Productivity Dynamics: A Comparison of the Manufacturing Sector in Korea and Japan

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- Motivation
- Long-term Trends
  - Decomposing Output and Value Added Growth
  - Factor Inputs and Productivity
- Data and Methods
  - Data
  - Productivity Dynamics Decomposition
- Preliminary Findings
  - Productivity Growth by Technology Level
  - Firm Dynamics by Technology Level
- Implications and Future Works
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- **Implications and Future Works**
Japan and Korea

**Similarities**
- Export-oriented growth
- Strong manufacturing (but weak tertiary sector?)
- Aging population
- Increasing competition from emerging economies (especially from China)

**Differences**
- Different size
- Distance to frontier
- Latecomer’s advantage
- Speed of recovery
- Different challenges
Past trends

Manufacturing Share relative to Total Economy

- Germany
- Japan
- Korea
- US

Value added and Employment trends from 1980 to 2010.
Projections

Figure 16. Real GDP of Major OECD Countries: Past Record and Forecast (2007=100)

OECD, Economic Outlook 88, November 2010.
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Long-term Trends: Japan (1)

Growth accounting results for Japan’s private sector.

TFP growth slowed down during the 1990s.

Since the 2000s, the most important source of Japan’s economic growth has been TFP growth.
Long-term Trends: Japan (2)

Growth accounting results for Japan’s manufacturing sector.

TFP growth also slowed down during the 1990s.

Since the 2000s, TFP growth in the manufacturing sector has recovered.
Growth accounting of Korea’s manufacturing sector output (KIP 2011)

TFP growth fluctuated, but recently has been decelerating.

Since the 1990s, the contribution of labor input has been close to zero.
Growth accounting for Korea’s manufacturing sector VA (KIP 2011)

Growth in VA decelerating, but productivity growth remains robust.
Contribution of factor input growth has been declining since 1990.
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Micro Data: Japan

- **Main Data Source:** *Census of Manufactures*
  - **Coverage:** All plants in the manufacturing sector (with 4 or more employees)
  - **Information:** Shipments, number of employees, book value of tangible fixed assets, wage bill, intermediate materials, etc.
  - Plant-level, not firm-level

- **Additional Data Sources**
  - *Establishment and Enterprise Census:* Larger coverage of establishments, but fewer items covered
Micro Data: Korea

- **Main Data Source:** *Mining and Manufacturing Survey*
  - **Coverage:** All plants with five or more employees in the mining and manufacturing industries
  - **Information:** Plant-level information on output, inputs, and a variety of additional items, including the plant ID, the regional code, and the industry code assigned to each plant based on its major product. Similar to *Census of Manufactures* of Japan
  - Plant-level, not firm level

- **Additional Data Sources**
  - *Census on Establishments*: Larger coverage of establishments, but fewer items covered
  - *Survey of Business Activities*: Firm-level data since 2005
Analysis of Productivity Dynamics

- Panel data based on *Census of Manufactures* (Japan, 1985-2005) and *Mining and Manufacturing Survey* (Korea, 1985-2003).

- Calculation of TFP at the plant level
  - Following Good, Nadiri and Sickles (1997) and Aw, Chen and Roberts (2001), we measured each plant’s TFP level in comparison with the industry average TFP level.
  - Aggregation at industry level (54 manufacturing sectors in Japan; 34 manufacturing sectors in Korea)

\[
\ln TFP_{f,t} = (\ln Q_{f,t} - \ln Q_t) - \sum_{i=1}^{n} \frac{1}{2}(S_{i,f,t} + \bar{S}_{i,t})(\ln X_{i,f,t} - \ln X_{i,t}) \quad \text{for } t = 0,
\]

and

\[
\ln TFP_{f,t} = (\ln Q_{f,t} - \ln Q_t) - \sum_{i=1}^{n} \frac{1}{2}(S_{i,f,t} + \bar{S}_{i,t})(\ln X_{i,f,t} - \ln X_{i,t}) + \sum_{s=1}^{t} \left( \ln Q_s - \ln Q_{s-1} \right) - \sum_{s=1}^{t} \sum_{i=1}^{n} \frac{1}{2}(S_{i,s} + \bar{S}_{i,s-1})(\ln X_{i,s} - \ln X_{i,s-1}) \quad \text{for } t \geq 1.
\]
Productivity Dynamics Decomposition

• We define the industry TFP level in year $t$ as:

$$\ln TFP_t = \sum_{f=1}^{n} \theta_{f,t} \ln TFP_{f,t}$$

• We can decompose changes in industry average TFP levels into the sum of the following four factors (Foster, Haltiwanger and Krizan, 2001):

  ➢ Within effect:
  $$\sum_{f \in S} \theta_{f,t-\tau} \Delta \ln TFP_{f,t}$$

  ➢ Between effect:
  $$\sum_{f \in S} \Delta \theta_{f,t} (\ln TFP_{f,t-\tau} - \ln TFP_{t-\tau})$$

  ➢ Covariance effect:
  $$\sum_{f \in S} \Delta \theta_{f,t} \Delta \ln TFP_{f,t}$$

  ➢ Entry effect:
  $$\sum_{f \in N} \theta_{f,t} (\ln TFP_{f,t} - \ln TFP_{t-\tau})$$

  ➢ Exit effect:
  $$\sum_{f \in X} \theta_{f,t-\tau} (\ln TFP_{t-\tau} - \ln TFP_{f,t-\tau})$$
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Productivity Dynamics: Japan

5 year intervals

10 year intervals

Exit effect
Entry effect
Reallocation effect
Within effect
TFP Growth
Productivity Dynamics: Japan

- TFP growth has been declining since 1990.

- Most of the productivity decline occurred within plants.

- Plants with higher productivity tend to increase their market share and Entering plants tend to have above-average productivity levels.

- Exiting firms also tend to have above-average productivity levels, lowering aggregate productivity level. Such negative exit effects have been sizable. (In fact, most of the decrease in TFP growth during 2000-2005 can be explained by negative exit effects.)
Productivity Dynamics: Korea

5 year intervals

10 year intervals

- Exit effect
- Entry effect
- Reallocation effect
- Within effect
- TFP Growth
Productivity Dynamics: Korea

- TFP growth rate still remains high.

- Within plant productivity growth has been declining, while plant entry continues to have positive effects.

- Similar to Japan, many exiting plants have above-average productivity.

- The negative exit effect was not only sizable but also persistent.
High technology industries, such as electronics and pharmaceutical industry account for most of the productivity growth in the manufacturing sector.

The contribution of medium-high and medium low technology industries (such as chemicals, motor vehicles, iron and steel) has sharply declined since 1995.
Technology and Productivity Dynamics: Japan

Shares of Industries in TFP growth

- Low Technology Manufactures
- Medium-Low Technology Manufactures
- Medium-High Technology Manufactures
- High Technology Manufactures

Technology and Productivity Dynamics: Korea

Shares of Industries in TFP growth

- Low Technology Manufactures
- Medium-Low Technology Manufactures
- Medium-High Technology Manufactures
- High Technology Manufactures

Entry Regulation and Productivity Dynamics

- Entry Regulation and Firm Dynamics
  - Entry regulation reduces entry rate
  - Entry regulation reduces exit rate

- Firm Dynamics and Economic Performance
  - Entry raises employment and TFP growth
  - Exit raises (output and) TFP growth

(Ahn, 2006)
Firm Dynamics: Japan

Entry, Exit, and Turnover Rates
(%, annualized, 1985-2005)

Entry rate Exit rate Turnover rate


High Technology Manufactures
Medium-High Technology Manufactures
Medium-Low Technology Manufactures
Low Technology Manufactures
## Firm Dynamics: Japan

### Entry, Exit, and Turnover Rates

(\%, annualized, 1985-2005)

<table>
<thead>
<tr>
<th></th>
<th>High Technology Manufacturing</th>
<th>Medium-High Technology Manufacturing</th>
<th>Medium-Low Technology Manufacturing</th>
<th>Low Technology Manufacturing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985-1990</td>
<td>Entry rate</td>
<td>7.5</td>
<td>6.8</td>
<td>6.1</td>
</tr>
<tr>
<td></td>
<td>Exit rate</td>
<td>7.3</td>
<td>6.0</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td>Turnover rate</td>
<td>14.9</td>
<td>12.8</td>
<td>11.5</td>
</tr>
<tr>
<td>1990-1995</td>
<td>Entry rate</td>
<td>4.8</td>
<td>4.6</td>
<td>4.3</td>
</tr>
<tr>
<td></td>
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<td>7.9</td>
<td>6.0</td>
<td>5.4</td>
</tr>
<tr>
<td></td>
<td>Turnover rate</td>
<td>12.8</td>
<td>10.7</td>
<td>9.7</td>
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<td>5.9</td>
<td>6.2</td>
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Source: Author’s calculations based on *Census of Manufactures.*
Entry, Exit, and Turnover Rates

Firm Dynamics: Korea

## Firm Dynamics: Korea

### Entry, Exit, and Turnover Rates


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Source: Author’s calculations based on Mining and Manufacturing Survey.
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Major Problems in Productivity Dynamics

- **Creative destruction** plays a very important role for productivity growth and innovation by enhancing:
  - The expansion or entry of high productivity firms
  - The contraction or exit by low productivity firms

- Productivity growth driven by *creative destruction* is impeded due to:
  - High entry costs
  - High levels of taxation
  - Labor market rigidity
  - ...
## Regulatory Costs of Entry are Sizable

### Japan-Korea-USA Comparison (1999)

<table>
<thead>
<tr>
<th>Number of procedures that a start-up has to comply with in order to obtain legal status</th>
<th>Japan</th>
<th>Korea</th>
<th>USA</th>
<th>Average of 85 countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety and health</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.34</td>
</tr>
<tr>
<td>Environment</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.14</td>
</tr>
<tr>
<td>Taxes</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2.04</td>
</tr>
<tr>
<td>Employment</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>1.94</td>
</tr>
<tr>
<td>Screening</td>
<td>7</td>
<td>7</td>
<td>2</td>
<td>6.04</td>
</tr>
</tbody>
</table>

### Time (business days; a week has 5 business days and a month has 22.)

- Japan: 26
- Korea: 27
- USA: 4
- Average of 85 countries: 47.4

### Cost (share of per capita GDP 1999)

- Japan: 11.6%
- Korea: 16.3%
- USA: 0.5%
- Average of 85 countries: 47.1%

### Time + Cost (share of per capita GDP 1999)

- Japan: 22.0%
- Korea: 27.1%
- USA: 1.7%
- Average of 85 countries: 66.0%

### Dollar Amount of Time + Cost

- Japan: $7,094
- Korea: $2,298
- USA: $517
- Average of 85 countries: $5,428

### Per capita GDP 1999

- Japan: $32,230
- Korea: $8,490
- USA: $30,600
- Average of 85 countries: $8,226

## Barriers to Economic Activity

### Japan-Korea-USA Comparison (2005 and 2010)

<table>
<thead>
<tr>
<th></th>
<th>Japan</th>
<th>Korea</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease of doing business index</td>
<td>-</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>(1=most business-friendly regulations)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start-up procedures to register a business (number)</td>
<td>11</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Time required to start a business (days)</td>
<td>31</td>
<td>23</td>
<td>17</td>
</tr>
<tr>
<td>Time to resolve insolvency (years)</td>
<td>0.6</td>
<td>0.6</td>
<td>1.5</td>
</tr>
<tr>
<td>Total tax rate (%)</td>
<td>53.1</td>
<td>48.6</td>
<td>36.4</td>
</tr>
</tbody>
</table>

OECD *Product Market Regulation* Indicator

1998 and 2003

[Bar chart showing product market regulation indicators for various countries in 1998 and 2003.]
OECD *Product Market Regulation* Indicator

**Barriers to Entrepreneurship (1998 and 2003)**
OECD Product Market Regulation Indicator

2003 and 2008

2003 2008

OECD

USA GBR CAN NLD ISL DNK ESP JPN NOR FIN AUS NZL CHE HUN SWE DEU ECE OECD AUT ITA BEL PRT FRA KOR LUX CZE MEX TUR POL
World Bank *Doing Business* Indicator

**FIGURE 1.8** In the past 6 years 163 economies moved closer to the frontier in regulatory practice

Distance to frontier, 2005 and 2011

![Graph showing changes in the Distance to Frontier index from 2005 to 2011](image-url)
Manufacturing to Services

- Services account for **over 60% of total economic activity** in most OECD countries.
  - Service sector growth has outpaced overall economic growth in the OECD area, a trend which is expected to continue.

- Services are **a growing source of employment** in the OECD area
  - Demand for highly skilled white-collar workers is rising, although services are also an important source of low-skilled jobs.

- **Increased trade and investment in services** is an important vehicle for growth and competition.
  - Technological advances are increasing the tradability of services.
  - Liberalization of markets is providing an environment more conducive to international competition.

(OECD, 2000)
Policy Issues for Services

- The role of services in economic growth and job creation calls for greater government attention to improving services’ performance.
  - This implies reforms to domestic regulation, liberalization of international trade and investment, and a reorientation of relevant government programs to meet the needs of service industries more effectively.

- Many of the barriers to service sector development are not found at the border between countries, but are rather of a domestic nature.
  - Domestic regulation is one of the principal factors limiting growth and competition in services.

- Services continue to be poorly covered in most basic statistics.
  - To improve understanding of service processes and performance, and to design policies that are better suited to the characteristics of the service sector, better and more comprehensive data are needed.

(OECD, 2000)
Manufacturing to Services

Service Sector relative to Total Economy

- Germany
- Japan
- Korea
- US


Value added vs Employment
Investment and Innovation in Services

Service Sector relative to Total Economy

- **Germany**
- **Japan**
- **Korea**
- **US**

- **Investment**
- **R&D**

Year:
- 1980
- 1990
- 2000
- 2010

Service Sector relative to Total Economy