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

Discussion
Bronwyn H. Hall
University of California at Berkeley and University of Maastricht
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)

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>257</td>
<td>Active Solid-State Devices (e.g., Transistors, Solid-State Diodes)</td>
</tr>
<tr>
<td>326</td>
<td>Electronic Digital Logic Circuitry</td>
</tr>
<tr>
<td>437</td>
<td>Semiconductor Device Manufacturing: Process</td>
</tr>
<tr>
<td>438</td>
<td>Semiconductor Device Manufacturing: Process</td>
</tr>
<tr>
<td>505</td>
<td>Superconductor Technology: Apparatus, Material, Process</td>
</tr>
<tr>
<td>716</td>
<td>Data Processing: Design and Analysis of Circuit or Semiconductor Mask</td>
</tr>
</tbody>
</table>
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
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