

Moore's Law, Increasing
Complexities, and Limits of
Organization: Modern Implications
of “Japanese DRAM Era”
by Chuma and Hashimoto

Discussion

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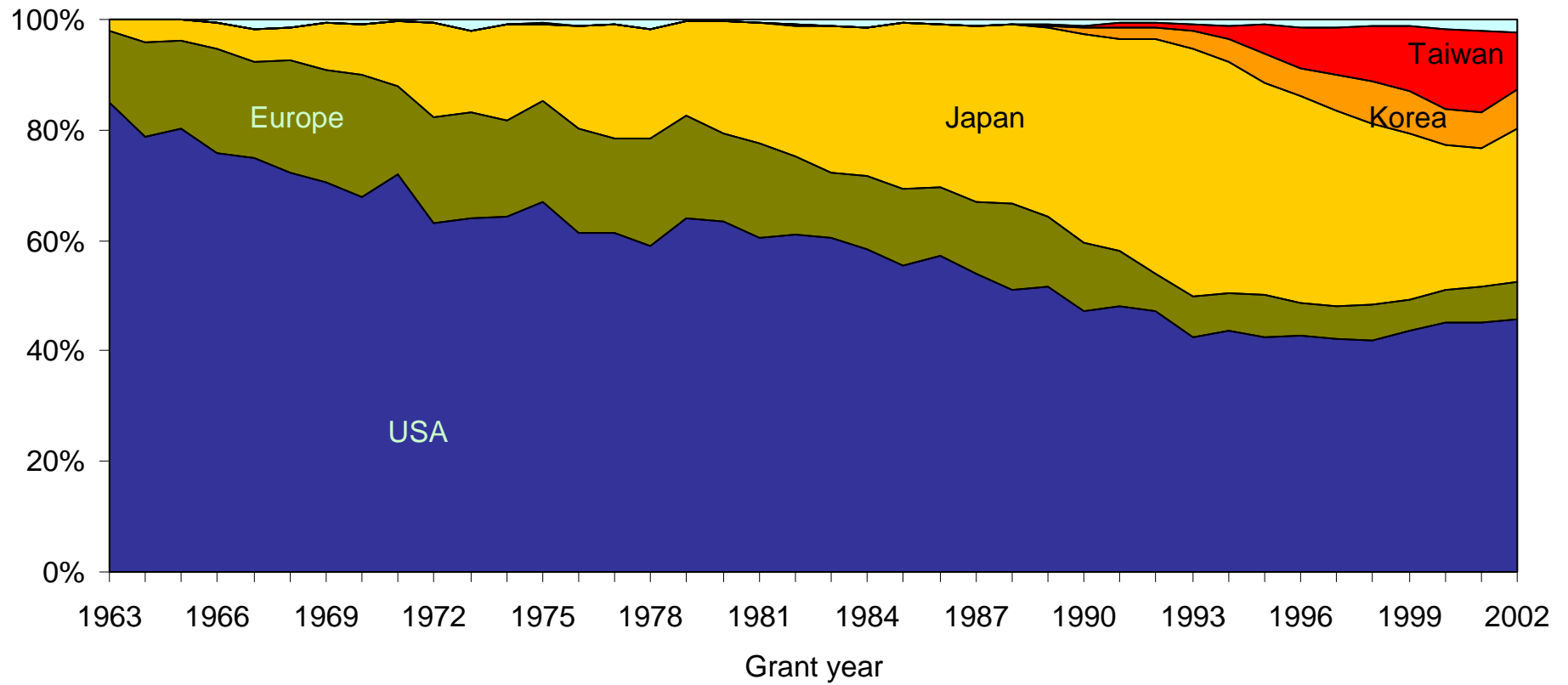
General comments

- A research project, not just a paper!
- Congratulate the authors
 - For their data-collecting efforts
 - For the presentation of many interesting tables and figures
 - For some interesting hypotheses about the DRAM industry evolution
- but it is not yet clear that the paper's conclusions follow from the data presented

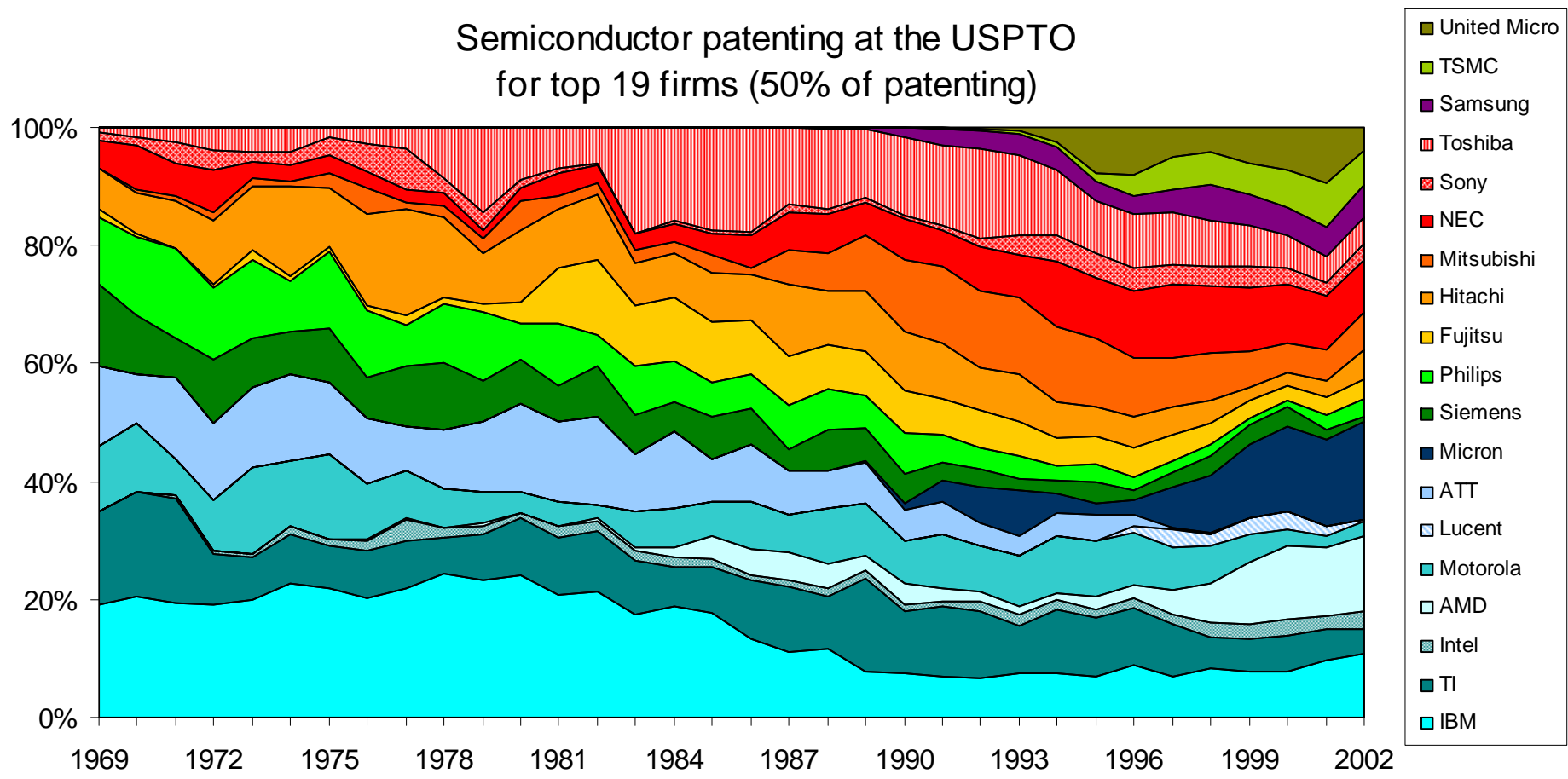
US semiconductor patent classes (HJT subcategory 46)

257	Active Solid-State Devices (e.g., Transistors, Solid-State Diodes)
326	Electronic Digital Logic Circuitry
437	Semiconductor Device Manufacturing: Process
438	Semiconductor Device Manufacturing: Process
505	Superconductor Technology: Apparatus, Material, Process
716	Data Processing: Design and Analysis of Circuit or Semiconductor Mask

Semiconductor patenting shares



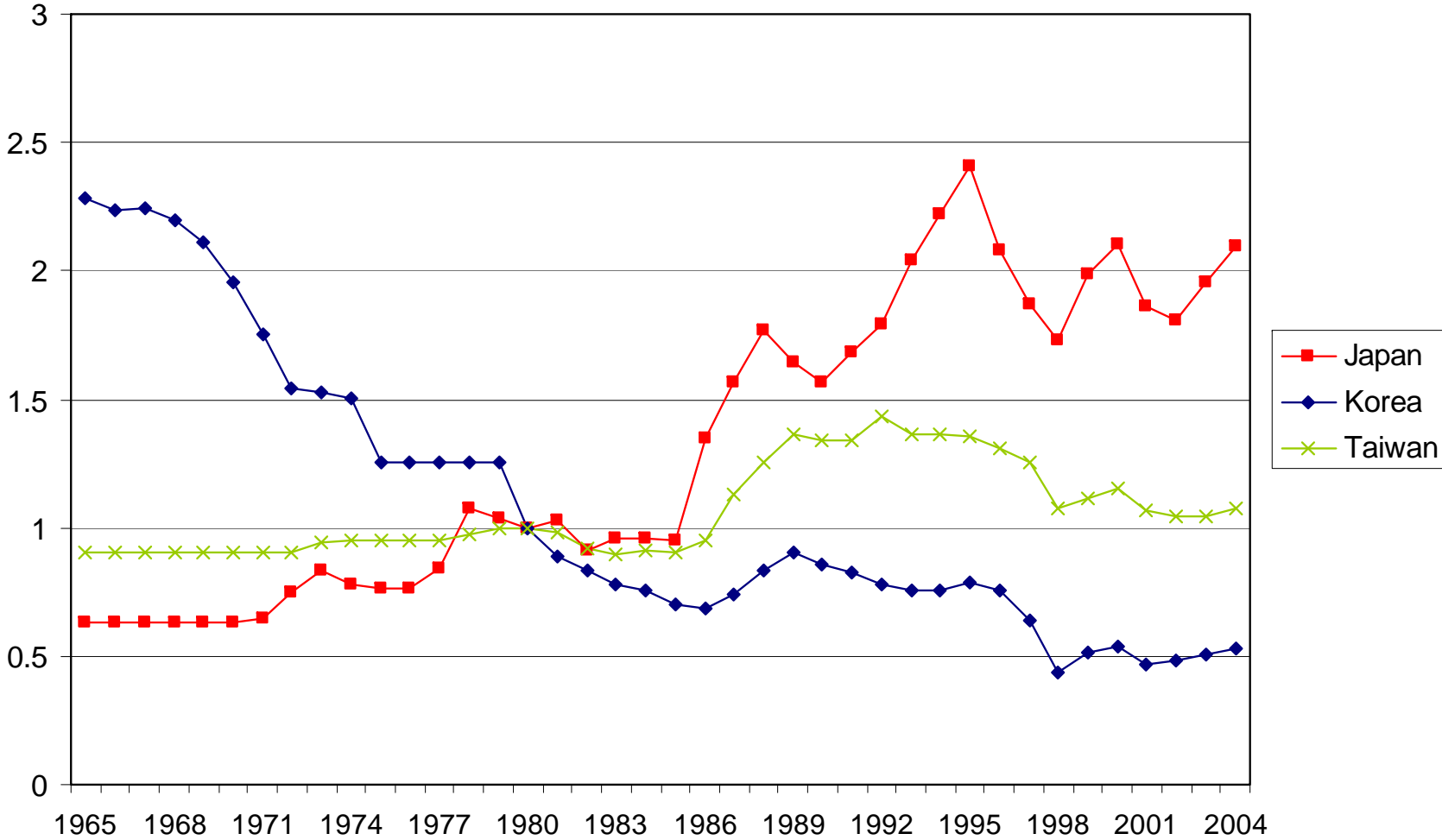
Semiconductor patenting at the USPTO for top 19 firms (50% of patenting)



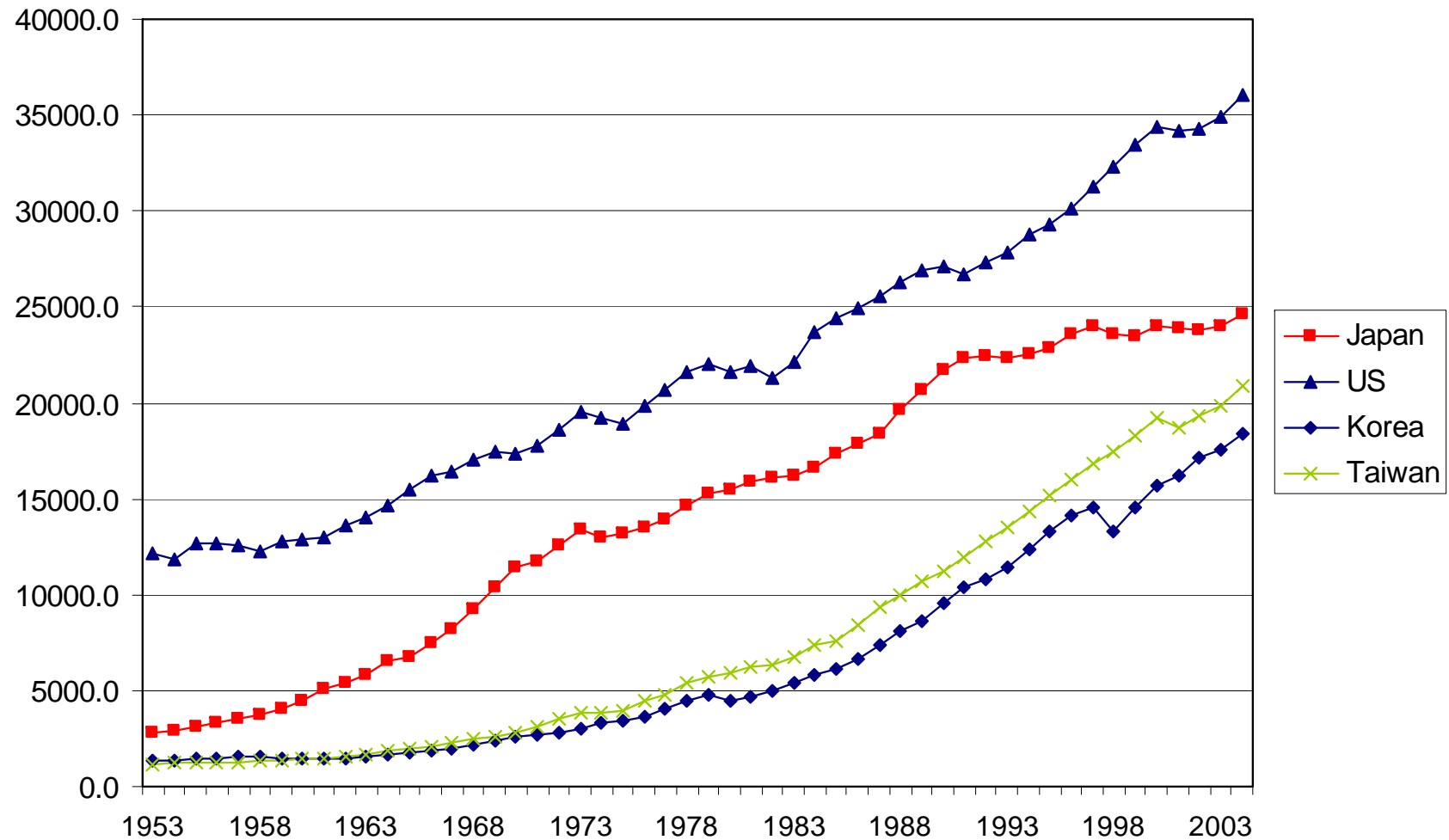
The question

- Why did Japanese manufacturers retreat from DRAM business?
- Simple-minded economist's answer: **Why not?**
 - DRAM became something of a commodity
 - Competition became cost-based
 - Japan was moving up in GDP per capita
 - Exchange rate moves

Exchange rate relative to dollar; normalized to one in 1980



Real GDP per Capita (chain-weighted prices)



Source: Alan Heston, Robert Summers and Bettina Aten, [Penn World Table Version 6.2](#), Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006.

Is this interpretation true?

- To some extent, but....
 - Does not explain the rise of Micron
 - Convergence in Japanese and Korean/Taiwanese GDP per capita suggests process may not be complete
 - Some of the cost advantage seems to come from collaborative R&D and introduction of new technologies

Authors' conclusions

- Interesting and possibly true but not currently supported by the evidence in the paper
 - Lack of organizational innovation across firm boundaries
 - Insufficient intra-firm synchronization of information (mfg, mktg, sales)
 - Slowdown in speed from development to mass production
 - Demand diversification problem

Further thoughts

- Would it be useful to break down the competitive process/positions?
 - Excellence in research and collaboration
 - Introduction of new technologies in production
 - The demand side – prices, marketing, etc.
- Ralph Siebert, PhD Humboldt U (now at Rutgers) – [Learning by Doing and Multiproduction Effects over the Life Cycle: Evidence from the Semiconductor Industry](#)
- Evaluate clearly the role that each plays in Japan relative to the other countries
- The mobility of researchers is striking and interesting – see Palomeras (2004)

Palomeras (2004)

- Thesis at Pompeu Fabra, Barcelona
 - 2394 engineers at IBM 1970-1999, with 8924 patents
 - 15% moved, they hold 33% of patents
 - Most to firms with small patent portfolios
 - Mover characteristics:
 - Patents more cumulative, less original, but more important, not as much in core tech of IBM
 - Quality is more important than quantity
 - Less likely to work in large teams when they patent