

Cooperation and Conflict in Semiconductor Manufacturing

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Who's this guy?

- Ph.D. Purdue, 1980, M.S. (Math), Purdue 1978, B.A. Florida, 1976
- Professor, U of Texas
- Taught at UWO, Caltech, MIT, U Chicago
- Co-designer, U.S. PCS auctions
- FTC Expert, Exxon-Mobil, BP-Arco, Rambus
- Former Co-Editor, *American Economic Review*
- Author, 60+ articles on
 - Auctions, Pricing, Antitrust

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Competitive
Solutions:
The
Strategist's
Toolkit

Princeton
University
Press,
2002



Outline

- Determination of Number of Firms
 - Option theory
- Cooperation
- Effect of Joint Ventures on Industry
- Conclusions

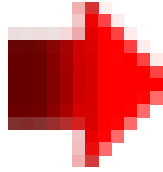
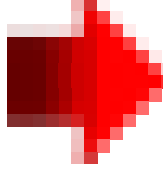
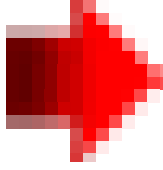
Theme: Two Positioning Strategies

- Accommodation
 - Leave room for rivals
 - Specialize in group of customers
 - Cooperate
 - e.g. HP
- Dissuasion
 - Fill product spectrum
 - Maximize threat of price war
 - Low marginal costs
 - e.g. Microsoft

Outline

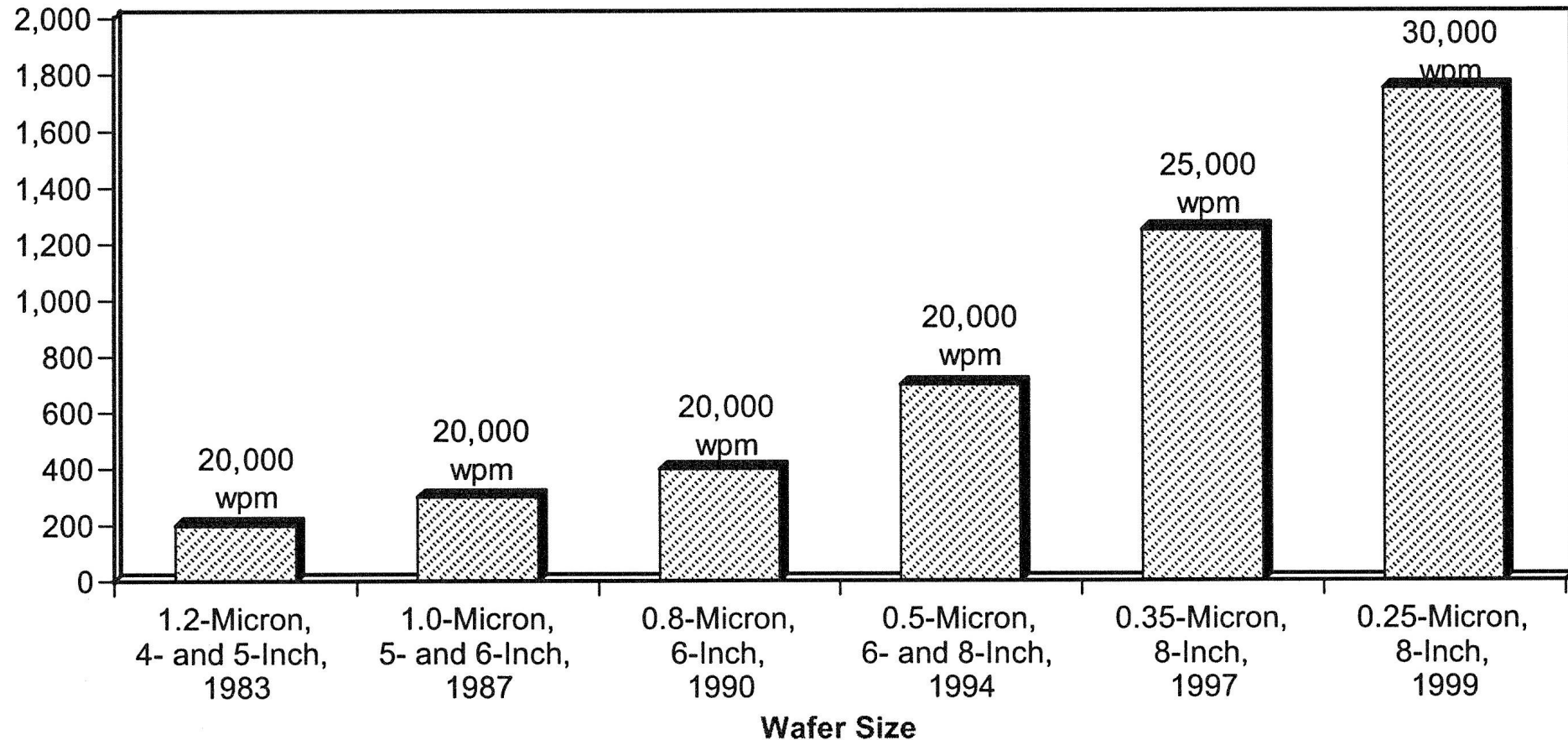
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Determination of Number of Firms

- Increasing fixed costs 
 - So shakeout necessary
 - Large reduction in magnitude
- Option value of remaining in industry 
 - Don't exit at zero profits
- Tendency for negative profits 

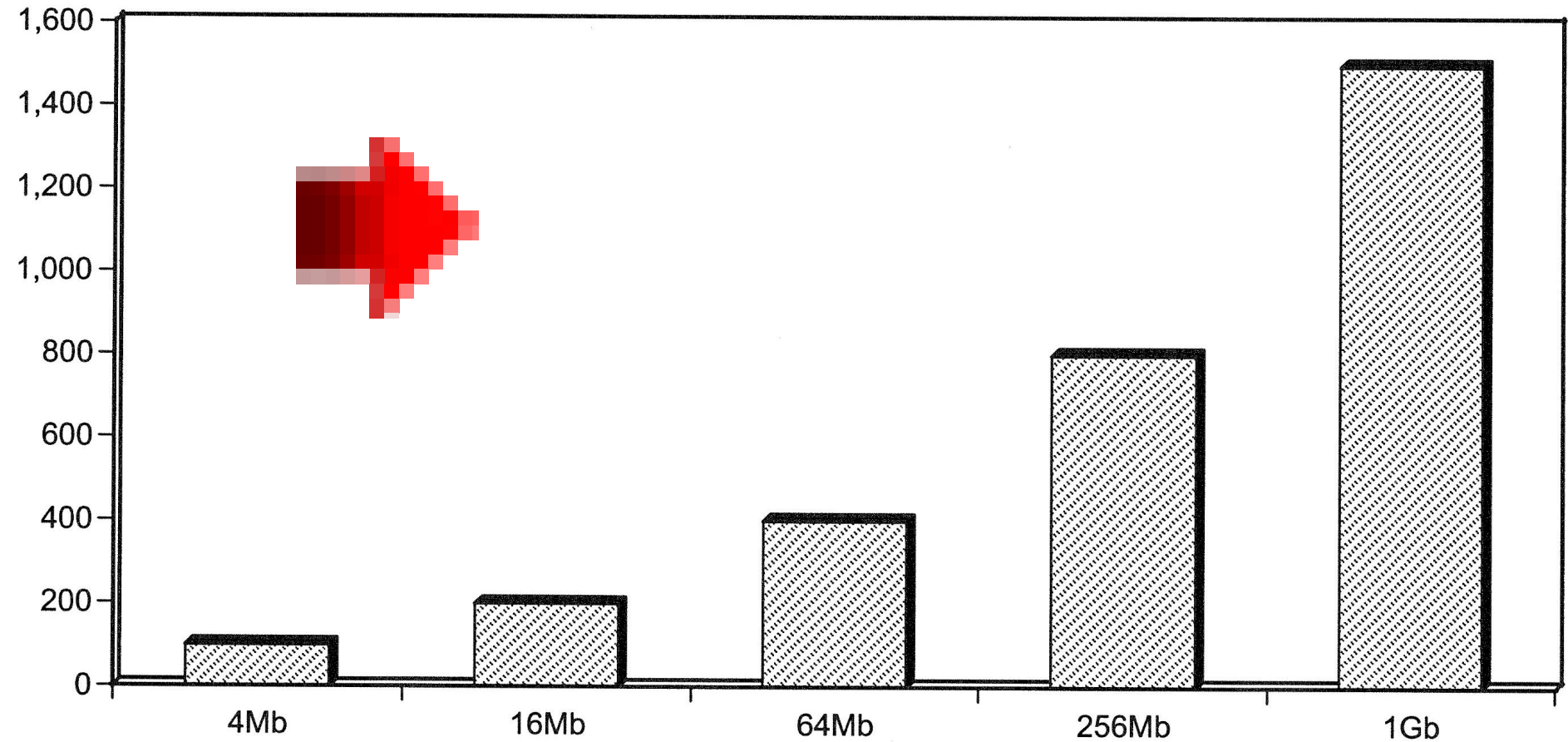
DRAM Plant Costs

Millions of Dollars



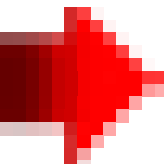
Estimated DRAM R&D Costs

Millions of Dollars



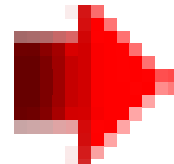
Option Value Considerations

- Option value considerations
 - Favor investments that preserve options like keeping a plant open
 - Disfavor investments that exercise options like building a plant
- Option value considerations increase as variability increases
 - More uncertainty decreases value of investments that use up options (waiting more valuable)
 - More uncertainty increases value of investments that create new options

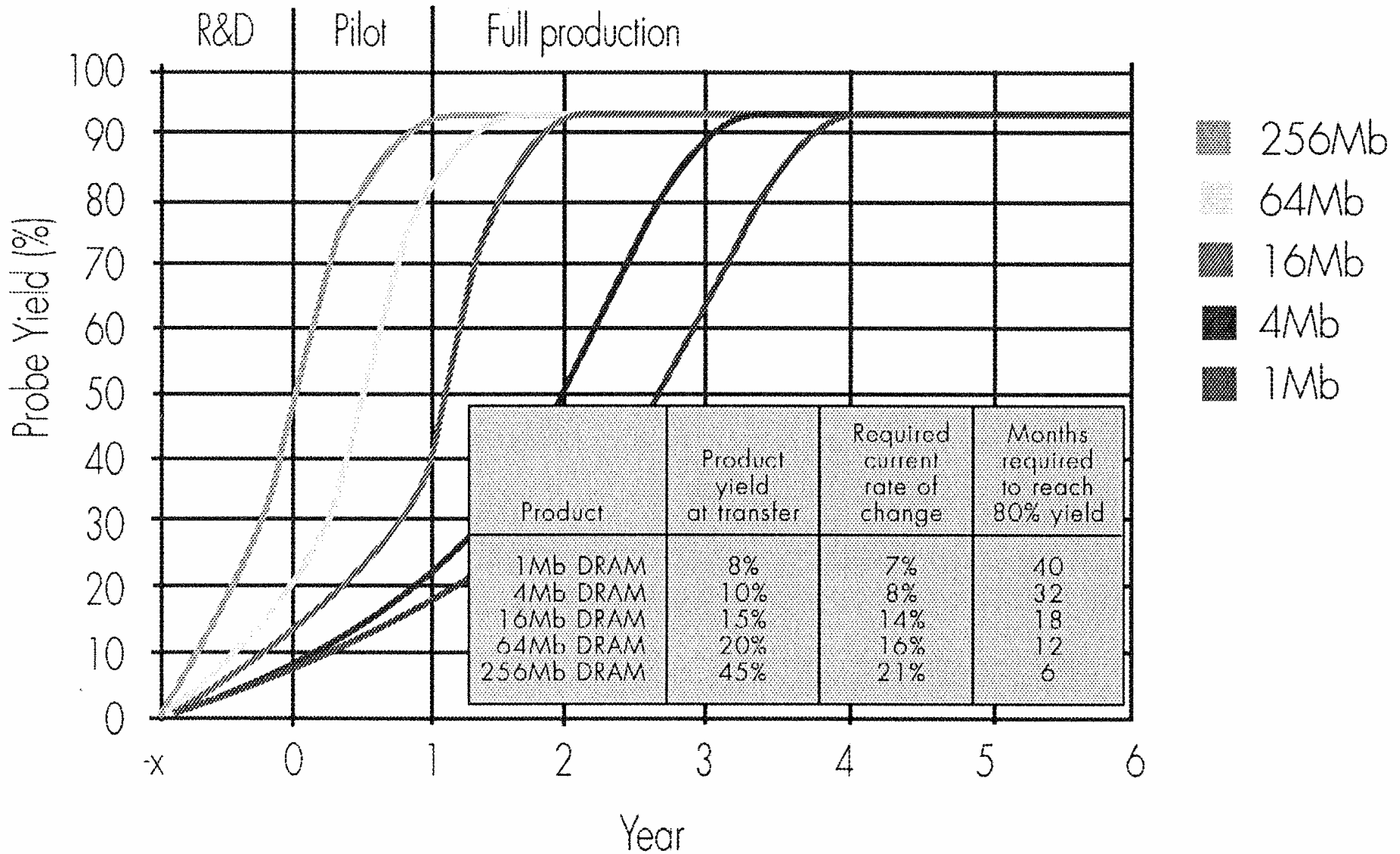


Tendency for Negative Profits

- As fixed costs rise, profitable number of producers falls
- Option considerations suggest remaining in industry even when zero profits reached
- Leads to losses for many participants
- Yield speed-up increases uncertainty
 - Increasing option value
 - Creates a cyclicality

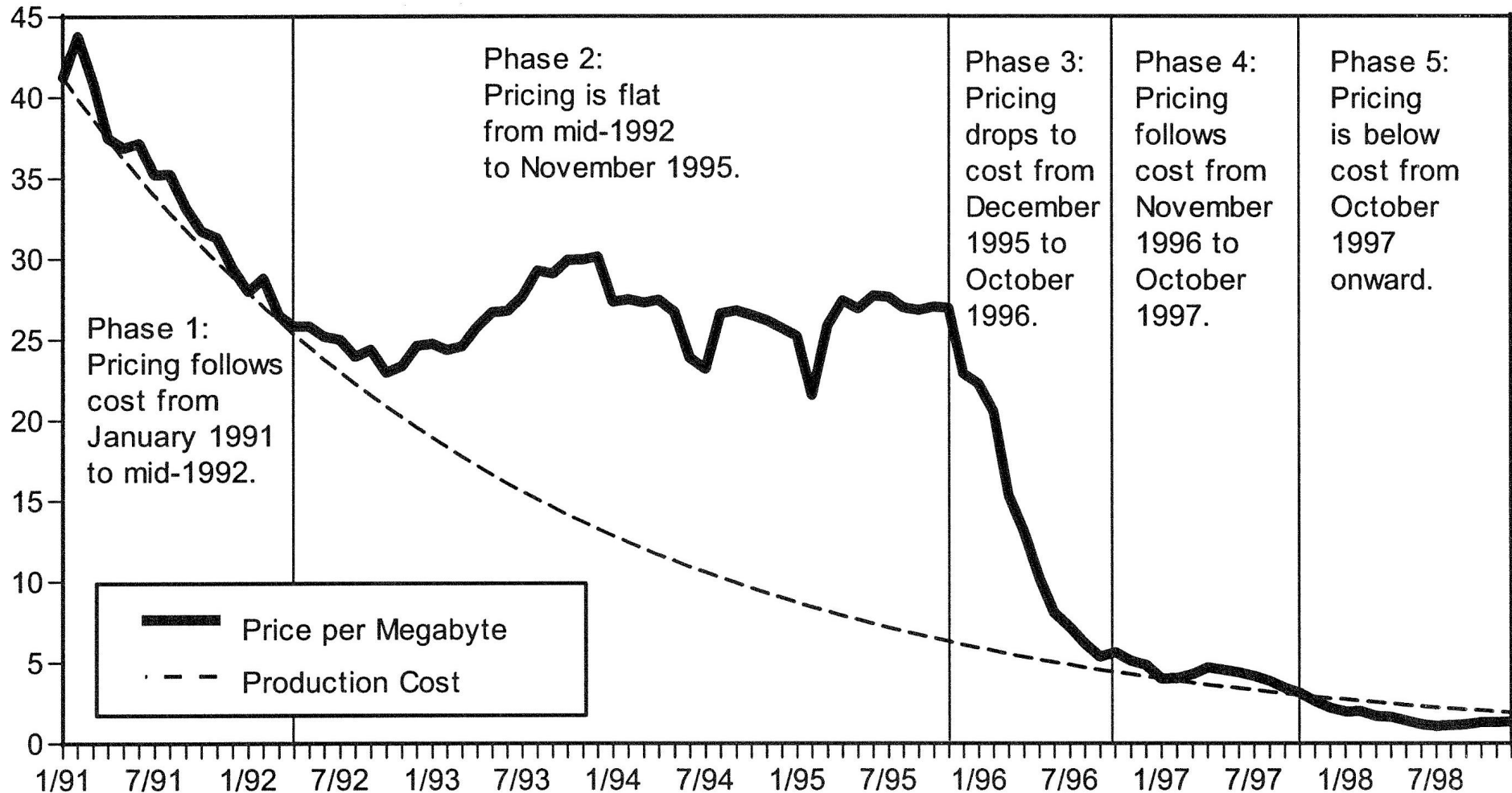


DRAM Yields

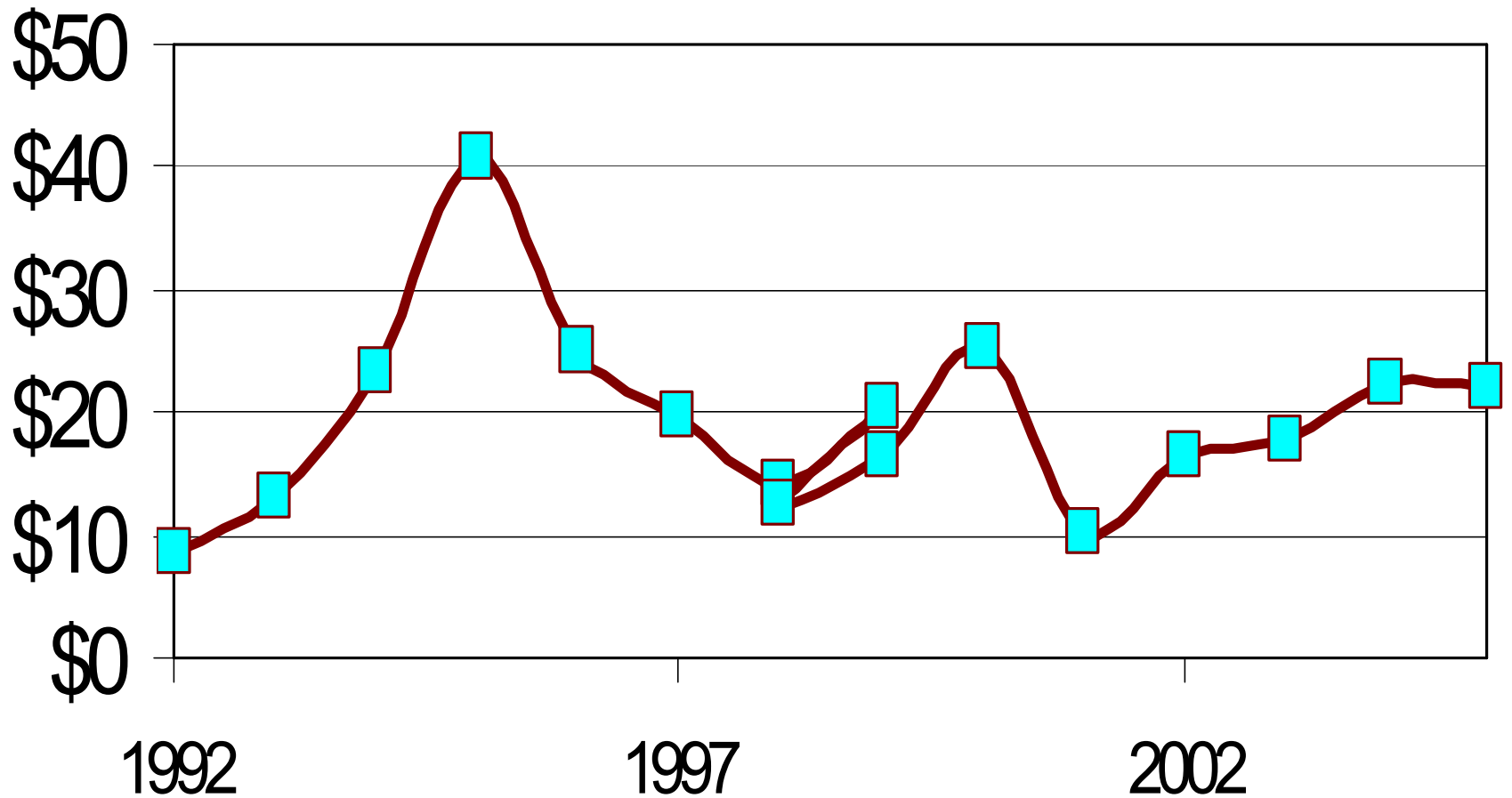


DRAM Costs, Prices

Price per Megabyte (\$)



Cyclicality: DRAM Revenues



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Dialogue monitored by radio and released by the
US NAVY:

Radio 1: Please divert your course 15 degrees to
the north to avoid collision.

Radio 2: Recommend you divert YOUR course 15
degrees to the south to avoid collision.

Radio 1: This is the Captain of a US Navy Ship. I
say again, divert YOUR course.

Radio 2: No, I say again, you divert YOUR course.

Radio 1: THIS IS THE AIRCRAFT CARRIER
ENTERPRISE. WE ARE A LARGE
WARSHIP OF THE US NAVY. DIVERT
YOUR COURSE NOW!

Radio 2: This is a lighthouse. Your call.

Many Bases For Cooperation

- AMD/American Austin/San Jose flights
- Complements
 - Wintel (MS/Intel)
 - Intel/Rambus
- No negative advertisements
- Politics/lobbying
- Standards for interoperability
- Patent pools

Major Elements of Cooperation

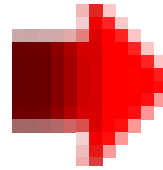
- Shared interest
 - Can be used to establish broader cooperation
 - Share the proceeds of cooperation so that the relevant parties participate
 - Hostages
- Punishment for misbehavior
 - Adequate deterrent
 - Credibility
 - Trigger strategy
- Recovery
 - Fixed length
 - Credibility
 - Punishment fits the crime?

Structural Factors

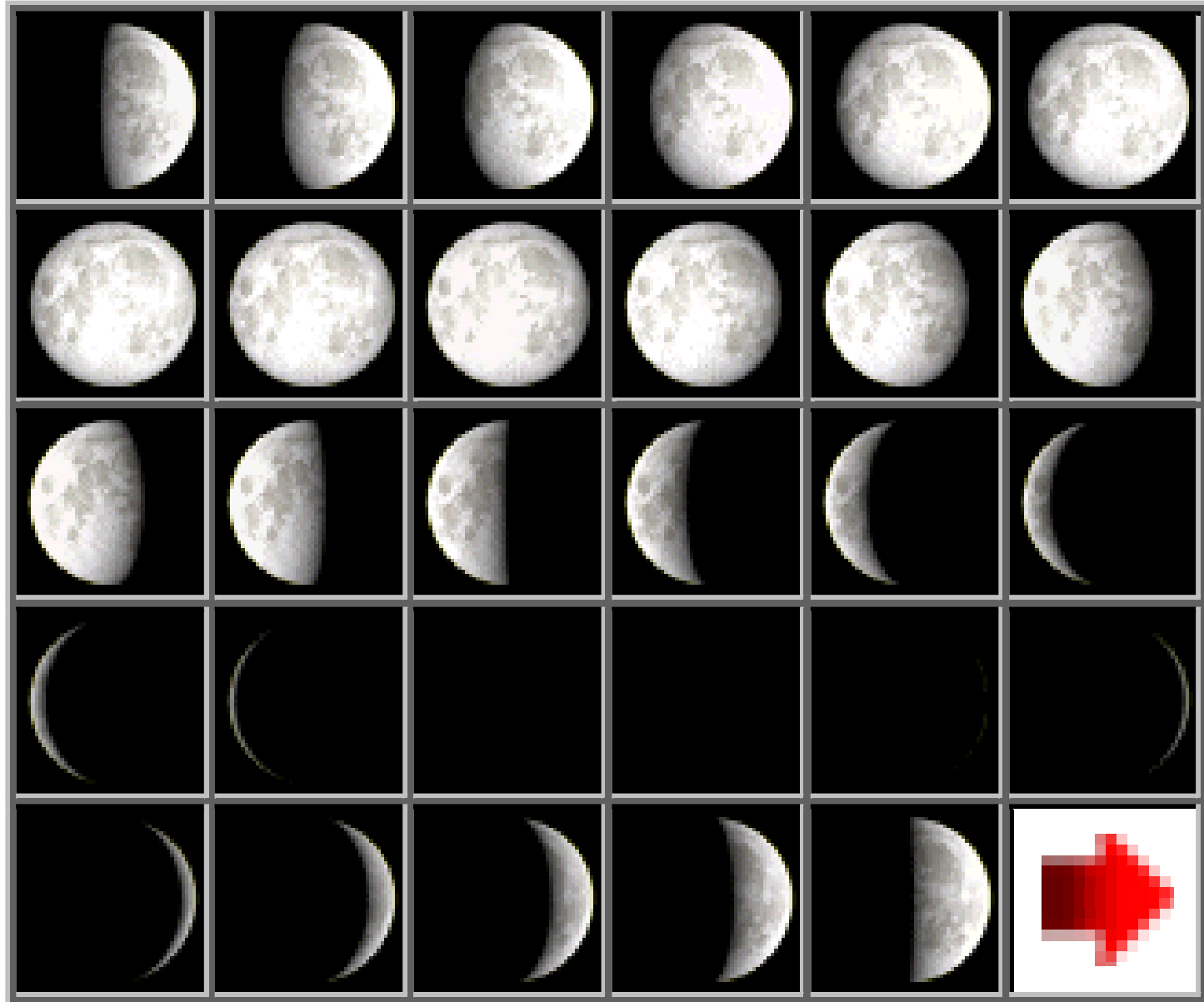
- Structural factors make cooperation difficult
 - Low variable/high fixed costs
 - Asymmetries among firms
 - Many firms or potential entrants
 - Reaction time
 - Small or failing firms
- Example: airlines

Facilitating Devices

- Industry association
- Published price lists
- Exclusive territories
- Pre-announced price increases
- Incrementalism



Phases of the Moon



Facilitating Devices, Continued

- Multi-market contact
- Multi-level contact
- Excess capacity
- Grow (or crush) small or bankrupt firms

Paradox of Cooperation

- What helps profitability often harms cooperation
- Cooperation depends on threat
 - Making threat worse improves cooperation
- Differentiation is bad for cooperation
- Identical products are good for cooperation
 - “Price book”
- Excess capacity is good for cooperation

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Paragon Cable in New York uses a novel strategy to get its customers to pay their overdue bills. Instead of incurring the costs associated with unhooking the cable and reconnecting it, Paragon runs C-SPAN on all 77 channels. It's supposedly the most effective bill collection measure yet.

(Telecommunications Policy Review 8 Oct 95 p9)

Two Strategies

- Accommodation
 - Partners/Joint Ventures
 - Defense consolidation
- Dissuasion
 - Drive weaker players out
 - Dell and Micron

Partners/Joint Ventures

- Improves positioning
- Specialization
- Combines skills: “Best of Breed”
- Interlocking, overlapping partnerships
 - Encourage cooperation
 - Create hostages
- Partnering that “symmetrizes” market encourages cooperation

Dissuasion

- Eliminate weaker players
- Reach a profitable industry structure more rapidly
- Large short-run industry losses

Accommodation vs. Dissuasion

- Accommodation generally more profitable
- Dissuasion is an “equilibrium”
 - Any major player can upset cooperation by not cooperating
- Option theory suggests dissuasion will dominate

Strategic Consequences of Options

- Pre-emption
 - Build today to deter rivals
 - Signaling: costs speak louder than words
- Positioning
 - Rival reacts to product positioning
- Production Capabilities
 - Ability to punish

Preemption and Real Options

- Value of preemption: commitment may discourage rivals
- Cost of preemption: commitment destroys flexibility
 - Obsolete technology
 - Too large, small

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During the heat of the space race in the 1960s, the U.S. National Aeronautics and Space Administration decided it needed a ball point pen to write in the zero gravity confines of its space capsules. After considerable research and development, the Astronaut Pen was developed at a cost of approximately \$1 million U.S. The pen worked and also enjoyed some modest success as a novelty item back here on earth.

The Soviet Union, faced with the same problem, used a pencil.

Conclusion

- Near-term prospects for accommodation seem remote
 - Cost pressure intense
 - Only one firm can have lowest cost
 - War of attrition to be the cost leader
 - Increasingly fast production cycle
 - Holdup threat by suppliers
 - ASIC potential bright spot
 - Specialization possible
 - But suppliers extract surplus?

Conclusions, Continued

- Increasing importance of complements
 - Creates hostages
 - Promote cooperation
- Joint ventures promise cooperation:
 - Creating shared interests
 - Interlocking, overlapping industrial organization

Conclusions, Continued

- Excess capacity
 - Option value
 - Deterrent value
 - Risk of obsolete technology
- Potential solutions are unilateral
 - Specialization
 - Shakeout
- “Integrated Circuits are Airlines”