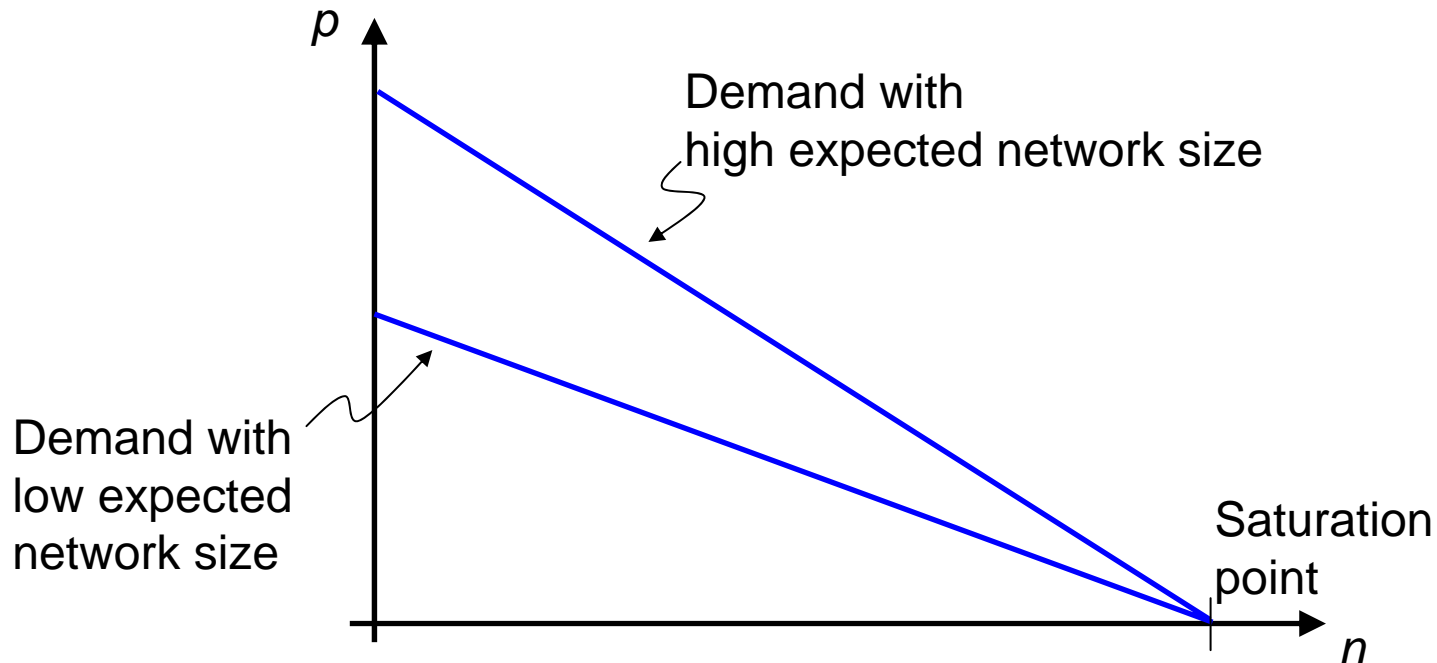
- A general model of utility from consuming a network good:

$$u(q, n^e) = v(q) + e(n^e)$$

where $v(q)$ represents intrinsic utility from consuming q units of the good and $e(n^e)$ represents the network benefit (externality) based on the expected network size n^e .

Demand for a Network Good

- For a given *expected* network size, we can derive the demand for the good depending on its price.
- A higher expected network size will increase willingness to pay at any actual network size.



Demand for a Network Good

- Additional assumptions to build a specific model:
 - No intrinsic utility: $v(q) = 0$
 - The good is a 'pure network good' e.g. instant messaging.
 - There are N infinitely divisible consumers in total who have different valuations of 'communicating' across the network.
 - For each consumer, $e(n^e) = xn^e$ where x is randomly drawn from a uniform distribution between 0 and 1.
 - Consumers are *heterogeneous* with respect to their valuation of the network benefits.
 - Consumers who join the network pay a price of p and will join if their net utility from doing so is positive.
 - Net utility: $xn^e - p$
 - All consumers have the same expectation of the network size.

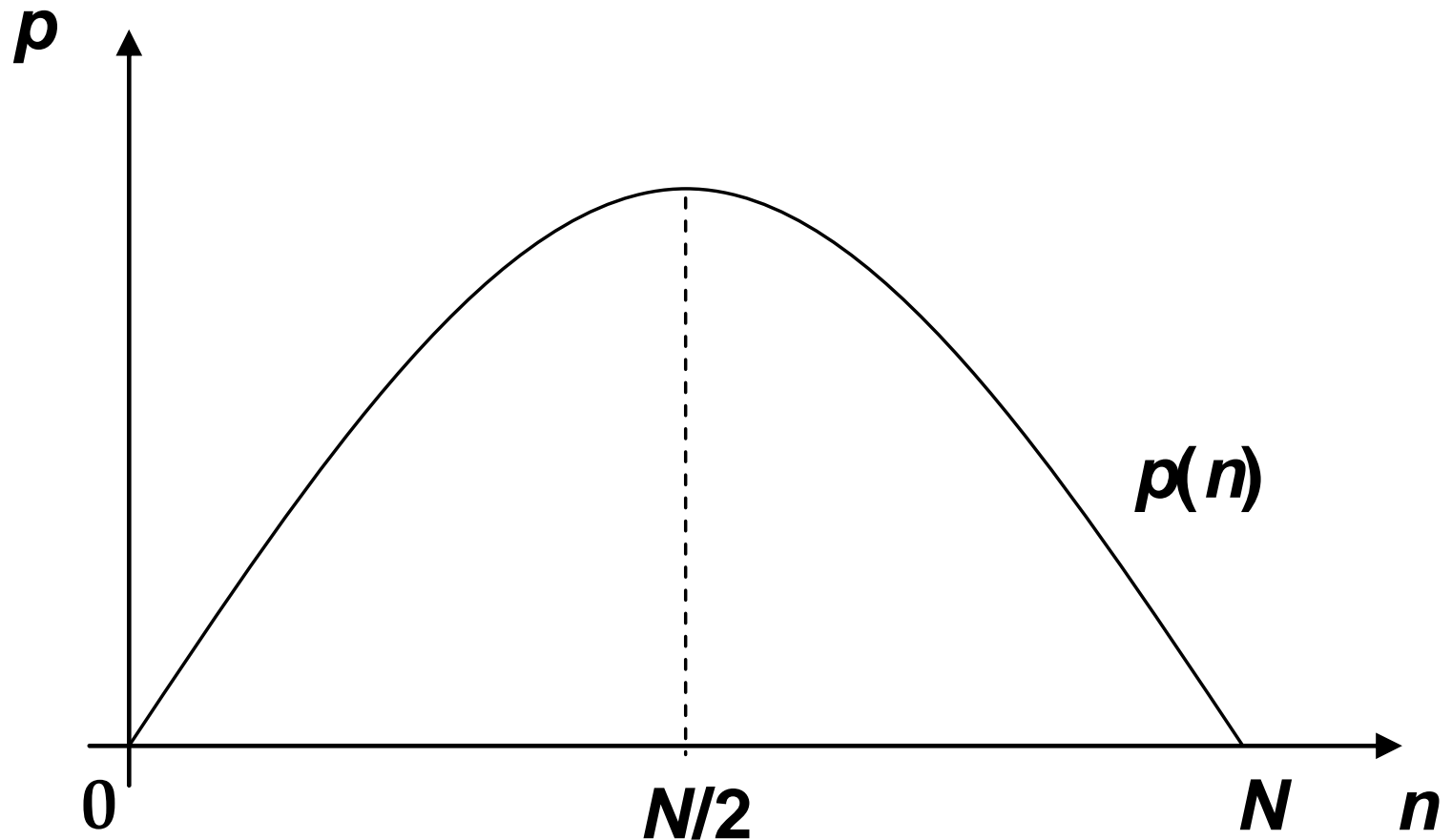
Demand for a Network Good

- Imposing the assumption that *consumers' expectations are correct* we can derive the inverse demand function for a network good:

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

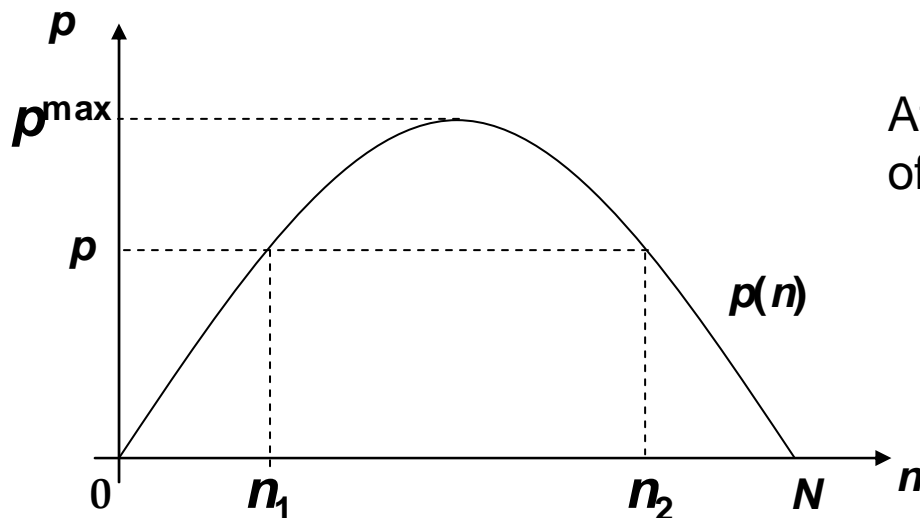
- It tells us what price is consistent with any given network size, n .
- Note this is a highly simplified and unrealistic model, however it does allow us to understand the basic characteristics of demand for network goods.

Demand for a Network Good



Observations from the Model

- For any given price below this maximum price, there are *two possible network sizes*.
 - Every price below the maximum is consistent with a relatively **small** network and a relatively **large** network.
- Demand slopes *up* at small network sizes and *down* at big network sizes.



At a price of p , network sizes of both n_1 and n_2 are possible.

The Importance of Expectations

- The two possible network sizes arise from consumers' expectations.
- If consumers expect the network size to be small, only consumers with relatively high valuations will join and the network size *will* be small.
- If consumers expect the network size to be large, consumers with relatively low valuations will join and the network size *will* be large.
- We say that the outcome with the smaller network size is characterised by *coordination failure* among consumers.
 - The network is small simply because consumers expect it to be small.
 - All consumers would be better off with the larger network size.
 - The larger network size is **Pareto superior** to the smaller size.
 - Similar to the equilibria in the simple games earlier in this lecture.

The Importance of Expectations

- In network markets, *expectations are crucial*.
- Network businesses need to think about generating positive expectations as part of their business strategy.
- Expectations can be equally important as prices and quality for determining the success of a network good.
- Expectations can be *self-fulfilling*.
- Expectations can be influenced through advertising.
- Reputation and past success can also be important.

Critical Mass

- Our simple model of demand is a static one.
 - All consumers decide whether or not to join the network at the same time.
- Suppose instead that consumers make their joining decisions over time, and base their expectation of the network size at each point in time on the actual network size in the previous period.
- Suppose the time periods are $t = 0, 1, 2, 3, \dots$
- Suppose the price is fixed at p in all periods and the *proportion* of consumers on the network in period t is n_t .

Critical Mass

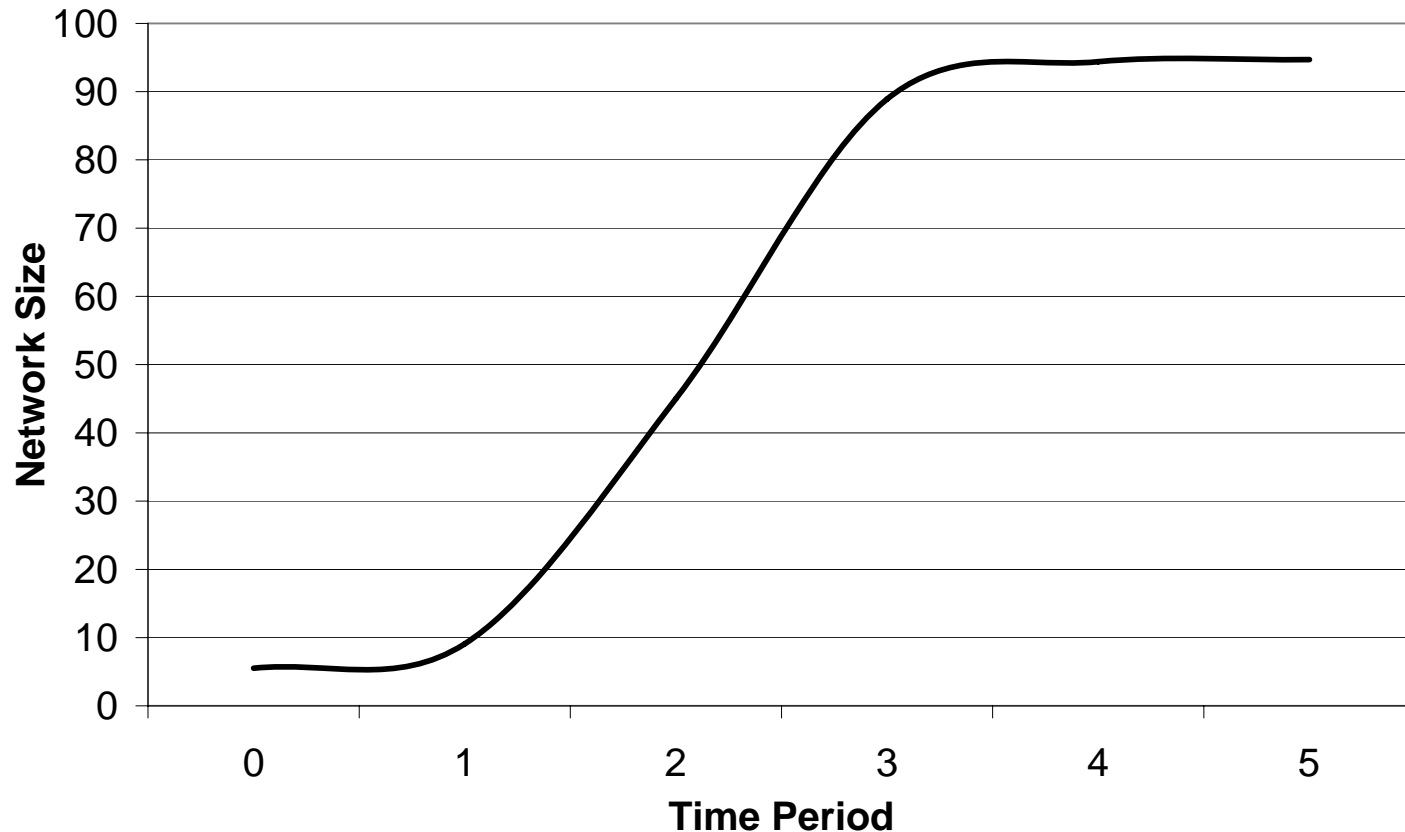
- Then, the *proportion* of consumers who join in period t is given by:

$$n_t = \left(1 - \frac{p}{n_{t-1}} \right)$$

- Suppose for example that $p = 0.05$ and $n_0 = 0.055$.
- Then we have $n_1 = 0.09$, $n_2 = 0.45$, $n_3 = 0.89$, etc.

Critical Mass

- Once the network size reaches a certain level, growth of the network accelerates rapidly until the network becomes large.



Path Dependence / Lock-In

- It is often the case in network markets that *history matters*.
- The past decisions of consumers to adopt a network technology (or not) will influence the adoption decisions of future consumers (path dependence).
- See Cabral section 17.2 for a simple model.