Assessing Industrial Competitiveness of Japan by Comparing Productivity Levels to China, Korea, Taiwan and US

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Decline of Japanese growth rate after 1990’s

-2%
-1%
0%
1%
2%
3%
4%
5%
6%
7%
8%

90~2003年の平均: 1.3%
80年代の平均: 4.0%
Trade Specialization Index
(Export-Import)/(Export+Import)

Source: Author’s calculation using “Trade Statistics,” Ministry of Finance
Motivation

• Slowdown of growth rate of Japan after 1990’s: supply-side or demand-side factors?
• Fading international competitiveness in Japan? Particularly for electronics industries?: catching up of other East Asian economies?
• Dual economy in Japan? Lower productivity level in services sectors
• Benchmarking Japanese industries’ competitiveness by productivity comparison with other East Asian countries as well as US
ICPA Project

- International comparison among Asian countries by RIETI (Research Institute of Economy, Trade and Industry)
- Productivity growth and level comparison among China, Japan, Korea, Taiwan and US by KLEM framework
- Network of researchers
  - China: Ren Ruoen (Beihang Univ.)
  - Japan: Kuroda, Shimpo and Kawai (Keio Univ.)
  - Korea: Hak Pyo (Seoul National Univ.)
  - Taiwan: Chi-Yuan Liang (Academia Sinica)
  - US: Jorgenson and Ho (Harvard Univ.)
Measuring Productivity by KLEM framework

- Industry level productivities are derived from comparable input-output tables as well as labor and capital by type (Jorgenson and his groups)
- IO table: 33 sector use matrix, and industry output and commodity input prices
- Labor data: hours worked and per hour wages by 18 types (2 sex*3 age*3 education) and 33 sectors
- Capital data: capital stock and rental service prices by 3 types (only depreciable assets) and 33 sectors
Framework for productivity level comparison

\[ Y^j = f^j(K^j, L^j, E^j, M^j, TFP(c)) \]  \hspace{1cm} (1)

\[ d \log Y/dc = \sum_{X \in K, L, E, M} (\partial \log Y/\partial c)(d \log X/d c) + \partial \log TFP/\partial c \]  \hspace{1cm} (2)

\[ \partial \log TFP/\partial c = d \log Y/dc - \sum_{X \in K, L, E, M} (\partial \log Y/\partial c)(d \log X/d c) \]  \hspace{1cm} (3)

\[ \partial \log TFP/\partial c = \sum_{PX \in PK, PL, PE, PM} (\partial \log P_Y/\partial c)(d \log P_X/d c) - d \log P_Y/dc \]  \hspace{1cm} (4)

\[ \partial \log TFP/\partial c = \sum_{PX \in PK, PL, PE, PM} s_x (d \log P_X/d c) - d \log P_Y/dc \]  \hspace{1cm} (5)

\[ \log TFP_{US/JP} = \sum_{X \in K, L, E, M} \overline{s_x}(\log P_{X, US} - \log P_{X, JP}) - (\log P_{Y, US} - \log P_{Y, JP}) \]  \hspace{1cm} (6)

where \( \overline{s_x} = 1/2 * (S_{X,JP} + S_{X,US}) \)
Relative input and output prices

- **Output prices:** relative basic prices (net subsidy adjustment with producer prices by industry)
- **Input prices:**
  - Intermediate inputs (E and M): relative purchased prices by commodity
  - Labor input (L): relative per hour wage
  - Capital input (K): relative rental service price
Issues for relative output prices

\[ P_{Y(orX),US/JP} = P_{Y(orX),US} \cdot e_{JP/US} / P_{Y(orX),JP} \]

- EPPPs or UVRs
  - EPPPs (Expenditure based PPPs): starting from official PPPs statistics by OECD, and make adjustments for distribution margins and int’l trade
  - UVRs (Unit Value Ratios): comparing per unit price (the value over the quantity) at detail commodity level and aggregated

- UVRs from GGDC, Groningen Univ. are used in this study
  - Covering non-OECD countries
  - Needs converting to industry level by make matrix, but no significant impacts of such adjustment at 33 sector level
Issues for relative input price

• Intermediate inputs
  – Purchased level relative prices, but not in this study (needs further developments)

• Labor inputs
  – Comparing per hour wage for matching categories, and Divisia aggregation to industry level

• Capital inputs
  – Same as labor inputs

\[
P_k = \left(\frac{1-zu}{1-u}\right) \cdot (r(1-\pi) + \delta - \pi + \tau) \cdot P_l
\]

\[
P_{K,US/JP}^i = \frac{\text{annualization\_factor}_{US}}{\text{annualization\_factor}_{JP}} \cdot P_{l,US/JP}^i
\]
Reservations !!

- Problems with hours worked -> biases with per hour wage (for example, no hours data for China)
- Underestimation of capital stock -> overestimation of rental services and TFP levels. E.g. China’s investment survey covering only SOEs and collective economies
- Ad-hoc approach to smooth out asset price movements

-> In most cases, no to much biases for factor input growth, but directly leads to miss-measurement of level comparison
## Results: TFP level in 1995 (Japan=1)

### Macro Economy Level

<table>
<thead>
<tr>
<th></th>
<th>China</th>
<th>Korea</th>
<th>Taiwan</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Price</td>
<td>0.29</td>
<td>0.68</td>
<td>0.47</td>
<td>0.68</td>
</tr>
<tr>
<td>Capital Price</td>
<td>0.69</td>
<td>1.07</td>
<td>0.81</td>
<td>1.29</td>
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<tr>
<td>Labor Price</td>
<td>0.02</td>
<td>0.21</td>
<td>0.30</td>
<td>0.68</td>
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<tr>
<td>Energy Price</td>
<td>0.27</td>
<td>0.53</td>
<td>0.50</td>
<td>0.53</td>
</tr>
<tr>
<td>Material Price</td>
<td>0.30</td>
<td>0.57</td>
<td>0.37</td>
<td>0.60</td>
</tr>
<tr>
<td>TFP</td>
<td>0.64</td>
<td>0.77</td>
<td>0.91</td>
<td>1.07</td>
</tr>
</tbody>
</table>

### Manufacturing Sector

<table>
<thead>
<tr>
<th></th>
<th>China</th>
<th>Korea</th>
<th>Taiwan</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Price</td>
<td>0.44</td>
<td>0.75</td>
<td>0.56</td>
<td>0.78</td>
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<tr>
<td>Capital Price</td>
<td>0.80</td>
<td>1.15</td>
<td>0.77</td>
<td>1.47</td>
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<tr>
<td>Labor Price</td>
<td>0.03</td>
<td>0.23</td>
<td>0.30</td>
<td>0.80</td>
</tr>
<tr>
<td>Energy Price</td>
<td>0.27</td>
<td>0.52</td>
<td>0.53</td>
<td>0.51</td>
</tr>
<tr>
<td>Material Price</td>
<td>0.36</td>
<td>0.72</td>
<td>0.54</td>
<td>0.70</td>
</tr>
<tr>
<td>TFP</td>
<td>0.59</td>
<td>0.81</td>
<td>0.90</td>
<td>1.00</td>
</tr>
</tbody>
</table>
Results by industry (Manufacturing)

[Bar chart showing percentage changes in manufacturing sectors for China, Korea, Taiwan, and US.]
Results – levels and growth (economy-wide)
Results – levels and growth (manufacturing)
Divergence of Productivity between Japan and US?  
Macro-level comparison

Jorgenson and Motohashi (2005)
The Role of IT in Macro-level Productivity Growth

Jorgenson and Motohashi (2005)
IT network use and firm level productivity

(Atrostic, Motohashi and Nguyen 2005)
Asian countries’ catching up:
Electronics Industry
Assessment: Multinationals in China

(“R&D of multinationals in China”, RIETI-DP-06-E-005)
Assessment: Multinationals in China-2

(“R&D of multinationals in China”, RIETI-DP-06-E-005)
Summary and Implications

- Productivity levels in manufacturing industries are generally higher in Japan, but a great amount of heterogeneity exists
  - Strong in Electrical machinery, automobiles, instruments
  - But weak in food, lumber and fabricated metals
- East Asian countries are catching up with Japan, while there is a divergence between Japan-US
  - Difference between Japan and US comes from IT using sectors
  - Growing China: substantial contribution of multinationals, but R&D level relatively low (market driven overseas R&D)
- Implications for Japan’s potential growth (TFP growth)
  - Better use of ICT in economy: growth opportunities (+)
  - Catching up from Korea, Taiwan and China: threat by loosing high productivity growing sector (-), but competitions pushes productivity growth? (+)
  - East Asian countries form a big market: demand size opportunities (+), and effects of globalization (tapping into overseas human resources) (GNP+)