The economic geography of Japanese industrialization (1800-2010)

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Outline

1. The age of cottage industry (1800-1874)
2. The gradual shift to manufacturing (1874-1914)
3. The emergence of an industrial power (1914-1950)
1. The age of cottage industry (1800-1874)

Modest growth rate of output, but some technical change (Odaka 1996)
- Steady increase in cotton processing between ca 1800 and 1850 (stagnation between 1850 and 1875)
- Steady increase of iron production between ca 1800 and 1830; technological shift in the mid-19th century from old (nanban 南蛮) to modern European technology

Political and economic fragmentation; conducive to the development of cottage industry during the Tokugawa period, particularly in the late 18th and early 19th century (estimates for 1804 and 1846)
- Cottage industry in all regions; but no more that 5% of GDP in most regions
- Concentration in the Edo (Tokyo) and Osaka areas (around 15% of GDP)
- Some degree of regional specialization (based on data for 1874)

After the opening to international trade (1858),
- winners: port-cities (Yokohama and Kobe) and silk processing areas (Kanto and Tosan)
- losers: rural cotton processing areas of western Japan
Figure 1. Value added per resident in the secondary sector in rice equivalent (kg)
Figure 2. Value added in the secondary sector in % of GDP in 1846
Figure 3. Regional specialization in 1874 (% of total output value in manufacturing)
2. The gradual shift to manufacturing (1874-1914)

In most prefectures (exception of the most urbanised)
- Labour input shares increasing much faster in the secondary sector than in the tertiary sector in Meiji I (1874-1890): labour intensive industrialisation
- But labour input shares increasing slower in the secondary sector than in the tertiary sector in Meiji II (1890-1909): gradual shift toward a more physical and human capital intensive industrialisation

Regional migrations: probably limited in Meiji I
Increasing in Meiji II: enhanced by the development of the railway network, particularly local lines (Saito 1998).
Figure 4: Increase of labour input share in the secondary and the tertiary sectors (1874-1890, in percentage points)

Source: Calculation based on underlying data in Fukao et al. (2015)

Note: Prefectures are ordered by labour productivity of each prefecture in 1909.
Figure 5: Increase of labour input share in the secondary and the tertiary sectors (1890-1909, in percentage points)

Source: Calculation based on underlying data in Fukao et al. (2015)

Note: Prefectures are ordered by labour productivity of each prefecture in 1909.
Regional productivity gaps and concentration

Small regional gaps in labour productivity in the secondary sector ca 1874

Secondary sector:
- gap increasing in Meiji I (1874-1890): modern manufacturing techniques with high labour productivity only in a few prefectures
- but stable in Meiji II (1890-1909): diffusion of best practices (e.g. silk reeling) and imported technologies (e.g. British cotton spinning technology)

Share of manufacturing increasing rapidly after 1890,
- in Osaka and Tokyo
- in a number of new industrial districts (e.g. mechanical industry and/or shipbuilding in Aichi and Fukuoka)
- in silk reeling district of eastern Japan (in particular in Nagano and Yamanashi prefectures)
3. The emergence of an industrial power (1914-1950)

Quantitative investigation of regional gaps in labour productivity during the Japanese manufacturing catch-up based on recent estimates (Fukao et al. 2015):

- Value added for 9 manufacturing subsectors: food, textile, wood, printing, chemicals, ceramics, metals, machinery, and misc. manuf. (available for 1874, 1890, 1909, 1925, 1935, 1940 at the prefecture level).

- Labour force (adjusted for by-employment) in these 9 subsectors (prefecture level for 1909, 1925, 1935, and 1940)

Methodology:

1) Calculation of regional gap in productivity: technology frontier vs. rest of the country

2) Calculation of indicators of changes in prefectural ranking (correlation matrices; Spearman's rho and Person’s index)
Labour productivity in the frontier (yf) and in other regions (yb), and ratio yf/yb (frontier: top 5 prefectures; yf and yb as indices, 1 for yb in 1909)

Figure 6: changes in regional labour productivity gaps
Regional productivity levels in manufacture: correlation matrix and ranking stability

<table>
<thead>
<tr>
<th></th>
<th>1925</th>
<th>1935</th>
<th>1940</th>
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<tbody>
<tr>
<td>1909</td>
<td>0.94</td>
<td>0.72</td>
<td>0.63</td>
</tr>
<tr>
<td>1925</td>
<td>-</td>
<td>0.83</td>
<td>0.75</td>
</tr>
<tr>
<td>1935</td>
<td>-</td>
<td>-</td>
<td>0.94</td>
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Table 1: correlation matrix of regional productivity levels

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</thead>
<tbody>
<tr>
<td>Spearman’s rho</td>
<td>0.92</td>
<td>0.90</td>
<td>0.92</td>
<td>0.76</td>
</tr>
<tr>
<td>p-value</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Pearson</td>
<td>0.92</td>
<td>0.90</td>
<td>0.92</td>
<td>0.76</td>
</tr>
</tbody>
</table>

Table 2: ranking stability of regional productivity levels
Changes in the technological frontier

List of bottom 10 and top 10 relatively stable, but instability in ranking.
Top 5 (“frontier”) also instable; e.g. manufacturing as a whole:
1909: 1 Tokyo, 2 Osaka, 3 Hyogo (Kobe), 4 Hokkaido, 5 Aichi (Nagoya)
1925: 1 Osaka, 2 Tokyo, 3 Hyogo, 4 Kanagawa (Yokohama), 5 Hokkaido
1935: 1 Kanagawa, 2 Fukuoka (north Kyushu), 3 Osaka, 4 Tokyo, 5 Yamaguchi
1940: 1 Fukuoka, 2 Yamaguchi (west Honshu), 3 Kanagawa, 4 Hyogo, 5 Tokyo

Rapid relative decline of Kyoto prefecture, former core area of Japanese proto-industry (high-quality tea, traditional handicraft, and textile products): rank 7 in 1909, rank 9 in 1925, rank 16 in 1935, rank 18 in 1940.
Regional gaps by manufacturing subsector

Decline of regional gaps (ratio $y_F/y_B$) in all subsectors, particularly between 1909 and 1925 (strong demand for manufactured goods during WWI)

Figure 7: regional gaps in productivity level (ratio $y_F/y_B$)
4. High speed growth and its aftermath 1950-2010

Rapid regional convergence occurred from the 1950s to the 1970s

Figure 2.1 Long-term trends in the coefficient of variation of per capita GPP (in local and national prices)
Japan continued to have a large productivity gap across sectors. Rapid industrialization in rural Japan in the high-growth era must have contributed to the regional convergence.
Diverse trajectories of structural transformation

Source: Paul and Fukao (2017)
Note: By-employment is considered while calculating man-hour input shares. The primary sector consists of agriculture, forestry and fisheries. See Fukao et al. (2015) for a detailed discussion on the data estimation methodology.
In 1955, manufacturing activity was still concentrated in rich prefectures.
From 1955 to 1970, the value added share of the manufacturing sector increased substantially in middle-income regions.
From 1970 to 1990, the CV did not decline substantially.
1955, weighted CV of labor productivity in the manufacturing sector=0.29 (weight=number of workers in the manufacturing sector)
From 1955 to 1970, the labor productivity gap across regions within the manufacturing sector slightly increased.
But from 1970 to 1990, the labor productivity gap across regions within the manufacturing sector declined.
Labor productivity differences across prefectures declined, because...

(1) Manufacturing activities spread to middle-income regions during the period of 1955-70.

(2) In contrast, within-manufacturing-sector differences in labor productivity across prefectures declined during the period of 1970-90.
Decomposition of Labor Productivity Differences between top 20% and bottom 20% of prefectures: 1970-2008

\[
\ln(\text{labor productivity of top 20%/bottom 20%}) = \text{differences of industrial structure} + \text{within-industry differences}
\]

(1) contribution of TFP
(2) contribution of capital-labor ratio
(3) contribution of labor quality

We use R-JIP database, which comprises, for the period 1970-2008, various types of annual data necessary for estimating total factor productivity (TFP) in 10 manufacturing and 13 non-manufacturing industries covering each prefecture’s economy as a whole.
## Factor decomposition of labor productivity differences

<table>
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<tr>
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<th>1970</th>
<th>1990</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Differences in labor productivity</td>
<td>0.642</td>
<td>0.454</td>
<td>0.435</td>
</tr>
<tr>
<td>(100.0)</td>
<td>(100.0)</td>
<td>(100.0)</td>
<td></td>
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<tr>
<td>Differences in industrial structure</td>
<td>0.275</td>
<td>0.119</td>
<td>0.102</td>
</tr>
<tr>
<td>(42.8)</td>
<td>(26.3)</td>
<td>(23.5)</td>
<td></td>
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<tr>
<td>Within-industry differences in labor</td>
<td>0.367</td>
<td>0.335</td>
<td>0.333</td>
</tr>
<tr>
<td>productivity</td>
<td>(57.2)</td>
<td>(73.7)</td>
<td>(76.5)</td>
</tr>
<tr>
<td>Contribution of TFP</td>
<td>0.162</td>
<td>0.205</td>
<td>0.299</td>
</tr>
<tr>
<td>(25.3)</td>
<td>(45.2)</td>
<td>(68.7)</td>
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<tr>
<td>Contribution of capital–labor ratio</td>
<td>0.149</td>
<td>0.067</td>
<td>0.010</td>
</tr>
<tr>
<td>(23.2)</td>
<td>(14.7)</td>
<td>(2.3)</td>
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<tr>
<td>Contribution of labor quality</td>
<td>0.109</td>
<td>0.103</td>
<td>0.069</td>
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<tr>
<td>(16.9)</td>
<td>(22.7)</td>
<td>(15.9)</td>
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<tr>
<td>Measurement error</td>
<td>-0.053</td>
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<td>-0.045</td>
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<td>(-8.2)</td>
<td>(-8.8)</td>
<td>(-10.4)</td>
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</tbody>
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**Fukao et al. (2015) Regional Inequality and Industrial Structure in Japan: 1874-2008.**
Labor productivity differences between the top and bottom 20% declined, because...

(1) Industrial structures in the top and bottom prefectures became similar.

(2) In contrast, within-industry differences in labor productivity across prefectures declined only marginally.

(3) The decomposition of within-industry differences reveals opposite/offsetting movements of TFP and capital-labor ratio.