The Sun Rises Again? Regaining Industrial Competitiveness of Japan in Science Based Economy Era

by
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Today’s talk is based on my recent book on industrial competitiveness of Japan from Nikkei (February 2014)
The Sun Rises again?

- Yes!
- But Japan needs to be adjusted to new economic environment.
- What is new environment?
- Industrial base economy -> Science base economy.
- What kind of change?
Japan’s competitiveness ranking (IMD’s WCY)

Change of evaluation criteria:
2000’s and after: “international experience of employees”, “quality of senior manager”, “transparency of government”, “structural reform”
Productivity slow down?

GDP growth = labor + capital + TFP growth

Mainly labor input decreases
International competitiveness index

\[(\text{Export-Import})/(\text{Export+Import})\] vs China & Korea
GDP share by country (1990 PPP US$)

(Angus Maddison, Long term economic growth database)
Per Capita GDP (1000$ \cdot \log \text{scale})

- US and Spain
- US
- Japan
- Korea
- Brazil
- Thailand
- Egypt
- China
- India

Year:
- 1000
- 1500
- 1600
- 1700
- 1820
- 1900
- 1920
- 1940
- 1960
- 1980
- 2000
- 2008
# Economics Regime Changes

<table>
<thead>
<tr>
<th></th>
<th>Manual Economy (-17th century)</th>
<th>Industrial Economy (18th ~20th)</th>
<th>Science Economy (21st)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key growth drivers</strong> (factor inputs)</td>
<td>(Physical) labor and land -&gt; Population=GDP</td>
<td>Capital investment, industrial technology -&gt; GDP/pop takes off</td>
<td>(Knowledge) labor -&gt; Within country variation of wage increases</td>
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<td><strong>Regime shift drivers</strong></td>
<td></td>
<td>Industrial Revolution (Machine &amp; infrastructure)</td>
<td>Science Revolution (IT, life-science, nanotechnology)</td>
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<td><strong>How previous key growth drivers became obsolete</strong></td>
<td></td>
<td>Machine-&gt; manual labor Infra-&gt; land</td>
<td>Implicit knowledge (industrial tech.) -&gt; explicit knowledge (scientific findings)</td>
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Changes of Innovation Process

Industrial Economy
- Users and society
- Process innovation
- Products and technologies (intellectual property)
  - Product innovation
  - Technological discoveries (inventions) (Steam engine, railroad, electric power system, etc.)

Science Economy
- Users and society
- Business innovation
- Technological platforms (products and technologies)
  - Science innovation
  - Scientific discoveries (IT, biotechnology, nanotechnology, etc.)
### Comparison of characteristics of innovation

<table>
<thead>
<tr>
<th>Industrial Economy</th>
<th>Science Economy</th>
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<tbody>
<tr>
<td><strong>Product + Process Innovation</strong></td>
<td>Science base + Business Innovation</td>
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<tr>
<td><strong>Technology Push or Market Pull</strong></td>
<td>Business system design</td>
</tr>
<tr>
<td>(Narrow technology and product specification)</td>
<td>(Broad market definition with dynamic technology evolution)</td>
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<tr>
<td><strong>Mono-zukuri</strong></td>
<td>Koto-zukuri</td>
</tr>
<tr>
<td><strong>In-house R&amp;D, business development</strong></td>
<td>Open Innovation</td>
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<td></td>
<td>Science base: U-I collaboration</td>
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<tr>
<td></td>
<td>Business: Collab. with customer (firm)</td>
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**Example**
- Komatsu’s comtrax (“big data” application)
- Uniqlo + Tray (for science based fabrication)

**Continuous innovation based on deep interaction between business partners with deep scientific backgrounds**
National Innovation System (NIS)

Chris Freeman, Dick Nelson, OECD works etc..
R&D ranking by company in Japan (2012FY)
Japan’s national innovation system

Compartment system by large company: Japan

Internal R&D
In-house technology development

Fixed compensation packages
Flexible internal labor market

R&D sector
Personnel rotation
Manufacturing sector

Affiliates and other subcontracting companies

Focus on manufacturing technology application development and establishment of information-sharing infrastructure within corporate group

Investors

Labor market problems

Venture companies

Finance market problems

Universities and national research institutes

Technology market problems

Introduction of foreign technology

Establishment of intended product image
UIC impacts on firm level productivity (Motohashi, 2005)

Kazuyuki Motohashi, “University-industry collaborations in Japan: The role of new technology-based firms in transforming the National Innovation System”, Research Policy 34(5), 583-594
NIS: Japan vs US (Silicon Valley)

Technology Based SMEs

Intensive Interactions

Large firms (old age) (JP)

Relation specific model

Large firms (young age) (US)

Market transaction model

Tech Acquisition

Universities/PRIs

Repeated Interactions

High-tech ventures

Spin-out

M&A

Spin-out

Joint R&D

Universities/PRIs
## Variety of Capitalism (Hall and Soskice)

<table>
<thead>
<tr>
<th>LMEs (Liberal Market Economies)</th>
<th>CMEs (Coordinated Market Economies)</th>
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<tr>
<td>US, UK, Australia, New Zealand</td>
<td>Germany, Sweden, Norway, Japan</td>
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<tr>
<td>Short term labor contract</td>
<td>Stable employer-employee relationship</td>
</tr>
<tr>
<td>Responsive capital market</td>
<td>Patient capital</td>
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<tr>
<td>Market mechanism</td>
<td>Non-market mechanism</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Relation specific asset investment</td>
</tr>
<tr>
<td>Disruptive innovation</td>
<td>Incremental innovation</td>
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Quantifying the difference in NISs by Agent Base Simulation Modes

Kwon and Motohashi (2014) How the relationship dependency between entities shapes national industrial landscape? Study through an agent-based model, mimeo
Key results (still developing…)

Kwon and Motohashi (2014) How the relationship dependency between entities shapes national industrial landscape? Study through an agent-based model, mimeo
Possible Solutions 1: Opens up Japanese NIS by using SME networks

Broadening business scope and increasing technological uncertainty
Possible Solutions 2: Use institutional arbitrage (such as link JP with US system)

Broadening business scope and increasing technological uncertainty

US system (such as innovation ecosystem of silicon valley)
Roads ahead: Research pipelines

• Macro perspective
  – ABM approach for NIS change and performance: Taking into account personnel mobility (labor market liberalization’s impact on innovation performance of Japan)
  – Modeling the impact of “institutional arbitrage”?

• Micro perspective: shift from firm level to individual level analysis
  – Social network analysis of inventor information in patent data: Internationalization of R&D
  – Cross borderer immigration of high-tech employees (brain drain and brain circulation), Chinese returnees (Haigui) research is undergoing
  – Cross national comparison of entrepreneurship activities (Japan-US comparison, possibly with China, as well?)