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Week 3: Network Externalities

SI 646

Mark J. McCabe
Today:

A Motivating Example: Apple and MS

What are network externalities?

A simple network “model”

Networks and Competition

Motivating Example:

Apple and Microsoft

- Different business strategies, different outcomes!
What are Network Externalities?

- First, what is an externality?

  An agent benefit or cost arising from another agent’s action, e.g. 2\textsuperscript{nd} hand smoking

- Second, what is a network?

  A series of nodes connected by links, where nodes represent users, producers, etc.

- So a network externality arises when user utility is (in)directly increasing in the number of other consumers using the same “network”.
Some examples:

- “direct” network effects occur in communication networks (telecom, facebook, e-mail, etc.), software file sharing, etc.

- “indirect” network effects (i.e. a secondary result of many people adopting the same standard or system) occur with:

  Media formats (CDs, DVDs, etc.), software variety

(Note: compatibility between complementary components is implied here, e.g. compatible operating systems and software).
So far we have discussed situations in which information *technology*, not information *per se*, is subject to network effects.

What about Markets for *Information Goods*?
Markets for Information Goods

• Markets for Information refers to markets in which information goods or products are exchanged.
• Information goods (“IGs”) are typically characterized by high “first copy” costs and relatively low reproduction and distribution costs.
• Examples include text, music, video, data, etc.
A Contradiction?

• But IGs do not usually exhibit demand-side network effects (NEs)!

• Consumer utility from reading a newspaper or listening to music is not (primarily) related to total demand for the IG.

• Rather, demand-side NEs normally arise from the use of infrastructure, e.g. AT&T’s array of landlines.

• Of course, information is communicated over a telecom network, but the NEs are not related to this fact.

• Note – software exhibits IG-like production costs and generates NEs
Only a semantic distinction?

- No!
- Although many infrastructure-based demand-side NEs affect markets for IGs – and deserve attention (e.g. see Shapiro and Varian)…
- …recognition of the distinction between infrastructure and IGs helps us identify another type of NE.
SNE ∩ IG = SNIG*

- supply-based network effect or SNE.
- supply-based networked information good or SNIG.
- A SNE exists when the value of some product X (typically an IG) to any single user ↑ as the number of producers creating X ↑.

* not to be confused with the Australian verb “snig”: to drag (a felled log) by a chain or cable
Some examples…

• Several classic cases: scientific journals, print encyclopedias (Britannica) and newspapers, weather data, etc., where producer = author/observer.

• More recent, web 2.0-enabled examples: Wikipedia, Digg, Slashdot, Amazon book reviews, Yahoo! Answers, Google

• (these various cases can be modeled as “2-sided” markets in which a platform mediates the flow of externalities between each side of the market, but not within each side of the market)
Not all IGs are SNIGs, etc.

- There are many IGs that do not (yet) exhibit SNEs, e.g. music, most books, film, etc.
- May want to distinguish between direct and indirect SNEs.
- An indirect SNE arises when a SNIG is created that complements some other pre-existing IG, e.g. user-contributed book reviews at Amazon complement consumption of books, music, DVDs, etc.
A Simple Network Model
Communications Network (Rohlfs 1974)

- A Single (monopoly) Supplier
- Consumer willingness to pay (wtp) is modeled as a function of a user's location on a "unit interval" of length 1; consumers are distributed uniformly on this interval.
- Suppose wtp is x; thus, users located closer to x=1 have the highest wtp.
- Net user utility is nx – p where n is the fraction of "networked" consumers and p is the access fee charged by the monopolist.
• The *marginal* consumer will be indifferent between using and not using this network, so for this person we know that \(0 = nx - p\)

• Since the fraction of consumers, \(n\), is given by \(1-x\), we have \(0 = (1-x)x - p\)

  or \(p = (1-x)x\).
Communications Network, III

2 non-trivial equilibria at $p_o$
- The “critical mass” equilibrium at $x^L$
- But the only stable equilibrium is $x^H$.

When $p=(1-x)x$, and $mc=0$
$x^*=2/3$ and
$p^*=(2/3)(1/3)=0.222$
Networks and Competition
Metcalf’s Law

- Metcalfe’s Law: “The value of a network goes up as the square of the number of users.”
- Named after Bob Metcalfe, inventor of Ethernet
- Suppose there are N people on a network, and the value to each is proportional to the number of other users. Then the total value of the network to all users is proportional to $N(N-1)$
Typical Adoption Curve

- Launch
- Takeoff
- Saturation

Time
Tipping and Lock-In

Fraction of Users on System B

Tipping Point

$V_A$

$V_B$
Expectations, Coordination, and Compatibility

- **Expectations**
  - Consumers adopt new technologies based in part on expectations about which will become dominant
  - Thus, corporate marketing strategies that convey a sense of inevitability can be very valuable

- **Coordination and Lock-In**
  - Even if collective switching costs are low enough to justify changing to a new technology, it may not occur without coordination across users

- **Compatibility**
  - Firms make a strategic decision to make their new technologies compatible with existing ones or not
Evolution vs. Revolution

- Evolution:
  - Improved design or adapters

- Revolution

- Compatibility

- Performance
Openness vs. Control

Share of Industry Value

Proprietary

Optimum

Your Reward

Open

Total Value Added to Industry
## Generic Network Strategies

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<th>Control</th>
<th>Openness</th>
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<td>Compatibility</td>
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<td>Performance Play</td>
<td>Discontinuity</td>
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Performance Play

- Characteristics
  - New, incompatible technology
  - Vendor retains strong proprietary control
- Used by Nintendo Entertainment in mid-80s, USR for Palm Pilot in 1990s, RIM in 2002
- Works best for outsiders with no installed base to cannibalize
Controlled Migration

- “Upgrade” strategy
- Characteristics
  - New technology is compatible with existing ones
  - Vendor retains control
- Examples:
  - Windows 98, Intel Pentium II, Turbotax, Windows CE/Pocket PC
Open Migration

- Characteristics
  - New technology is compatible w/old one
  - Low switching costs, little proprietary control

- Examples
  - Modems, fax machines, HP

- Makes most sense when your advantage is based on manufacturing capabilities
  - You gain from expanding the market
Discontinuity

- Characteristics
  - Incompatible new technology
  - Offered by multiple suppliers

- Examples
  - CD audio system, 3.5” floppy disks

- Favors efficient manufacturers (hardware) or firms with value-added services (software)
Network Competition

- Two key questions:
  - Should a firm compete “for the market” or “in the market?”
  - Is it possible to topple the existing standard?
## Will a Given Market Tip?

<table>
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<tr>
<th>Low demand for variety</th>
<th>Low Economies of Scale</th>
<th>High Economies of Scale</th>
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</thead>
<tbody>
<tr>
<td>Unlikely</td>
<td></td>
<td>Highly likely</td>
</tr>
<tr>
<td>High demand for variety</td>
<td>Low</td>
<td>It depends</td>
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“For the Market” or “In the Market?”

- Monopoly in a smaller market may be more valuable than competing as a small player in a large market.
- It is critical to attract early adopters.
- Without a common standard (or at least a sufficiently large installed base), complementary products may not be forthcoming.
“For the Market” or “In the Market?”

- To enlist manufacturers of complementary products, share value-added with them
- If the standards war gets too costly, agree on a common standard
- (Battle of the Sexes)
Fighting a Dominant Standard Successfully

- Installed base gives the incumbent the edge
- The challenger must offer superior quality (Sony vs. Nintendo, RIM vs. Palm?). 10X?! 
- Should be able to tap into the complementary goods market (Microsoft Pocket PC and Outlook)
Summary

- Information markets often exhibit network effects, which can create a powerful first-mover advantage. Yet breakthrough innovations can create a “successive monopolies” competition.

- Such markets create opportunities for interesting competitive tactics, including expectations management, user coordination, and compatibility choices.