

# Network Economics

Hal R. Varian

<http://www.sims.berkeley.edu/~hal>

**School of Information Management and Systems**

**Haas School of Business**

**Department of Economics**

**UC Berkeley**

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## 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

# Examples of networks

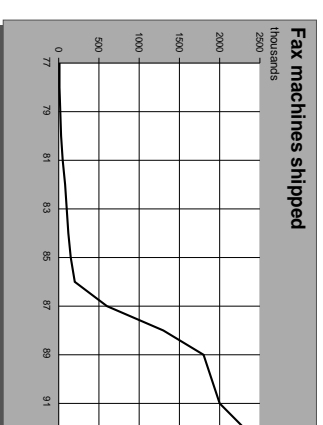
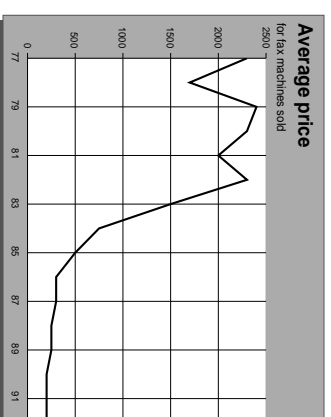
Networks with one kind of user

- faxes
- Internet email
- video phone

Networks with two kinds of users

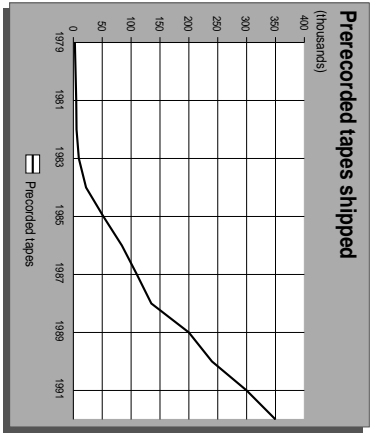
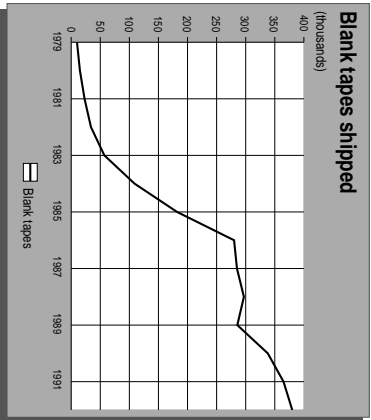
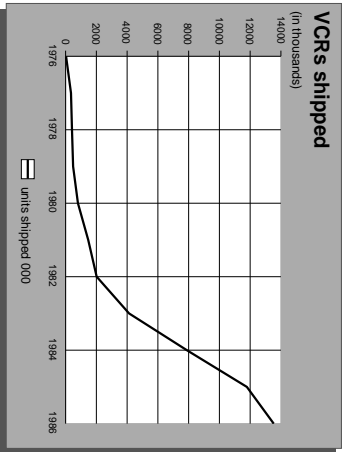
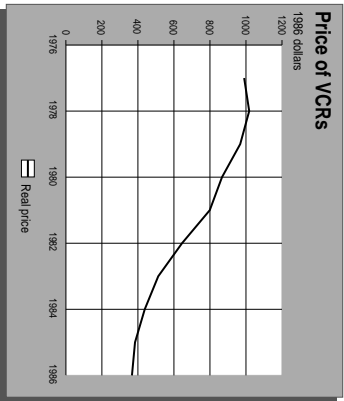
- WWW: users and "publishers"
- digital cash: buyers and sellers
- electronic publishing: authors and readers
- videos: VCRs and tapes

## Fax machines shipped



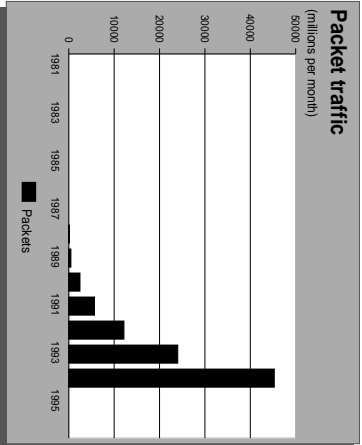
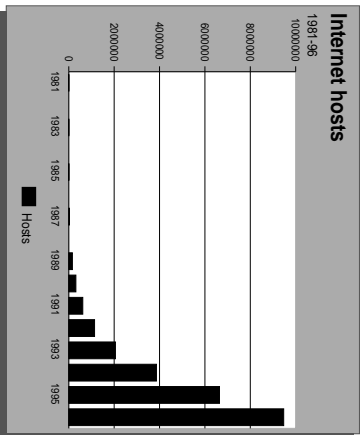
source: Economides and Himmelberg, 1995

# Home video machines



# Video tapes

# Internet



# Intellectual history

- Jeff Rofls: 1974 *Bell Journal of Economics*
- J. Farrell, M. Katz, and C. Shapiro: *Journal of Economics Perspectives* 1995
- Nick Economidies  
[http://edgar.stern.nyu.edu/network/Berkeley connection](http://edgar.stern.nyu.edu/network/Berkeley%20connection)  
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 =  $n = 1 - p$

## 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:

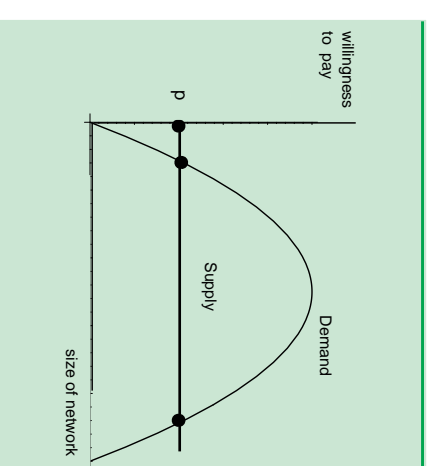
$$p = n(1 - n)$$

# Network externality

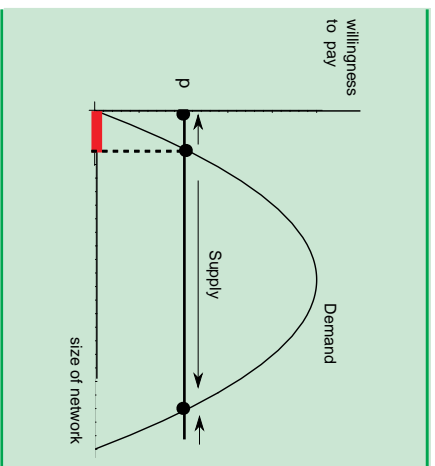
For "network good", wtp depends on number of users value of fax, email, picturephone

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)

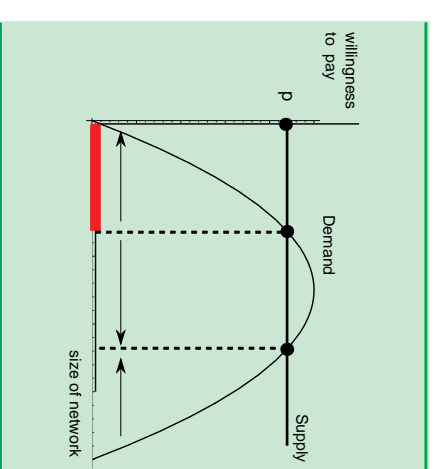
## Demand curve for network



# Which equilibrium?



# Basin of attraction



## 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

$$w = v \cdot t$$

- number of tapes available depends on number of machines

$$t = k \cdot m$$

- substitute to get  $w = v \cdot k \cdot m$

- marginal person is indifferent about buying machine:

$$p = v^* \cdot k \cdot m$$

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

# 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