Capturing Value in a Global Innovation Network: Comparing the iPod and Notebook PCs

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ITIF Forum on Mapping IT Supply Chains: Does the U.S. Benefit from U.S. IT Products Made Overseas?
Cannon House Office Building
Washington DC, October 3, 2007

Supported by a grant from the Alfred P. Sloan Foundation
Agenda

- Overview: global innovation networks
- Incremental innovation in PCs
- Radical innovation in the iPod
- Capturing value from innovation
  – Methods, data, results
- Implications for competition
- Implications for the U.S.
Global innovation networks: Who benefits?

• Innovation is believed to be a key driver of economic growth and source of national competitiveness.
  – Academic literature supports this view
  – National policies reflect this belief
• But what happens when innovation and production are distributed across many countries?
  – Multinationals operate multiple R&D centers around the world
  – Industries becoming more modular, with production and product development outsourced to specialists in many countries
• Where is value created, and who captures that value?
How does innovation occur?

• Locus of innovation
  – Core technologies: e.g. semiconductors, hard drives, optical drives, displays, software, battery, materials
  – System integration: Brand name vendors incorporate core technologies in new products to meet market demand.

• Incremental vs. radical innovation
  – Incremental: improvements within existing product architectures, e.g., faster computers, bigger TVs
  – Radical: disruptive changes in core technologies or creation of new architectures, e.g., from CRT to flat-panel TVs
Case studies: iPods and notebooks

- Global innovation networks that incorporate these distinctions found in many industries
- We study two products built on a global supply and innovation network—iPods and notebook PCs
  - Similar technologies involved (chips, storage, software, displays), mostly the same suppliers
  - One is radical, one incremental
  - Do they tell similar or different stories about value capture?
- We focus on a few products in one industry to do a very detailed analysis of value capture in global networks
Incremental innovation in the PC industry

- PC a mature product with established dominant design
- Modular product architecture with defined interfaces. Allows innovation to proceed independently in all layers of the industry
- Microsoft and Intel define key standards and shape innovation decisions of component and system makers
- Branded PC makers decide which innovations to incorporate. Most innovations available to everyone
PC industry value network

Component suppliers → CM/ODM → Brand name vendors → Distributors

Indirect channel

Direct sales

3rd party peripherals manufacturers → Software publishers

R&D Manufacturing

IP, design, marketing

Distribution, sales, customer service

PCs

Peripherals

Software
Radical innovation in the iPod

- Emerging product category, no dominant design
- Innovation aided by advances in core technologies: hard drive, flash memory, audio compression (MP3), batteries
- Apple created complete system of hardware, software, services.
  - Worked with suppliers to customize key components
  - Created an ecosystem that includes iPod, iTunes software for PCs, iTunes store, content
  - Success based on design, ease of use, integration of product and services to satisfy consumers
The iPod ecosystem
The iPod value network

- **R&D**
  - Component suppliers

- **Manufacuring**
  - CM/ODM
  - 3rd party accessory providers

- **Sales, distribution**
  - iTunes store
  - Apple stores, web
  - Other retailers
  - Distributors

- **Content providers**

- **IP, design software marketing**
Comparing iPods and notebooks

• Similarities
  – Components are supplied globally by mostly the same U.S. and Asia-Pacific firms
  – Assembly is in China
  – Distribution and retail is local or regional around the world.

• Differences
  – Whose brand is on the label: Apple vs. various U.S., Japanese, Taiwanese, Chinese notebook vendors
  – Who controls the standards: Apple vs. Microsoft and Intel
Who captures the value of innovation?

• Critical issue for companies and countries.
• Companies need to know
  – how much to invest and where to focus their own efforts
  – when and how to leverage global networks
  – where to retain control to capture value.
• U.S. needs to know
  – real facts about globalization
  – how to capture more value from participating in global networks
  – how to prepare their people to compete globally
  – how to create an environment for innovation
Research approach

- Need a framework to measure value creation and capture.
  - Use value chain analysis.
  - Identify who captures value along the supply chain
- Need a methodology to measure value at the firm and country level.
  - We break down individual products, identify who makes the major components, who assembles the product, who sells it
  - Estimate the value captured by each party.
  - Firm level data is then aggregated to country level
Accounting methodology

- Value added = sale price - purchased inputs = direct labor + gross profit
- Value capture = gross profit = value added - direct labor

<table>
<thead>
<tr>
<th>Sales price</th>
<th>- purchased inputs</th>
<th>Value added</th>
<th>Gross profit</th>
<th>- cost of goods sold</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- direct labor</td>
<td></td>
<td></td>
<td>- SG&amp;A</td>
</tr>
<tr>
<td></td>
<td>- SG&amp;A</td>
<td></td>
<td></td>
<td>- R&amp;D</td>
</tr>
<tr>
<td></td>
<td>- R&amp;D</td>
<td></td>
<td></td>
<td>- Depreciation</td>
</tr>
<tr>
<td></td>
<td>- Depreciation</td>
<td></td>
<td></td>
<td>- Net profit</td>
</tr>
<tr>
<td></td>
<td>- Net profit</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Product level estimation

- Obtained teardown data from Portelligent, Inc.
  - 30 GB iPod, 2003
  - 30 GB Video iPod, 2005
  - 8GB iPod Nano, 2005
  - HP nc6230 notebook, 2005
  - Lenovo T43 notebook, 2005

- Break down cost and identify manufacturers of major inputs
  - For each input, estimate gross margin using company and comparative data.
  - Multiply cost by margin to get value capture by firm.
  - Direct labor costs are not broken out in firm financial reports, so we cannot measure value added. Possible future research.
### Key Inputs in the 30GB 5th-Generation iPod (Video iPod), 2005

<table>
<thead>
<tr>
<th>Type</th>
<th>Input</th>
<th>Supplier</th>
<th>Supplier HQ Country</th>
<th>Estimated Input Price</th>
<th>Price as % of Factory Cost</th>
<th>Supplier Gross Profit Rate</th>
<th>Est’d. Value Capture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td>Hard Drive</td>
<td>Toshiba</td>
<td>Japan</td>
<td>$73.39</td>
<td>50%</td>
<td>26.50%</td>
<td>$19.45</td>
</tr>
<tr>
<td>Display</td>
<td>Display Assembly</td>
<td>Toshiba-Matsushita</td>
<td>Japan</td>
<td>$23.27</td>
<td>16%</td>
<td>28.70%</td>
<td>$6.68</td>
</tr>
<tr>
<td>Processors</td>
<td>Video/Multimedia Processor</td>
<td>Broadcom</td>
<td>US</td>
<td>$8.36</td>
<td>6%</td>
<td>52.5%</td>
<td>$4.39</td>
</tr>
<tr>
<td>Processors</td>
<td>Controller chip</td>
<td>PortalPlayer</td>
<td>US</td>
<td>$4.94</td>
<td>3%</td>
<td>44.8%</td>
<td>$2.21</td>
</tr>
<tr>
<td>Battery</td>
<td>Battery Pack</td>
<td>Unknown</td>
<td>Japan*</td>
<td>$2.89</td>
<td>2%</td>
<td>30.0%*</td>
<td>$0.87</td>
</tr>
<tr>
<td>Memory</td>
<td>Mobile SDRAM Memory - 32 MB</td>
<td>Samsung</td>
<td>Korea</td>
<td>$2.37</td>
<td>2%</td>
<td>28.2%</td>
<td>$0.67</td>
</tr>
<tr>
<td>Memory</td>
<td>Mobile RAM - 8 MBytes</td>
<td>Elpida</td>
<td>Japan</td>
<td>$1.85</td>
<td>1%</td>
<td>24.0%</td>
<td>$0.46</td>
</tr>
<tr>
<td>Memory</td>
<td>NOR Flash Memory - 1 MB</td>
<td>Spansion</td>
<td>US</td>
<td>$0.84</td>
<td>1%</td>
<td>10.0%</td>
<td>$0.08</td>
</tr>
</tbody>
</table>

**Sub-Total**: $117.91  80%

**Other parts**: $22.79  15%

**Estimated assembly and test**: $7.40  5%

**Estimated factory cost**: $148.10  100%  $38.50
## iPod and notebook PC input values

Purchased inputs as percentage of factory cost

<table>
<thead>
<tr>
<th></th>
<th>Video iPod</th>
<th>HP nc6230 notebook</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software</td>
<td>Developed inhouse</td>
<td>11%</td>
</tr>
<tr>
<td>Storage</td>
<td>50%</td>
<td>12%</td>
</tr>
<tr>
<td>Display</td>
<td>16%</td>
<td>16%</td>
</tr>
<tr>
<td>Processors</td>
<td>9%</td>
<td>27%</td>
</tr>
<tr>
<td>Assembly</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Battery</td>
<td>2%</td>
<td>5%</td>
</tr>
<tr>
<td>Memory</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>PCBs</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>Enclosure</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>Input Device(s)</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>Total Parts</td>
<td>451</td>
<td>2,196</td>
</tr>
</tbody>
</table>

Developed inhouse

Personal Computing Industry Center
University of California, Irvine
Distribution of value capture: iPod

Value capture for $299 iPod

- Apple margin, $76
- Distribution and retail, $75
- Unmeasured inputs and direct labor, $113
- Taiwan inputs, $4
- Korea inputs, $1
- U.S. inputs, $7
- Japan inputs, $27
Distribution of value capture: notebook PC

Value capture for $1400 HP notebook

- HP margin, $171
- Distribution and retail, $350
- Japan inputs, $81
- US inputs, $216
- Korea inputs, $11
- Taiwan inputs, $23
- Other inputs and direct labor, $548
Comparison of value capture

Share of value capture, $299 iPod

Apple margin, 25%

Distribution and retail, 25%

Unmeasured inputs and direct labor, 36%

Taiwan inputs, 1%

Korea inputs, 0%

U.S. inputs, 2%

Japan inputs, 9%

Share of value capture, $1400 HP notebook

HP margin, 12%

Distribution and retail, 25%

Unmeasured inputs and direct labor, 39%

Taiwan inputs, 2%

Korea inputs, 1%

US inputs, 15%

Japan inputs, 6%
Where’s China?

• Value added
  – All products studied assembled in China
  – Value added from final assembly a few dollars of direct labor
  – Additional assembly of components and subassemblies in China
  – Total less than 5% of final value

• Value capture
  – No Chinese firms in major suppliers
  – Assembly done by Taiwanese and multinational companies in China, who capture value in gross profit

• For Lenovo laptop, China’s share is bigger
China capturing value: Lenovo

Value capture for $1479 Lenovo notebook

- Lenovo margin, $212
- Distribution and retail, $370
- Japan Inputs, $81
- Taiwan Inputs, $22
- Korea Inputs, $15
- U.S. Inputs, $214
- Other inputs and direct labor, $565
Innovation and competition

• Key distinction in who captures value is not between radical and incremental innovation. It’s who defines the market and controls standards
  – Apple for iPod
  – Microsoft and Intel for PCs

• “Wintel” is not the model for the rest of the electronics industry.
  – Even Microsoft doesn’t use it outside of PCs (XBox and Zune)
  – Lead firms in other segments don’t want suppliers to capture most of the value.
Value of innovation to the U.S.

• Value captured by countries depends mostly on success of domestically-owned firms
  – Electronics industry dominated by U.S. and Japanese brands
  – U.S. continues to generate new innovations and set standards

• Innovation by domestic companies creates value for shareholders, who are mostly in the U.S.

• Creates employment in the U.S. in management, R&D, design, sales, marketing, accounting etc.

• As technologies mature, activities move offshore. Constant innovation creates new opportunities.
Top 50 U.S. Patent Grantees By Country, 2005

<table>
<thead>
<tr>
<th>Country or Region</th>
<th>Number of Grantees</th>
<th>Number of Patents</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>25</td>
<td>18,310</td>
</tr>
<tr>
<td>Japan</td>
<td>16</td>
<td>14,710</td>
</tr>
<tr>
<td>Europe</td>
<td>5</td>
<td>3,359</td>
</tr>
<tr>
<td>Korea</td>
<td>3</td>
<td>2,490</td>
</tr>
<tr>
<td>Taiwan</td>
<td>1</td>
<td>441</td>
</tr>
</tbody>
</table>

U.S. competitiveness

• The U.S. has strong assets to capture value in a global innovation environment.
  – Brand name companies
  – Core technologies
  – Sophisticated markets
• But those advantages can be lost
  – When technologies shift or market conditions change
  – When domestic market is slow to adopt new technologies
• The U.S. is falling behind in key growth markets, especially wireless.
• Global competition now affecting U.S. knowledge workers as well as production workers
Trade data are misleading

- **Bilateral trade statistics can be misleading**
  - Bilateral U.S./China trade deficit increases by the factory cost of imported iPod or notebook
  - Yet most valuable inputs are made elsewhere and shipped to China for final assembly.

- **Example**
  - Intel chips fabricated in U.S., assembled in Malaysia, shipped to China for final assembly and exported to U.S.
  - Increases U.S. surplus with Malaysia and deficit with China
  - But most of the value from Intel was created and consumed in the U.S.
Policy issues

• Focus on bilateral trade deficit is misguided.
  – As China cost rises, production will move, but not to the U.S.
  – Raising tariffs or revaluing of RMB will only shift the trade deficit somewhere else.

• U.S. should focus on value creation and capture via innovation.
  – Promote dynamic domestic markets
  – Sustain favorable environment for entrepreneurs

• U.S. knowledge workers need to adapt rapidly
  – Cross-disciplinary skills (e.g., hardware and software)
  – Business and industry knowledge
  – Cross cultural management

• Bad news: Production jobs probably gone for good
Thank you.

- For the iPod-notebooks comparison paper, see:  
- For the methodology paper, see:  
- For the iPod paper, see:  

- COMMENTS, QUESTIONS???
## The Geography of Value Capture for Five Products

<table>
<thead>
<tr>
<th>Product</th>
<th>Retail Price</th>
<th>Distribution</th>
<th>Lead Firm Gross Margin</th>
<th>U.S. Inputs</th>
<th>Japan Inputs</th>
<th>Korea Inputs</th>
<th>Taiwan Inputs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>30GB iPod, 2003</td>
<td>$399</td>
<td>$40</td>
<td>$60</td>
<td>$114</td>
<td>$4</td>
<td>$32</td>
<td>$2</td>
<td>$5</td>
</tr>
<tr>
<td>30GB Video iPod</td>
<td>$299</td>
<td>$30</td>
<td>$45</td>
<td>$76</td>
<td>$7</td>
<td>$27</td>
<td>$1</td>
<td>$4</td>
</tr>
<tr>
<td>4GB iPod Nano, 2005</td>
<td>$249</td>
<td>$25</td>
<td>$37</td>
<td>$30</td>
<td>$3</td>
<td>$4</td>
<td>$32</td>
<td>$3</td>
</tr>
<tr>
<td>HP nc6230, 2005</td>
<td>$1399</td>
<td>$140</td>
<td>$210</td>
<td>$171</td>
<td>$216</td>
<td>$81</td>
<td>$11</td>
<td>$23</td>
</tr>
<tr>
<td>Lenovo T43, 2005</td>
<td>$1479</td>
<td>$148</td>
<td>$222</td>
<td>$212</td>
<td>$214</td>
<td>$81</td>
<td>$15</td>
<td>$22</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations