

# Network Economics

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April 1996

## Examples of networks

Networks with one kind of user

- faxes
- Internet email
- video phone

Networks with two kinds of users

- WWW: users and "publishers"
- digital cash: buyers and sellers
- electronic publishing: authors and readers
- videos: VCRs and tapes

## Behavior of interest

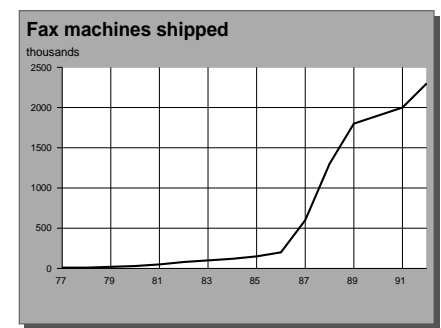
Often exhibit rapid growth after "critical mass"

Questions

- why?
- what determines critical mass?
- what will succeed and what won't?
  - early history: unsuccessful networks
  - recent history: (very!) successful networks

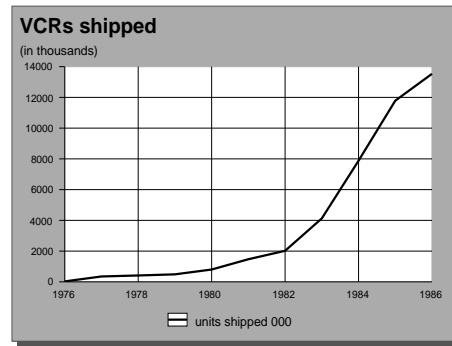
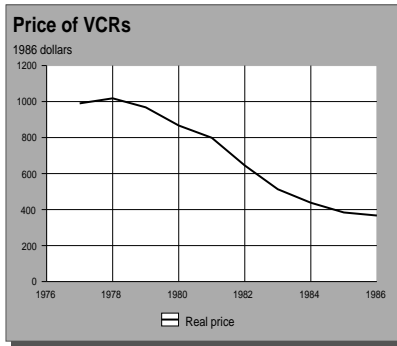
Examples of successful networks

## Fax machines shipped

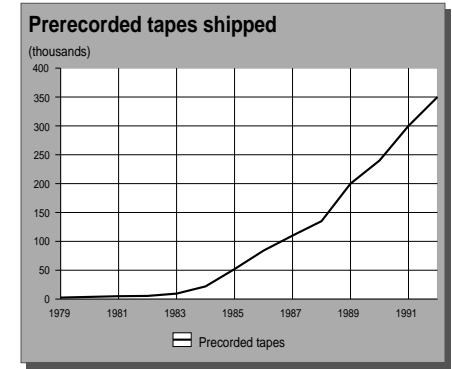
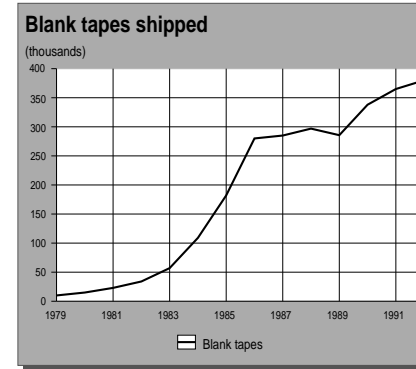


source: Economides and Himmelberg, 1995

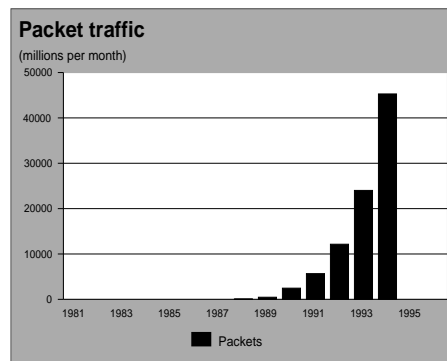
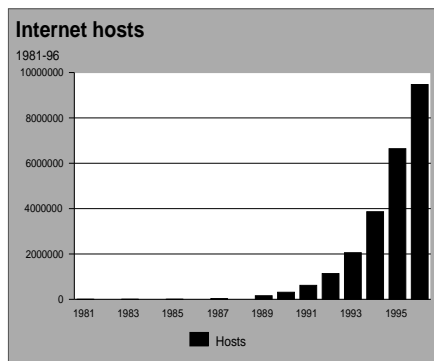
# Home video machines



# Video tapes



# Internet



# Intellectual history

- Jeff Rolfs: 1974 *Bell Journal of Economics*
- J. Farrell, M. Katz, and C. Shapiro:  
*Journal of Economics Perspectives* 1995
- Nick Economides  
<http://edgar.stern.nyu.edu/network/>  
Berkeley connection  
My own interest

# Simple model of demand

- *reservation price*: maximum willingness to pay for single unit of good
- example
  - think of willingness to pay as being uniformly distributed in population
  - normalize population to 1, max wtp to 1
- total demand at price  $p$  = everyone who has wtp greater or equal to  $p$
- for this example, total demand =  $n = 1 - p$

# Network externality

For "network good", wtp depends on number of users  
value of fax, email, picturephone

Example: willingness to pay described by  $w = vn$  where  
 $v$  is uniformly distributed over  $[0,1]$   
 $n$  is fraction of  $[0,1]$  that purchases good (connects to network)

## Demand for network

If price is  $p$ , how many people will connect?

Let  $v^*$  be value of "marginal" consumer; by definition:

$$p = v^*n$$

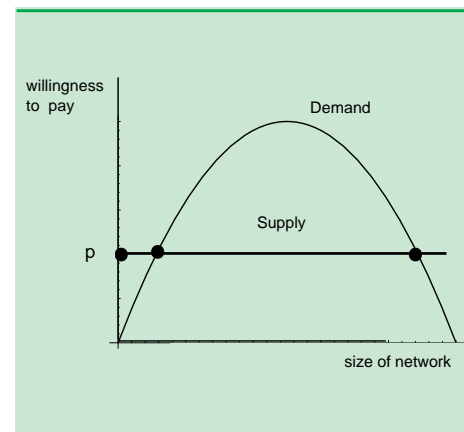
Everyone who values connection more than  $v^*$  connects:

$$n = 1 - v^*$$

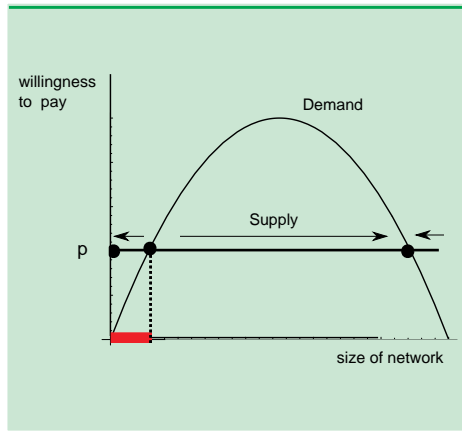
Result:

$$p = n(1-n)$$

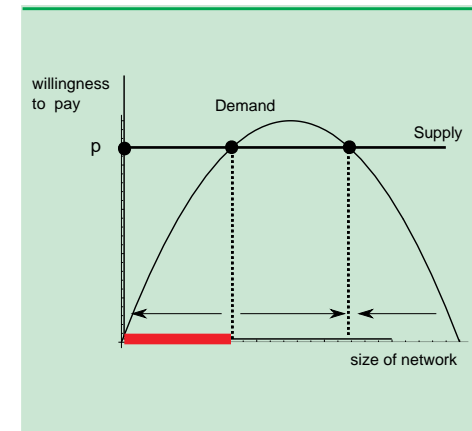
## Demand curve for network



# Which equilibrium?



# Basin of attraction



# Competing technologies

## Competing networks

Mac users, Unix users, PC users

k56Flex v x2 56kbps modem standards

Competition *for* market v competition *within* market

## Strategies

preemption and vaporware (MS)

penetration pricing (browsers)

manage expectations (bandwagons)

migration path and compatibility (upgrades)

making commitments

# Critical mass

- Lower the price, the lower the critical mass
- Software giveaways
  - Adobe
  - Netscape
  - Microsoft Money
- Dominant firms
  - "Tipping"

# Video machines and tapes

- wtp pay for video machine depends on number of tapes available

$$w = v t$$

- number of tapes available depends on number of machines

$$t = k m$$

- substitute to get  $w = v k m$
- marginal person is indifferent about buying machine:

$$p = v^* k m$$

- everyone with higher value buys, so  $m = 1 - v^*$
- equilibrium number of VCRs solves  $p = k m(1-m)$

# Video store behavior

How did video stores facilitate growth?

- rental of VCRs
- created critical mass
- role of Sony decision

# Picturephone

- Picturephone in 70s flopped  
never got critical mass
- Video conferencing in 90s may exhibit network effect  
slow growth followed by explosive growth  
already have computer and connectivity  
incremental cost for camera is small  
may also have "rental" market
- Killer app of the Internet?

# Extensions

- Easy  
more general frequency distributions  
more general market structures
- Hard  
better dynamics  
better empirics

# Lessons

- Critical mass depends on price
- One-sided and two-sided networks are similar
- Takeoff may be stochastic
- A simple model goes a long way