

# Innovation in non-bank payment systems

Professor Bronwyn H. Hall

University of California at Berkeley  
and University of Maastricht

# Payment system innovations

- Non-networked but micro-chipped
  - Stored value cards (telephone, Starbucks, transit)
- Networked
  - Older proprietary networks:
    - Credit cards
    - Debit cards
    - Bank wire transfers
  - Web-based:
    - Internet (web) payment using credit cards
    - Micro-payment aggregation on the web (e.g., iTunes)
    - Bank transfers; electronic bill paying
    - Non-bank bill pay services
  - And mobile telephones

All these innovations use microprocessors or the internet  
=> General Purpose Technologies

# Themes

- supply and demand for innovation
- networks and standards – effects on diffusion
- general purpose technologies and co-inventions
- A few facts (but difficult to define the sector accurately)
  - Who are the players
  - Who are the patenters? (inventors?)

# Determinants of innovation

- Supply
  - Cost
  - Market size and expected demand
  - Expected cost reduction
  - Market structure (radical vs incremental)
  - Appropriability (Alappat, State Street)
- Demand
  - Perceived benefits
  - Reliability and security
  - Sunk costs of learning (network effects)

# Networks and standards

- Many innovations based on IT exhibit network characteristics
  - Value to individual user depends on the number (and sometimes identity) of other users => larger networks preferred
  - Full benefits occur when there are a variety of ways to connect to the network => benefits from standard interfaces; gateway technologies
  - Increasing returns to scale => tend toward quasi-monopoly
- Theory: networks supplied either monopolistically or competitively tend to be too small

# Payment networks

- Internet – model open network
  - There is only one
  - Open standards
  - Relatively rapid diffusion for payment methods
  - But need for security; some proprietary methods - not ideal from consumer point of view
- Proprietary standards networks:
  - Stored value cards?
    - limits diffusion and value to consumer
  - Mobile telephones
    - Much lower cost for consumer (no computer or internet connection)
    - Alternative to stored value cards?

# GPTs

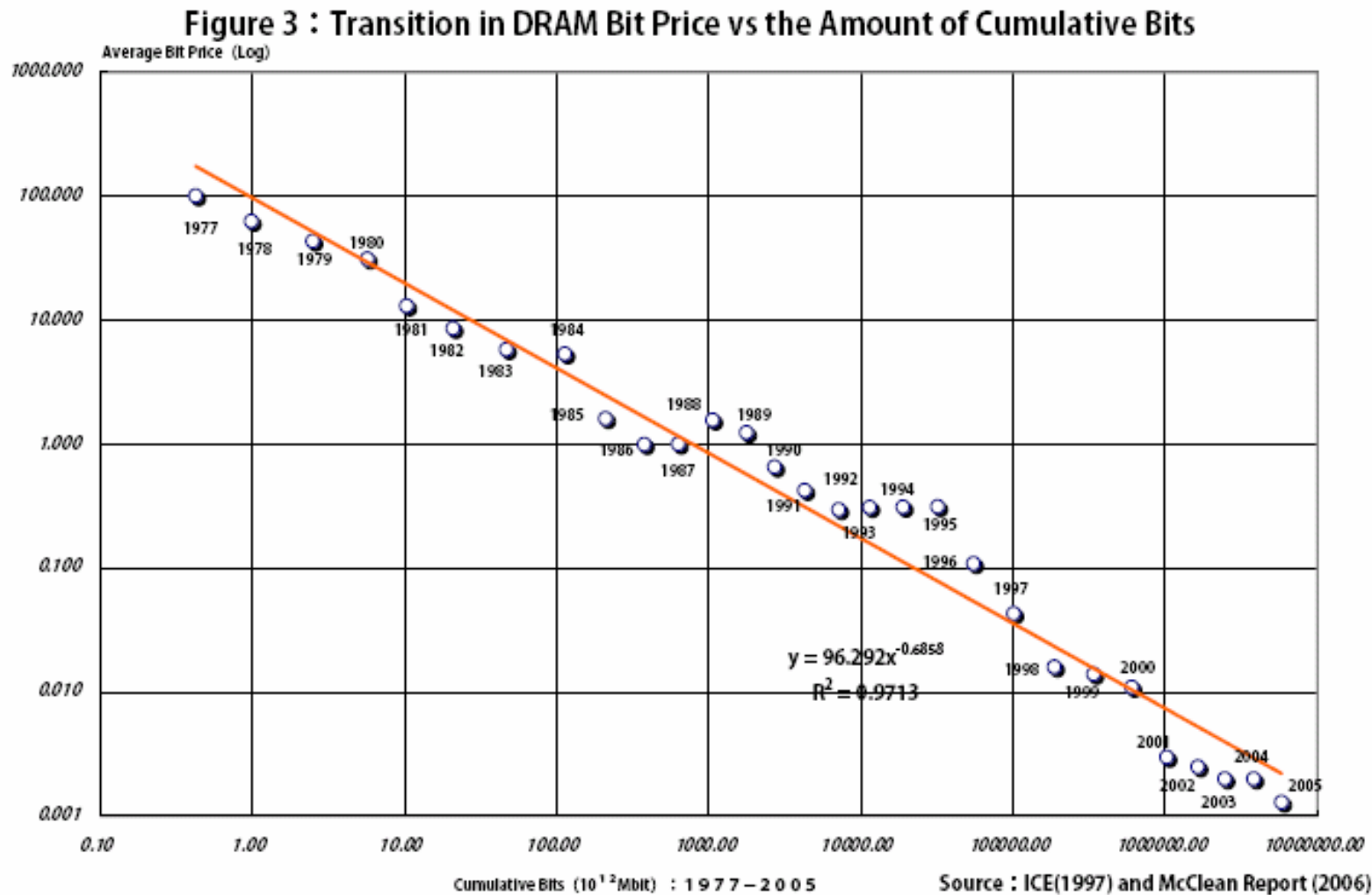
- A technology that is useful in a broad range of industries and for a variety of purposes.  
Characterized by
  - Pervasiveness
  - Inherent potential for technical improvements
  - Innovational complementarities
  - Importance of technical standards for interoperability
- Historical examples:
  - Steam engine
  - Electricity

# Microprocessor

- A GPT that has been essential to
  - Personal computing revolution
  - Internet
  - Wireless communication
- Different from earlier examples
  - More complex set of innovations
  - Much steeper cost declines over longer periods

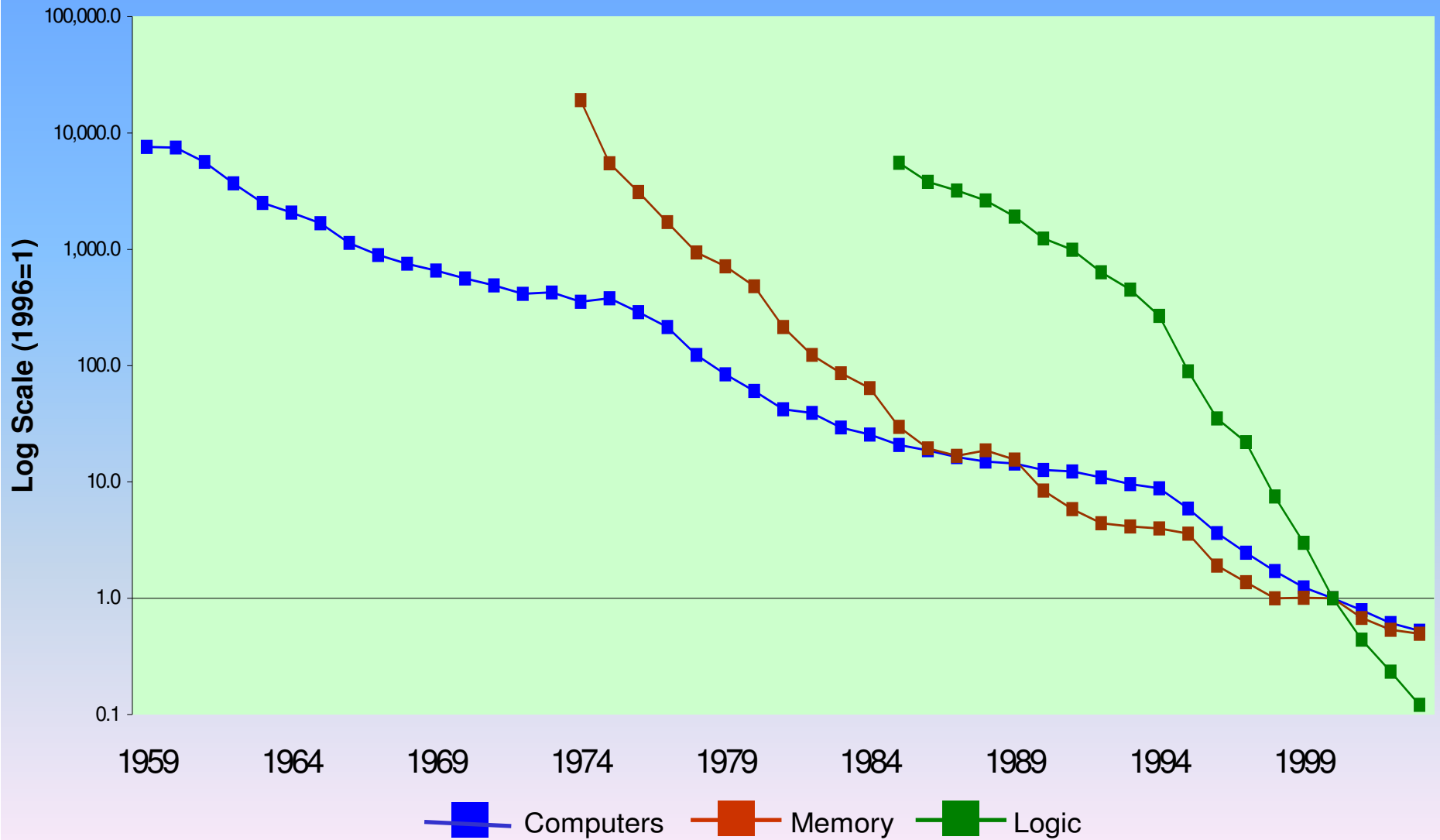


As memory size increases, price falls: over 30 years, by  $10^8$  per bit



# Relative Prices of Computers and Semiconductors, 1959-2003

All price indexes are divided by the output price index



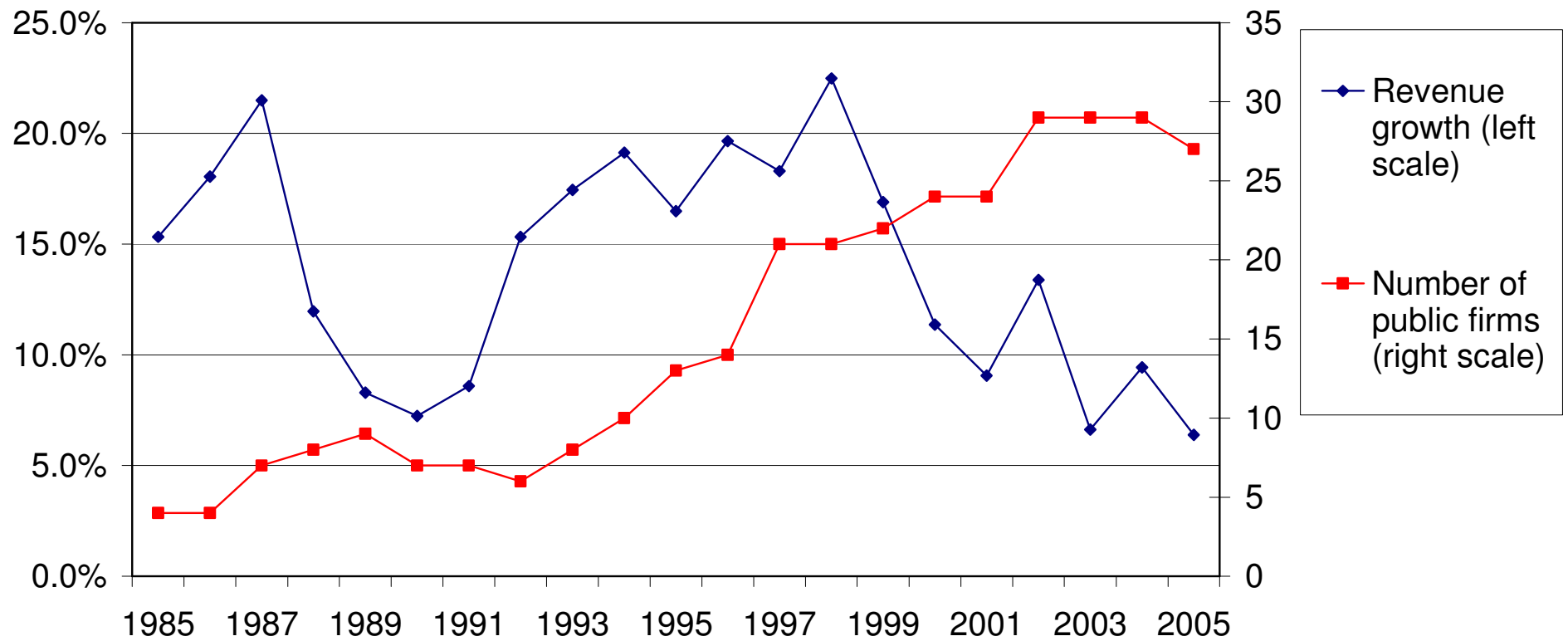
# Consequences of GPTs

- Many co-inventions needed (and become possible), e.g. non-bank payment systems, digital security, etc.
- Skill requirements increase at first; can lead to temporary increases in wage inequality
- Diffusion may be slow
  - encouraged by open standards or those sponsored by a large player or industry consortium
- Achieving full benefits slow (increasing returns)
- As industry matures, often tends to vertical disintegrate (spinoffs, specialization and outsourcing)

# Who are the players?

- Bradford, Davies, and Weiner (2006) lists main players:
  - 10 alliances
  - 45 firms, in 22 industries:
    - Most important: data processing & hosting; financial transaction processing – about 14% of all firms in these sectors
  - 20 entered after 1993
- Look at the two NAICS codes with the largest share of these firms
  - High median revenue growth for 20 years, now falling
  - Growth in number of firms, flat since 2001

## Median annual revenue growth - Data processing, hosting, and financial transaction processing



# Patenting

- Rapid growth following court decisions in 1994/95 and 1998
- 60% of BDW firms hold patents in technologies related to payment systems
  - However, almost all patents in these technologies are held by other firms (IBM, large Japanese, etc.)
  - BDW firms hold only about 2-3% of the patents (figure)

## Patents granted in 94 class/subclass combinations used by NPS firms

