A Tale of Two Standards: Patent Pools and Innovation in the Optical Disk Drive Industry
Extended Paper Outline

Kenneth Flamm
University of Texas at Austin
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Preliminary– Comments Only, Not for Citation

Outline

- Stylized Historical Facts
  - The CD-ROM/CD-R/CD-RW story, vs.
  - The DVD-ROM/DVD+-R/RW/BR story
- Issues
- Empirical Game Plan

The CD/DVD Story – RoughTimeline

- 1982 Philips-Sony CD-Audio intro
- 1986 1st CD-ROMs shipped
- 1990 1st CD-R's shipped
- 1994 Taiwan, Korea Entry in CD-ROMs
- 1996 1st DVD-Video players shipped
- 1997 1st DVD-ROM, DVD-R units shipped
- 1998 Taiwan, Korea Entry in CD-R/RWs
- 2000 1st DVD+R units shipped
- 2003 1st Blu-Ray players shipped
- 2005 1st HD-DVD players shipped

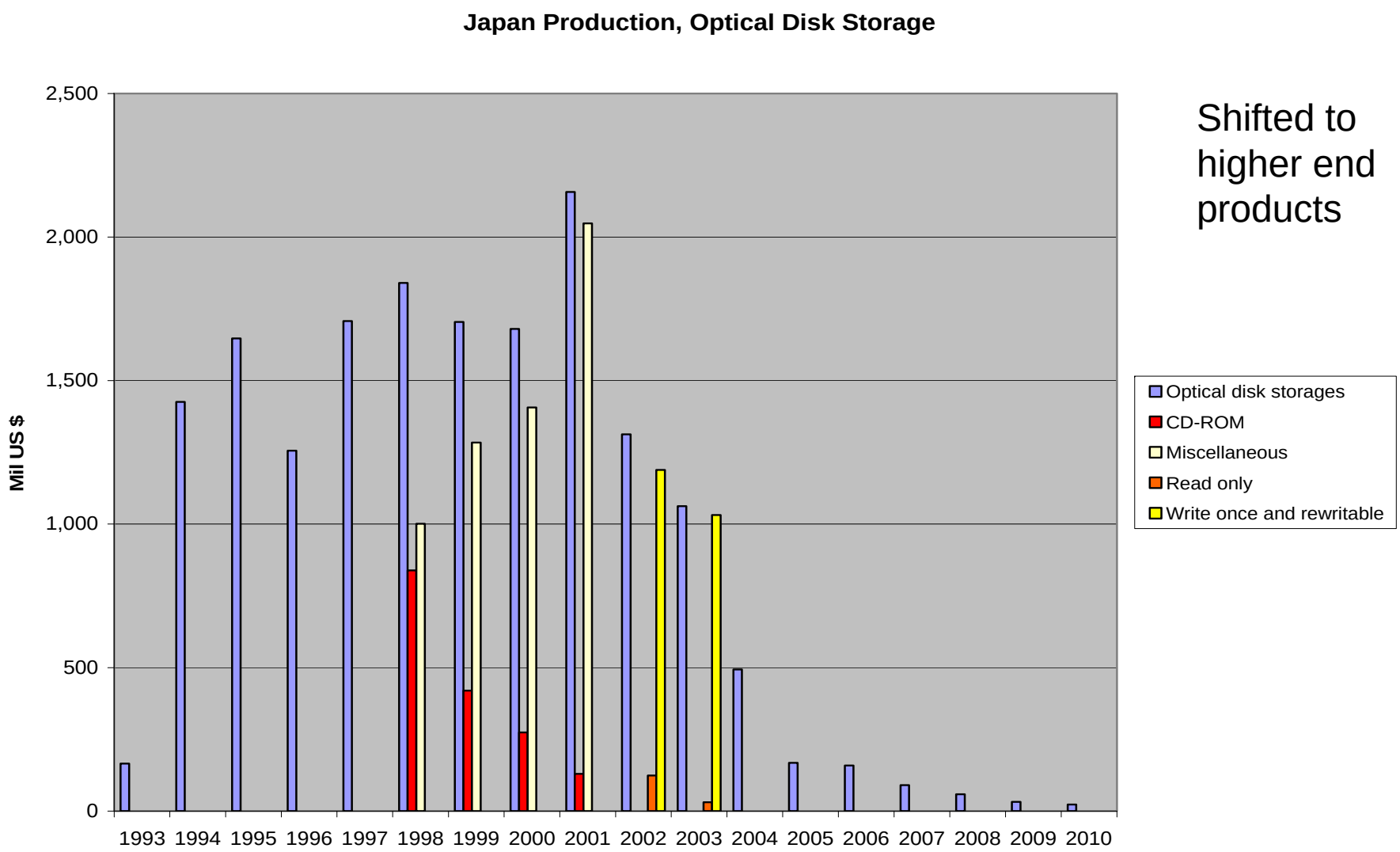
Philips-Sony 1st Modern (post 1982) Patent Pool

- Philips offered joint license for both companies' essential patents
- No "comfort letter" but tolerated by antitrust authorities
- Reportedly, 3% royalty on hardware units
- Low royalty reportedly intended to speed adoption of standard
  - Memories of Beta vs. VHS?
- On disk manufacture, also absolute floor of 10 yen royalty per disk
  - Later, an issue in Princo patent misuse case

Low Royalty Led to Rapid Imitation

- NEC, Toshiba, Panasonic, Hitachi w/CD-ROMs, late ‘80s
- Mitsumi, LG, Samsung follow in early to mid-’90s, lower priced models
- Followed by Taiwanese in late 90s, explosion in competition
- By 1996, pool members (Sony/Philips) had <10% of CD-ROM market
- By 1999, LG #1, 2 Taiwanese companies (Acer, Lite-on) had 9% of DVD/CD-ROM market vs. 6% for Sony
- Japanese abandoned low-end products, switched to high end (first DVD, then Blu-Ray)

Japanese Production Peaked in 2001, Then Declined Sharply



Shifted to higher end products

Consequences of Intense Competition

- Sharp Decline in Price
  - -38% CADR for ODD prices over 1995-2000
    - (Korean PPI, converted to $)
    - Comparable to memory chips, magnetic disk storage over same period
- Rapid Quality Improvement
  - Read/write speeds
- Rapid New Product Introductions
  - Disk capacity improvements
  - CD➔higher capacity CD-R➔DVD➔DVD dual layer➔Blu-Ray/HD-DVD

Followers Took Lead on Next Gen Products

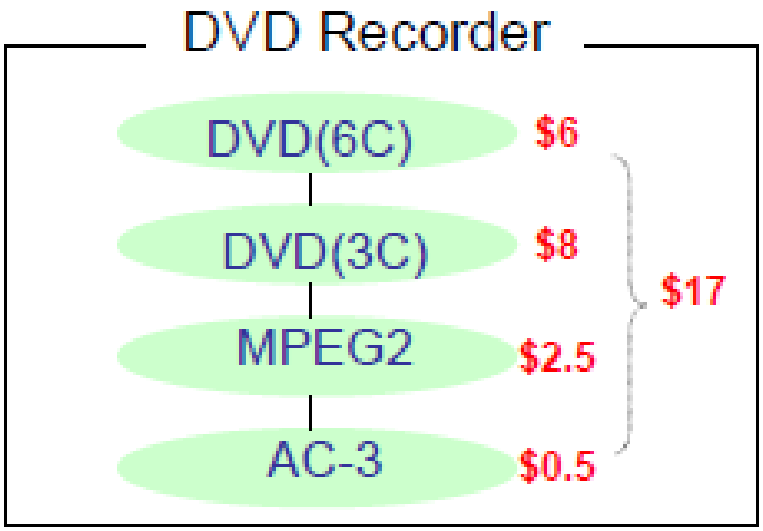
- Toshiba, Hitachi, Pioneer, Panasonic
  - Begin work on DVD standard in 1993
- Philips, Sony react
  - Begin work on own alternative next gen format, 1994
- Both groups enlist allies in industry
- IBM brokers compromise, DVD-Forum
- DVD-Video spec worked out,
  - But not common recordable spec
    - 2 competing groups introduce incompatible recording formats
  - Unable to agree on single license to DVD-Video patents
- 2 competing groups seek “comfort letters” for separate patent pools from DoJ
  - Following path of MPEG patent pool
  - But very different pool structures, administration
    - Not open
    - Evidence suggests not non-discriminatory licensing rates
    - No independent or 3rd party administrator
- Much higher royalties
- Minimum absolute floor on royalty for hardware

Competition Continued to Drive Prices Down at First

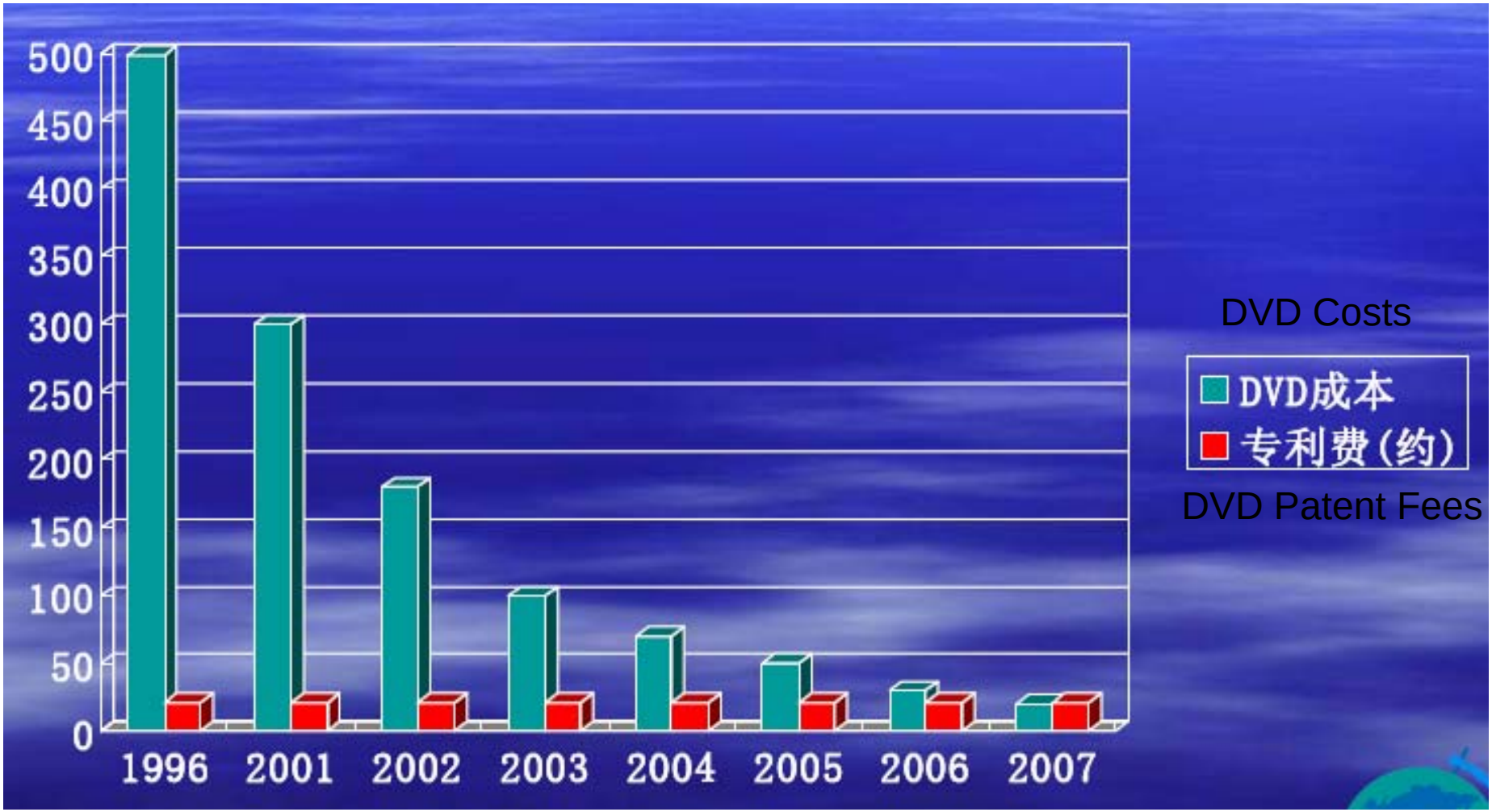
- But royalty floors started to bite
- Japanese patent pool members formed 51% controlled manufacturing jv's with lower cost Korean or Taiwanese partners
  - 51% controlled jvs did not have to pay royalties to majority parent patent pools
  - Hitachi-LG (2000)
  - JVC-Lite-on (2001)
  - Philips-Benq (2003)➔Philips-Lite-on (2005)
  - Toshiba-Samsung (2003)
  - Sony-NEC➔Sony Optiarc (2005), outsourced mfg

Royalties Came to Dominate Cost Economics

Hisashi Kato, Mitsubishi Electric(2008): DVD recorder royalty ~ $17
= 68 % DVD recorder ASP, larger share of cost



DVD Costs & Patent Fees



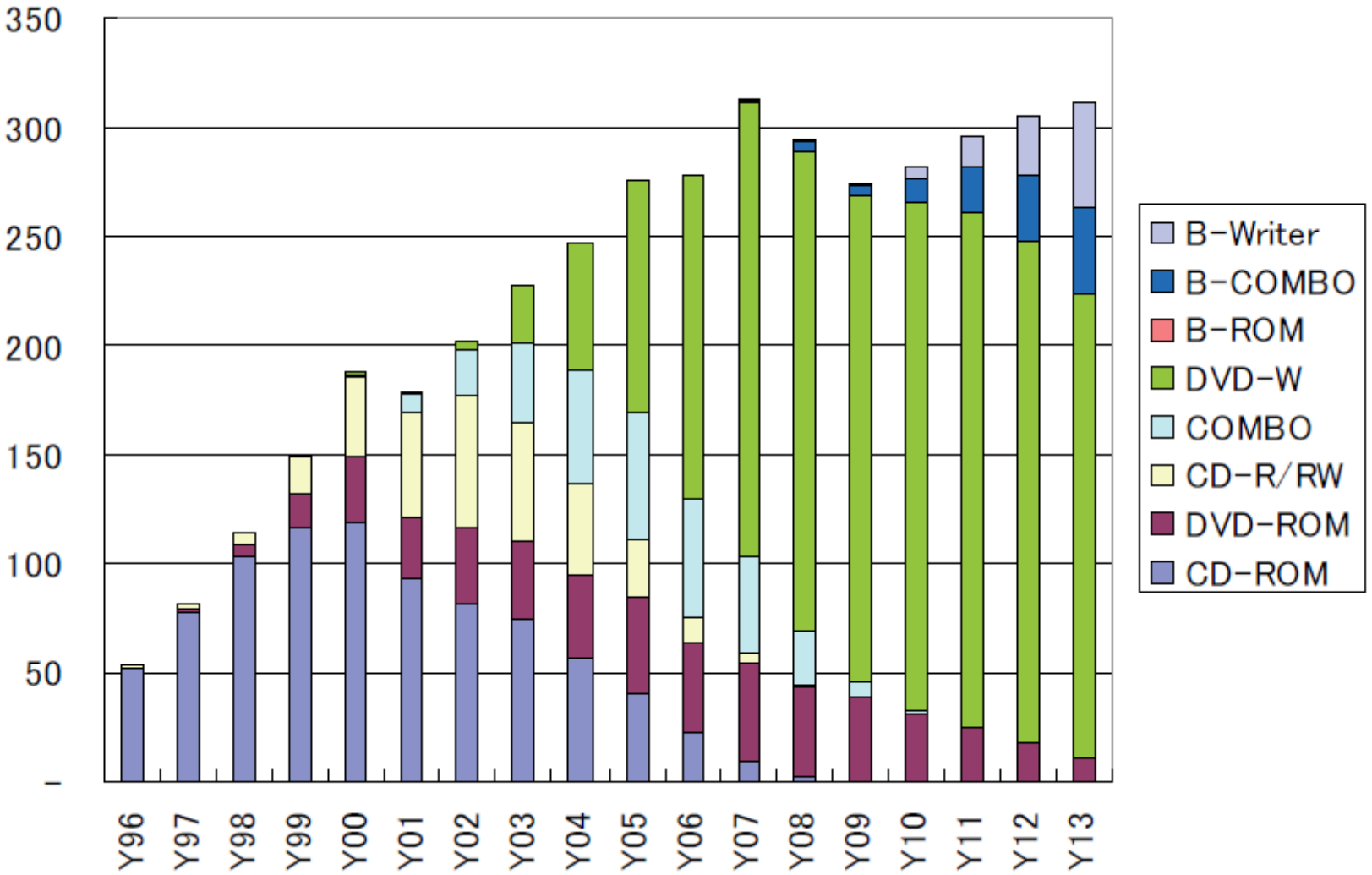
Approx. Share of Global ODD Sales Accounted for By Patent Pool Members

- 1999: 38%
- 2001: 49%
- 2003: 55%
- 2004: 66%
- 2005: 94%
- 2006: 87%
- 2007: 90%
- 2008 95%

Since 2007, Pace of Innovation Appears Much Slower

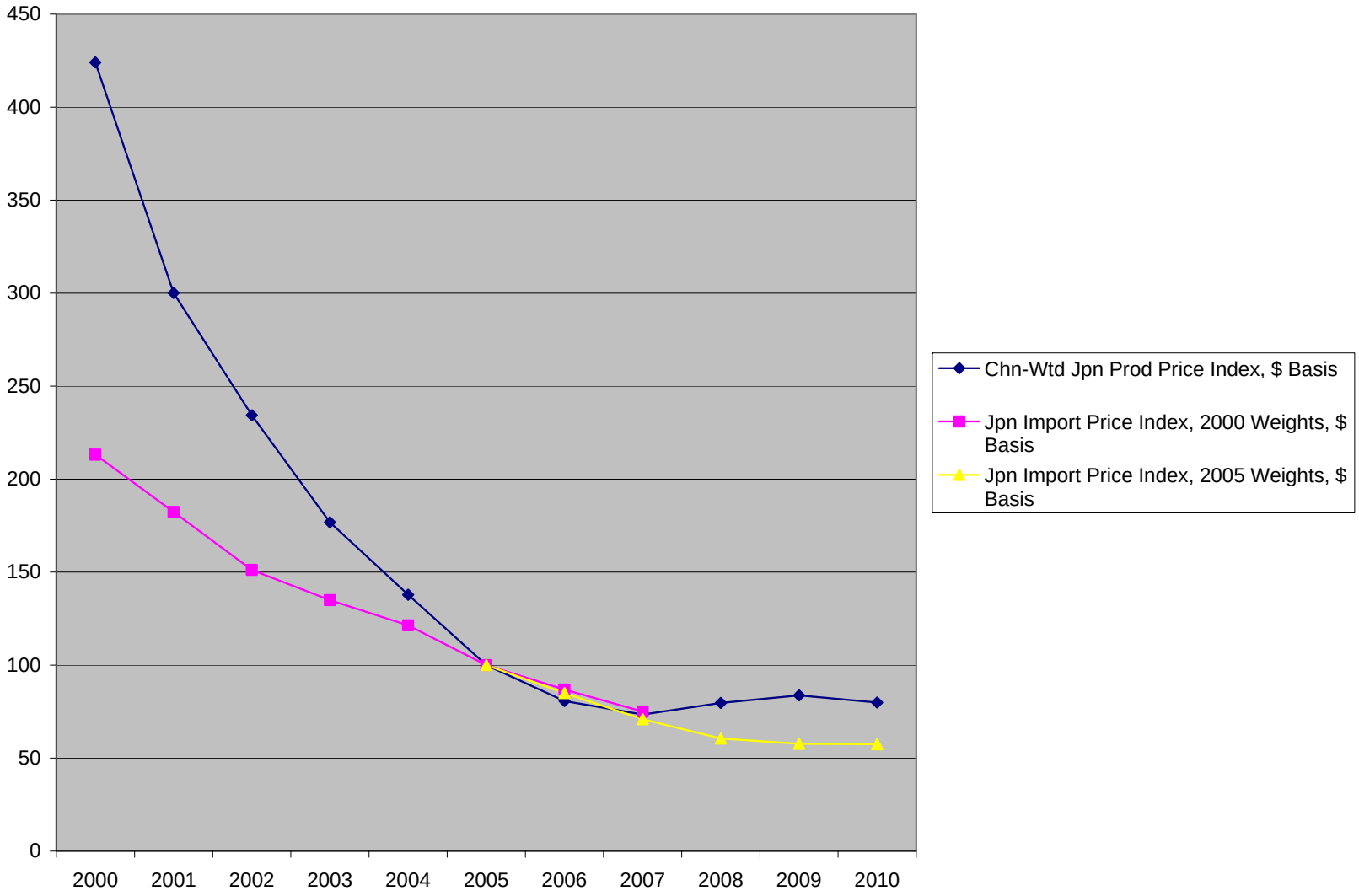
- Market growth
- Price Change
- Quality measures for Units Shipped

Global ODD Shipments Peak in 2007

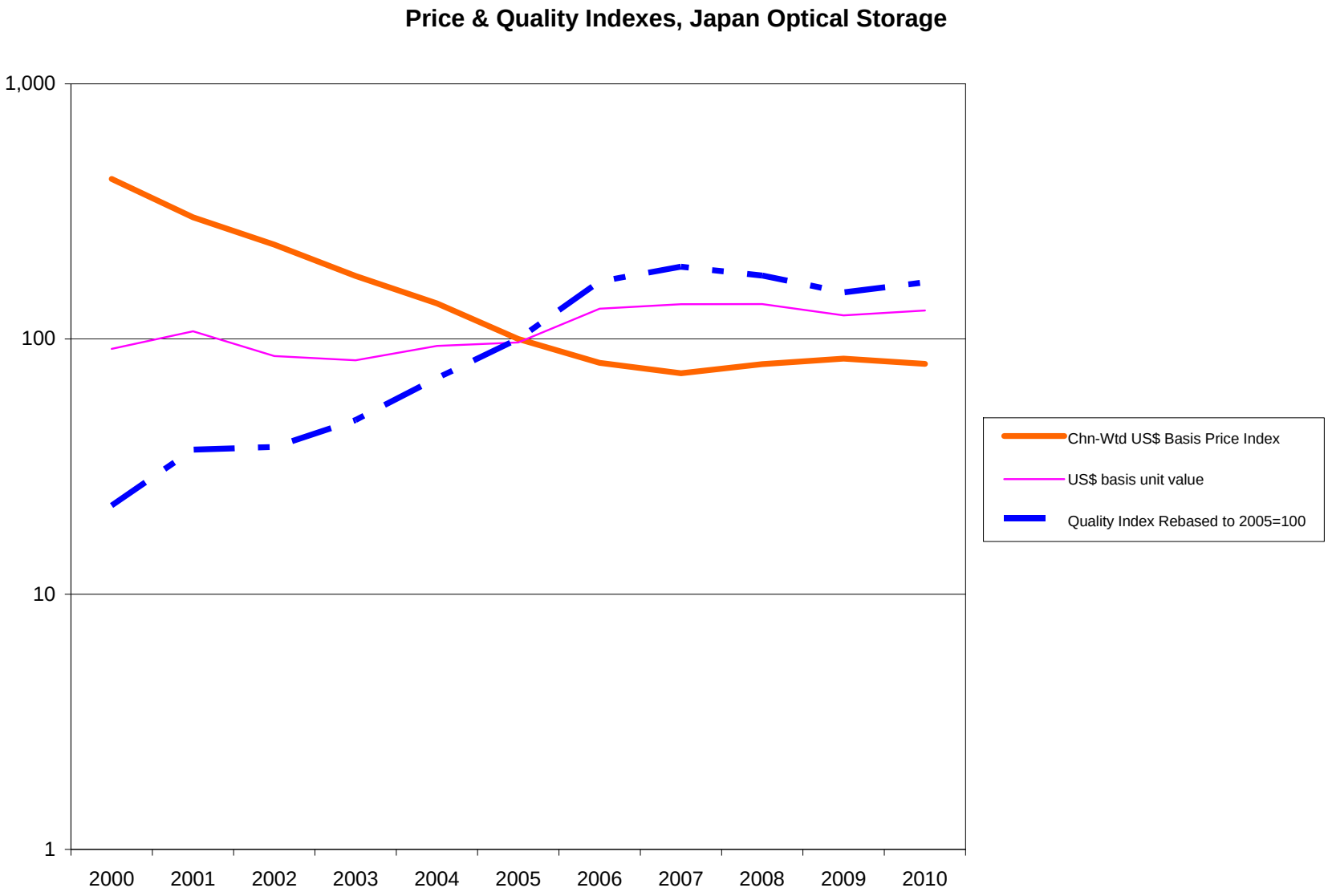


Historical shipments and forecasts from TSR, 2009

Quality-Adjusted Prices Flat After 2007



Unit Quality Index Also Flat 2007+



Issues

- IF slower pace for ODD innovation after pool formation, what is role of patent pool, patent pool structure, vs. other factors?
- Theory of patent pool effects on innovation:
  - Reduce effect of “patent thickets,” royalty stacking, transactions costs, litigation costs
  - Vs. protect weak or invalid patents, reduce investment in competitive innovation, foreclose downstream competition
    - But note with vertically integration, patent pool membership is welfare-enhancing (lower P) vs. counterfactual of no pool, royalty stacking in downstream industry
- Role of other factors
  - Rates of innovation in substitute products
    - Flash memory, broadband, magnetic disk storage
  - Pool administration and structure, royalty policies
  - Technological exhaustion of field, diminishing returns to R&D
    - But compare to magnetic data storage, some similarities
- Heightened sensitivity to antitrust issues evident
  - Price-fixing investigation
  - BD4C slide!

Empirical Game Plan

- Product review-based database on introduction of technological innovations into ODDs over time, direct measurement
  - Key metrics- disk capacity, read speed, write speed
- Technical literature on significant technological improvements to ODDs
  - Appearances of new features in standards
  - Lag from publication in standard to new product intro
- Time series matched model index data, hedonic price analysis➔measures of implicit quality improvement
- Econometric analysis of patenting activity in technology areas directly related to ODDs by pool and non-pool members, difference-in-differences/fixed effects approaches
  - Volume and composition