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Industrial Structure, Prefectural Inequality, and Convergence in Pre-war Japan (1874-1940)

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Abstract

The aim of this paper was to examine changes in prefectural income inequality and industrial structure during the pre-war period (1874-1940). The findings of the analysis can be summarized as follows. Prefectural income inequality, which increased in the early stages of Japan's modern economic development, was mainly due to within-industry differences in labor productivity. From 1874 to 1890 labor productivity differences in the manufacturing, mining, and construction sector increased considerably. Although further analyses are necessary to draw firmer conclusions, it appears that the rise of major industrial centers such as Osaka during this period played a key role. Nevertheless, it is important to note that industrialization was not confined to urban centers, but also took place in other (rural) regions, where increases in employment in the manufacturing sector kept pace with the leading areas. In this sense, it could be said that industrialization during this period was not regionally biased.

Moreover, regional inequality increased only moderately in the following period from 1890 to 1909, when the industrialization process had gathered steam. The reason is that although differences in labor productivity due to differences in industrial structure increased during this period, within-industry productivity differences in manufacturing and services did not rise further or in fact declined. A likely reason, it was suggested, was active investment in rural areas as part of the "regional industrialization ideology," which mitigated labor productivity differences.

Overall, the analysis in this paper suggests that changes in industrial structure and in within-industry differences in labor productivity played a key role in shaping trends in spatial income inequality in Japan.

Industrial Structure, Prefectural Inequality, and Convergence in Pre-war Japan (1874-1940) *

Tokihiko Settsu**

1 Introduction

The analysis of inequality in per capita gross prefectural product (GPP) in Bassino et al. (2015) showed that such inequality was relatively low at the start of Japan's modern economic growth in the early years of the Meiji period. However, prefectural inequality (as measured by the coefficient of variation, CV, in per capita GPP) increased from 1874 to 1890 during the first so-called "enterprise boom" (*kigyo bokko*, 1886–1890) and continued to rise at a somewhat slower pace during the second and third enterprise booms (1895–1900 and 1905–1910) between 1890 and 1909. The trend reversed during World War I and the subsequent recession in the following subperiod from 1909 to 1925, but inequality rose again during the period following decade, which was characterized by economic turmoil and high inflation due to expansionary fiscal and monetary policies from 1931 to 1936 under finance minister Korekiyo Takahashi, before declining between 1935 and 1940 reflecting the transition to a wartime economy.[1]

Following the hiatus of World War II, prefectural inequality declined rapidly during the high-speed growth era from 1950 until the early 1970s, but then increased again somewhat during the period of stable growth during the late 1970s/early 1980s as well as the bubble economy in the second half of the 1980s. Prefectural inequality declined again during the first half of the 1990s following the burst of the bubble economy and has remained more or less unchanged since the mid-1990s. Overall, therefore, regional inequality in Japan, as measured by the population-weighted CV in GPP per capita, more or less follows an inverted U curve with some fluctuations, with inequality peaking sometime during the first few decades of the 20th century (see Figure 2.1 in Bassino et al. 2015).

The aim of this paper is to examine the factors underlying these trends in prefectural inequality focusing on prefectural differences in industrial structure and developments therein, focusing in particular on the pre-war period. However, before looking at prefectural differences in industrial structure, it is useful to provide an overview of changes in Japan's

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[1] Why prefectural income inequality declined during the period 1909–1925, i.e., the period comprising World War I, is of considerable interest and deserves further research in the future.

industrial structure overall, which we do in the next section (Section 2). This is followed by an examination of prefectural differences in industrial structure (Section 3). Next, Section 4 presents a decomposition of differences in GPP per capita into prefectural differences in industrial structure and differences in labor productivity within the same industry. Finally, Section 5 provides a summary of the findings of this paper.

3.2 Long-term trends in Japan's industrial structure

To gain a sense of trends in Japan's industrial structure over the course of its economic development, Tables 1(a) to (c) provide various indicators for our benchmark years for the country as a whole. While the tables present data for the entire period from 1874 to 2008, in the discussion here we will confine ourselves primarily to the pre-war period. Let us begin by looking at sectoral shares in value added overall (Table 1(a)). As can be seen, at the start of our observation period in 1874, the primary sector accounted for roughly 60% of output, the secondary sector for 10%, and the tertiary sector for 30%, indicating that at the start of the Meiji period Japan was still an agrarian economy. However, the primary sector share declined steadily throughout the pre-war period, falling to 18% in 1940 and, conversely, the secondary sector share gradually rose to more than 40%, while the share of the tertiary sector remained relatively stable in a range of 30–40%. Although the primary sector share immediately after the war was somewhat higher than in 1940, it then continued to fall rapidly throughout the rest of the period, so that by 2008, the primary sector accounted for less than 2% of national output. On the other hand, the output shares of the secondary and tertiary sectors expanded considerably during the high-speed growth era. However, whereas the secondary sector share peaked sometime around 1970 and subsequently contracted, the share of the tertiary sector continued to increase, so that in 2008 it accounted for almost 70% of total value added.

Looking at labor force shares (Table 1(b)), the large role played by the primary sector at the start of our observation period in 1874 is even more pronounced, with the sector accounting for 71% of employment compared to 13% for the secondary and 16% for the tertiary sector. In addition, subsequent trends also differ somewhat from those in the value added shares: while the share of the primary sector declines, the shares of the secondary and tertiary sectors increase at more or less the same pace. Meanwhile, in the post-war period, the expansion of the tertiary sector share is more pronounced than on a value added basis.

Finally, Table 1(c) shows labor productivity levels and growth rates measured in terms of value added per gainfully occupied person based on the data in Tables 1(a) and (b). In this context, it is important to note that the data on the gainfully occupied population in Table 1(b) take by-

employment into account.[2] The process of rural industrialization during the latter half of the Edo period meant that many farm households were engaged in by-employment in production activities in the secondary sector, such as silk-reeling and weaving, and this pattern continued after the Meiji Restoration.[3] This means that if we were to classify gainfully occupied persons simply based on their principal occupation, the labor input for goods produced through such by-employment would not be measured, so that labor productivity in the primary sector would be underestimated, while labor productivity in the secondary and tertiary sectors would be overestimated.[4]

Looking at the results in Table 1(c), the first thing to note is that labor productivity in the primary and secondary sectors in 1874 was almost identical, while that in the tertiary sector was more than twice as high as in the other two sectors. Moreover, even in 1890, when industrialization was well underway, labor productivity in manufacturing and construction was still essentially the same as in the primary sector (agriculture, forestry and fisheries). This indicates that, as already argued by Saito (2008, 2013), Sugihara (2013), and Gerschenkron's (1962) relative backwardness hypothesis, which suggests that more backward countries experience larger labor productivity differences between traditional and modern industries in the early stages of industrialization, does not hold in the case of Japan, which followed a path of labor-intensive industrialization based on the development of rural industry during the Edo period.

Let us consider developments in labor productivity during the pre-war period in more detail. Highlighting that employment in agriculture during much of the pre-war period remained constant at 14 million, Hayashi and Prescott (2008) have suggested that Japan was slow to make the transition out of agriculture due to institutional barriers in the form of social norms, namely the desire of farmers that one of their children – typically the first-born son – succeed them and

[2] That being said, it should be noted that the way by-employment is taken into account differs for the pre-war and post-war periods. For the pre-war period, the gainfully occupied population is calculated by assuming that those engaged in by-employment divide their time equally between their principal occupation and their by-employment, and they are counted as "half a worker" in each sector in which they are employed. This means that there is no double-counting of gainfully occupied persons (Saito and Settsu, 2010). On the other hand, for the post-war period, we used the employment figures of the JIP Database, where no such adjustments are made, so that persons employed in two different sectors are counted twice when summing up the total number of gainfully occupied persons across sectors. This means that we would underestimate labor productivity if we used the employment data as they are. However, since, as explained by Fukao and Miyagawa (2008), labor productivity in the JIP Database is calculated on a man-hour basis, we can allocate double-counted persons using detailed information on their working time, allowing us to eliminate this problem.

[3] For a further discussion of rural industrialization (proto-industrialization) during the Edo period, see Appendix 1.

[4] See Saito and Settsu (2010) for details. It should be noted that this is the case because in Japan the typical pattern was for those principally occupied in farming to have by-employment in another sector. If the pattern were different and many who were principally employed in the secondary or tertiary sector had by-employment in agriculture, the implications for the estimation of labor productivity would be different.

continue the *ie* (household). Specifically, employing a two-sector model consisting of agriculture and the rest of the economy, they argue that this barrier impeded economic growth and that in its absence pre-war GNP per capita would have been 32% higher. However, their assumption that farmers work in agriculture and non-farmers work in other sectors of the economy ignores the widespread existence of by-employment. The wage gap between agriculture and the rest of the economy derived from the model (especially at the start of economic development) likely would be smaller than assumed in their study if by-employment were taken into account. Moreover, given the findings on inter-sectoral labor productivity differences above, the key issue appears to be not the insufficient movement of labor from agriculture to non-agricultural sectors but from other sectors to the tertiary sector.[5]

Finally, let us examine labor productivity growth in each sector. In the primary sector, labor productivity increased at an annual average rate of 1.2% from 1874 to 1890. Focusing on agriculture and forestry in the subsequent periods, labor productivity growth accelerated to 2.1% between 1890 and 1909, before slowing somewhat to 1.4% between 1909 and 1925. The reason for these increases in productivity likely is the diffusion of new farming methods and the development of the sericulture industry in line with growing exports of filature. Turning to the secondary sector, labor productivity grew at an annual rate of 1.4% in 1874–1890 (manufacturing, construction, and mining), 4.2% in 1890–1909 (manufacturing and construction), and 3.5% in 1909–1925 (again, manufacturing and construction), suggesting that productivity growth jumped after 1890. On the other hand, the picture in the tertiary sector is very mixed. Productivity growth in domestic trade and services remained below 1% for most of the pre-war period; in stark contrast, transport, communication, and utilities registered extremely high productivity growth rates of 8.6% in 1890–1909 and 5.9% in 1909–1925. This high productivity growth likely reflects the rapid progress in infrastructure development such as the building and improvement of roads and railways.

Productivity growth slowed sharply in the period from 1925 to 1935, which includes the Great Depression, in all industries/sectors except for mining as well as manufacturing and construction (in fact, productivity growth turned negative in agriculture and forestry as well as domestic trade

[5] As argued by Obi (1971; also see Saito, 2008), a farmer's decision whether to quit farming likely depends on the farmer's household income, i.e., including income other than farming income. This means that, typically, one would employ a model that considers household income and in which labor is allocated such that agricultural and non-agricultural wages are equalized. This, in turn, implies that a model which does not do this, such as that employed by Hayashi and Prescott (2008), does not really lend itself to sufficiently examining the causes why the transition out of agriculture did not occur. A study presenting ample evidence on how much non-agricultural income farm households could earn in the pre-war period that could be used for such an analysis is provided by Sato (2002: chapter 11). Meanwhile, Masui (1969), whom Hayashi and Prescott (2008) also cite, argues that it is only during the post-war period that factory workers' wages came to clearly exceed the cost of leaving agriculture for the household head and the heir (eldest son), and that when it did, farmers did leave agriculture and the transition out of agriculture proceeded rapidly (see Tables 1 to 4 in Masui, 1969).

and services). This likely reflects the slump in raw silk thread prices in the United States during the Great Depression and the large shock to the rural economy this imposed.[6]

Taking a brief look at the post-war period, we find that manufacturing and transport, communication, and utilities registered high rates of productivity growth of 7% and 8% respectively during the high-speed growth era until ca. 1970, but productivity growth almost across the board thereafter. Particularly noteworthy is the slow rate of productivity in domestic trade and services from 1990 to 2008 of only 0.5% annually.[7]

Table 1 Value added, employment, and labor productivity by sector

(a) Value added (output) by industry (in 1,000 yen for 1874–1940 and million yen for 1955–2008)

GDP and sectoral share in current prices

	GDP	Agriculture	Forestry	Fisheries	Mining	Manufacturing	Construction	Domestic trade and service industries	Transport, communication, and utilities	Total
						Sectoral Share				
1874	728,724	49.31%	7.16%	2.15%	0.57%	7.45%	2.88%	30.48%		100.00%
1890	1,224,063	37.77%	5.16%	1.56%	1.12%	12.20%	2.97%	36.91%	2.30%	100.00%
1909	4,028,122	27.20%	4.84%	1.53%	2.57%	16.55%	3.99%	36.55%	6.77%	100.00%
1925	18,154,468	21.88%	3.22%	1.49%	1.95%	19.21%	4.84%	35.07%	12.35%	100.00%
1935	19,238,524	13.30%	1.93%	1.19%	2.62%	27.02%	5.32%	36.30%	12.32%	100.00%
1940	38,021,539	12.59%	3.64%	1.31%	3.52%	31.59%	7.39%	29.19%	10.77%	100.00%
1955	8,286,675		18.58%		1.96%	32.10%	4.59%	32.84%	9.93%	100.00%
1970	68,911,619		6.02%		0.89%	37.95%	8.26%	37.14%	9.74%	100.00%
1990	406,485,348		2.46%		0.26%	28.52%	10.51%	49.05%	9.20%	100.00%
2008	442,078,644		1.47%		0.07%	22.86%	6.64%	59.73%	9.24%	100.00%
In constant prices (1874–1940: average of prices in 1934–1936; 1955–2008: prices in 2000)										
1874	3,946,854	1,466,650	212,845	63,971	13,242	211,138	57,821	1,921,187		
1890	5,279,794	1,626,737	217,000	75,062	34,243	459,757	127,300	2,666,994	72,700	
1909	8,201,001	2,235,884	305,100	79,416	149,552	1,009,122	291,000	3,676,427	454,500	
1925	14,597,585	2,725,099	361,400	179,656	282,410	2,439,079	594,000	6,115,942	1,900,000	
1935	19,010,553	2,541,677	381,500	228,739	417,423	5,247,644	1,028,000	6,680,569	2,485,000	
1940	24,360,850	2,461,313	584,400	220,822	633,127	7,229,061	1,408,000	8,831,128	2,993,000	
1955	53,883,712		8,039,866		304,741	8,108,567	6,221,177	28,326,390	2,882,972	
1970	191,606,178		8,432,721		961,710	47,407,917	32,156,827	86,081,450	16,565,553	
1990	415,148,700		9,282,027		914,571	106,059,520	48,780,802	213,249,876	36,861,903	
2008	523,620,729		8,142,102		315,093	149,840,662	30,202,276	281,580,085	53,540,511	

Note: Okinawa is excluded in 1955 and 1970.

(b) Gainfully occupied persons (taking by-employment into account)

[6] Moreover, as shown by Settsu (2006), during the period of the Great Depression, excess labor was absorbed in the urban small commerce sector, which likely contributed to the decline in productivity growth in the service sector.

[7] This point will be discussed in greater detail in Chapter 5 of Bassino et al. (2015).

Total number of persons and sectoral share

	Total number of persons	Agriculture and forestry	Fisheries	Mining	Manufacturing and construction	Commerce	Other services	Transport, communication, and utilities	Total	Total population
1874	21,745,206	70.96%		12.71%			16.33%		100.00%	34,840,434
1890	23,263,244	58.25%	1.74%	0.63%	20.33%	9.92%	6.58%	2.54%	100.00%	39,876,027
1909	23,299,661	53.76%	2.28%	1.36%	19.95%	12.18%	7.36%	3.12%	100.00%	48,947,737
1925	27,217,303	44.94%	1.79%	1.33%	22.96%	15.89%	8.76%	4.32%	100.00%	59,985,602
1935	31,596,012	41.06%	1.75%	1.17%	23.48%	17.84%	11.00%	3.70%	100.00%	69,466,361
1940	33,275,036	39.03%	1.57%	2.05%	26.35%	16.25%	10.53%	4.23%	100.00%	71,868,772
1955	40,763,353	41.35%		1.09%	23.38%	11.75%	17.45%	4.98%	100.00%	89,270,945
1970	54,259,458	19.86%		0.43%	33.95%	15.48%	24.13%	6.15%	100.00%	103,725,580
1990	64,262,899	8.79%		0.15%	32.76%	16.22%	35.76%	6.31%	100.00%	123,608,423
2008	64,202,212	5.01%		0.06%	25.39%	14.98%	48.13%	6.42%	100.00%	127,692,273
Annual growth rate in the number of gainfully occupied persons										
1874–1890	0.42%	-0.63%		3.55%			1.38%			0.84%
1890–1909	0.01%	-0.41%	1.44%	4.00%	-0.09%	1.09%	0.60%	1.08%		1.08%
1909–1925	0.97%	-0.15%	-0.53%	0.84%	1.85%	2.64%	2.07%	3.02%		1.27%
1925–1935	1.49%	0.59%	1.25%	0.26%	1.72%	2.65%	3.76%	-0.08%		1.47%
1935–1940	1.04%	0.02%	-1.09%	12.17%	3.34%	-0.84%	0.16%	3.72%		0.68%
1940–1955	1.35%	1.48%		-2.84%	0.55%	-0.80%	4.72%	2.44%		1.45%
1955–1970	1.91%	-2.98%		-4.28%	4.39%	3.74%	4.07%	3.32%		1.00%
1970–1990	0.85%	-3.23%		-4.32%	0.67%	1.08%	2.81%	0.97%		0.88%
1990–2008	-0.01%	-3.13%		-4.93%	-1.42%	-0.45%	1.64%	0.09%		0.18%

Notes: Utilities are included in manufacturing before 1940. Other services consist of public administration, self-employed professionals, domestic servants, etc. Growth rates are calculated as log differences. Okinawa is excluded in 1955 and 1970.

(c) Labor productivity (output per gainfully occupied person; in yen for 1874–1940; in 1,000 yen for 1955–2008)

Current prices

	All industries	Agriculture	Forestry	Fisheries	Mining	Manufacturing	Construction	Domestic trade and service industries	Transport, communication, and utilities
1874	34		28			29		63	
1890	53	39		39	93	39		118	48
1909	173	103		36	327	178		323	375
1925	667	373		127	982	699		949	1,906
1935	609	226		489	1,360	839		766	2,031
1940	1,143	475		439	1,965	1,691		1,245	2,912
1955	203		91		365	319		229	406
1970	1,270		385		2,609	1,729		1,191	2,012
1990	6,325		1,771		10,788	7,535		5,968	9,229
2008	6,886		2,013		7,161	7,997		6,517	9,918
Relative productivity level (all industries=1)									
1874	1.00		0.83			0.86		1.87	
1890	1.00	0.74		0.74	1.76	0.75		2.24	0.90
1909	1.00	0.60		0.21	1.89	1.03		1.87	2.17
1925	1.00	0.56		0.19	1.47	1.05		1.42	2.86
1935	1.00	0.37		0.80	2.23	1.38		1.26	3.33
1940	1.00	0.42		0.38	1.72	1.48		1.09	2.55
1955	1.00		0.45		1.79	1.57		1.12	2.00
1970	1.00		0.30		2.05	1.36		0.94	1.58
1990	1.00		0.28		1.71	1.19		0.94	1.46
2008	1.00		0.29		1.04	1.16		0.95	1.44

(c) Labor productivity (output per gainfully occupied person; in yen for 1874–1940; in 1,000 yen for 1955–2008) (contd.)

Constant prices (1874–1940: average of prices in 1934–1936; 1955–2008: prices in 2000)

	All industries	Agriculture	Forestry	Fisheries	Mining	Manufacturing	Construction	Domestic trade and service industries	Transport, communication, and utilities
1874	182		113			102		541	
1890	227	136		186	232	124		695	123
1909	352	203		149	474	280		808	626
1925	536	252		368	781	485		911	1,615
1935	602	225		414	1,126	846		733	2,128
1940	732	235		422	929	985		991	2,129
1955	1,322		477		685	1,504		2,380	1,421
1970	3,531		783		4,107	4,319		4,005	4,963
1990	6,460		1,643		9,260	7,355		6,383	9,094
2008	8,156		2,531		7,748	11,043		6,949	12,994
Annual growth rate									
1874–1890	1.40%		1.23%			1.38%		0.84%	
1890–1909	2.31%	2.10%		-1.14%	3.76%	4.28%		0.79%	8.57%
1909–1925	2.63%	1.36%		5.64%	3.13%	3.45%		0.75%	5.92%
1925–1935	1.15%	-1.13%		1.16%	3.65%	5.55%		-2.18%	2.76%
1935–1940	3.92%	0.80%		0.38%	-3.84%	3.05%		6.03%	0.00%
1940–1955	-0.65%		-0.68%		1.68%	-0.10%		-1.30%	-0.19%
1955–1970	6.55%		3.30%		11.94%	7.03%		3.47%	8.34%
1970–1990	3.02%		3.71%		4.07%	2.66%		2.33%	3.03%
1990–2008	1.29%		2.40%		-0.99%	2.26%		0.47%	1.98%

Notes: Okinawa is excluded in 1955 and 1970. The growth rates for 1940–1955 are based on Mizoguchi (2003).

3 Prefecture-level industrial structures

3.1 Trends in prefectures' GPP by industry

Having looked at changes in Japan's industrial structure overall, let us now examine developments in prefectures' GPP by industry. To this end, Figure 1 shows the gross value added per capita in each prefecture broken down by industry relative to the gross value added per capita in Japan as a whole (Japan=1). We saw earlier that in 1874 the primary sector (agriculture, forestry, and fisheries) accounted for the overwhelming majority of output in Japan overall, and this is also the case for most prefectures. However, taking a closer look, the figure indicates that wealthier prefectures such as Tokyo and Osaka tended to have larger tertiary sector shares, and correlation analysis shows that, as a general rule, prefectures with a high gross value added per capita tended to have a large tertiary sector share.[8] Exceptions to this rule are Gunma, Shiga, Nara, Wakayama, Yamaguchi, and Kochi, where the share of the primary sector was larger than that of the tertiary sector, but per capita value added was nevertheless relatively high. However, the contribution of the primary sector to per capita value added in these prefectures subsequently declined (with the exception of Miyazaki in 1890), while the share of manufacturing industry expanded.

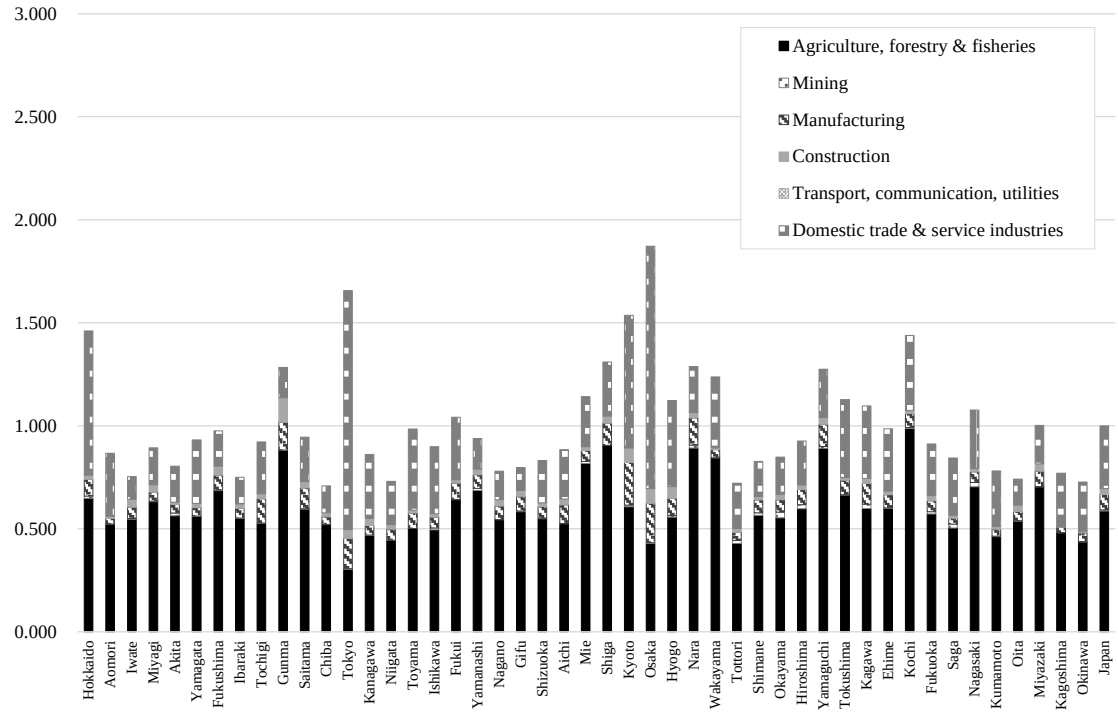
In fact, the years from 1874 to 1890 are when industrialization in Japan gathered considerable steam – despite, or maybe because, of considerable economic and political upheaval during this period. During the latter half of the 1870s, Japan experienced severe inflation as a result of the issuance of notes to raise funds for the government's industrial development policy and to cover the war expenditure to quell the 1877 Satsuma Rebellion. However, from the early 1880s, the government embarked on deflationary policies under finance minister Masayoshi Matsukata. While these brought ruin to many small and medium-scale farmers, leading to a growing concentration of farmland among large owners, they also created a pool of wage laborers to provide the necessary workforce for industrialization. The deflationary policies bore fruit in the mid-1880s and Japan started to embark on full-fledged industrialization. In the next subsection, we will consider how this industrialization process affected prefectural income inequality.[9]

Figure 1 Per capita value added and industrial structure (based on local prices, Japan=1)

(a) 1874

[8] The correlation coefficients are 0.53 for 1874, 0.60 for 1890, 0.74 for 1909, 0.67 for 1925, 0.34 for 1935, and 0.12 for 1940, indicating that the correlation first increased before gradually becoming weaker over time.

[9] Figures of prefectures' GPP by industry for the post-war period are not shown to conserve space, but are available from the authors on request.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Ibaraki
Tochigi
Gunma
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Oita
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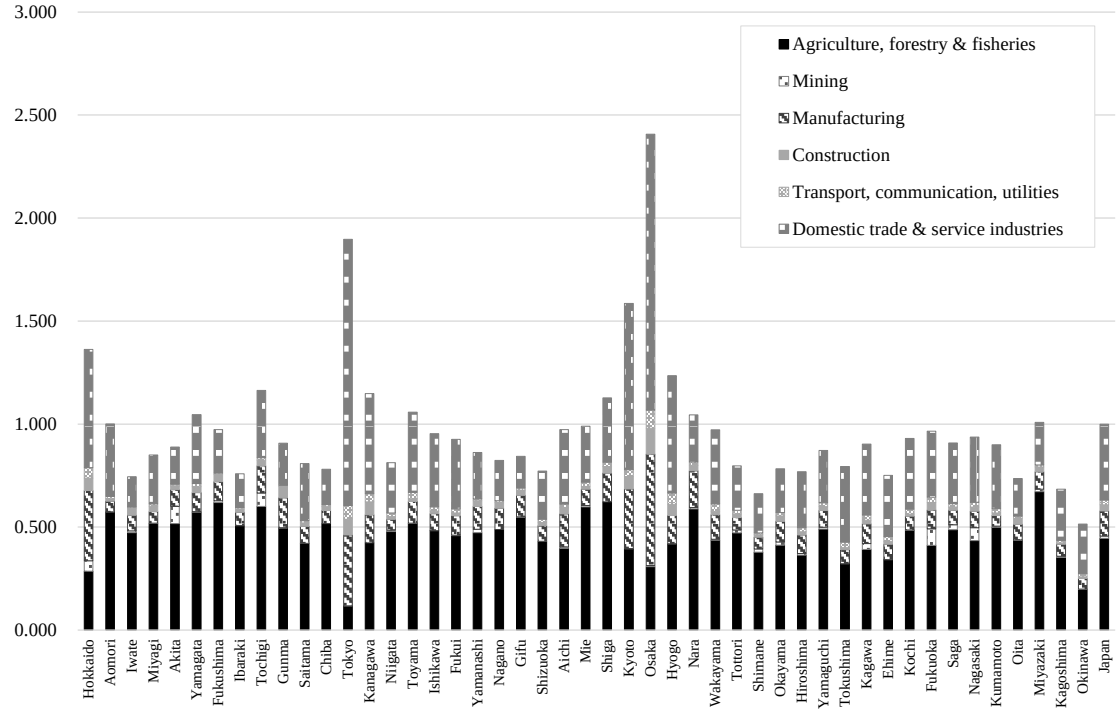
Kagoshima
Okinawa
Japan

(b) 1890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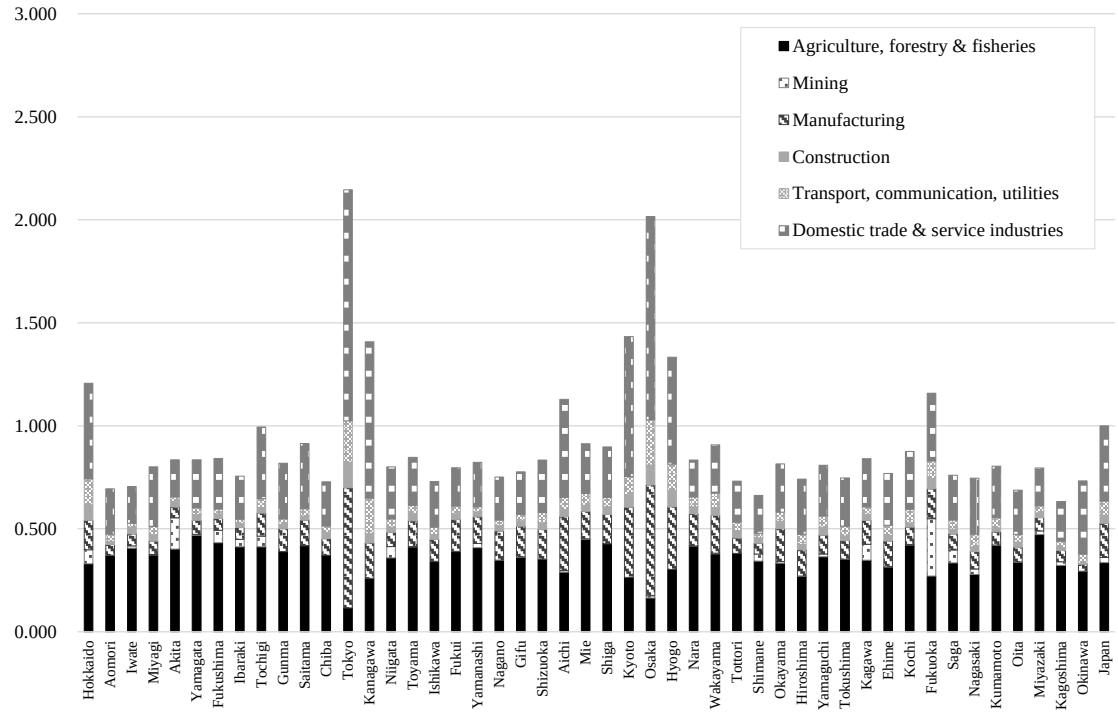
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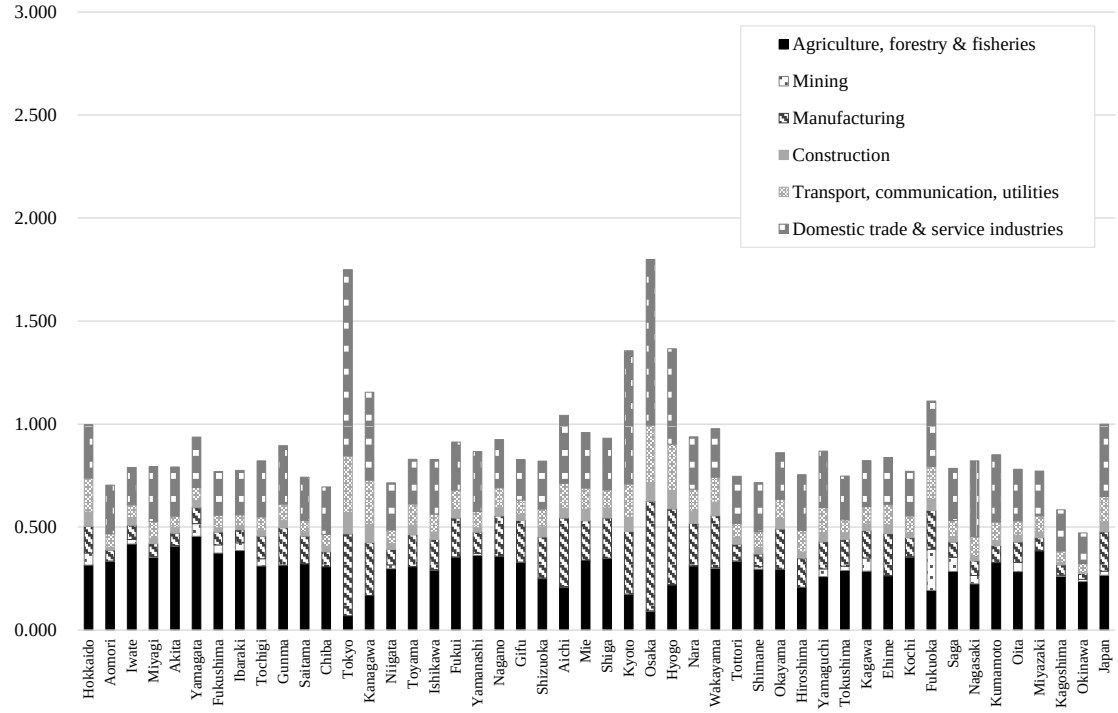
(d) 1925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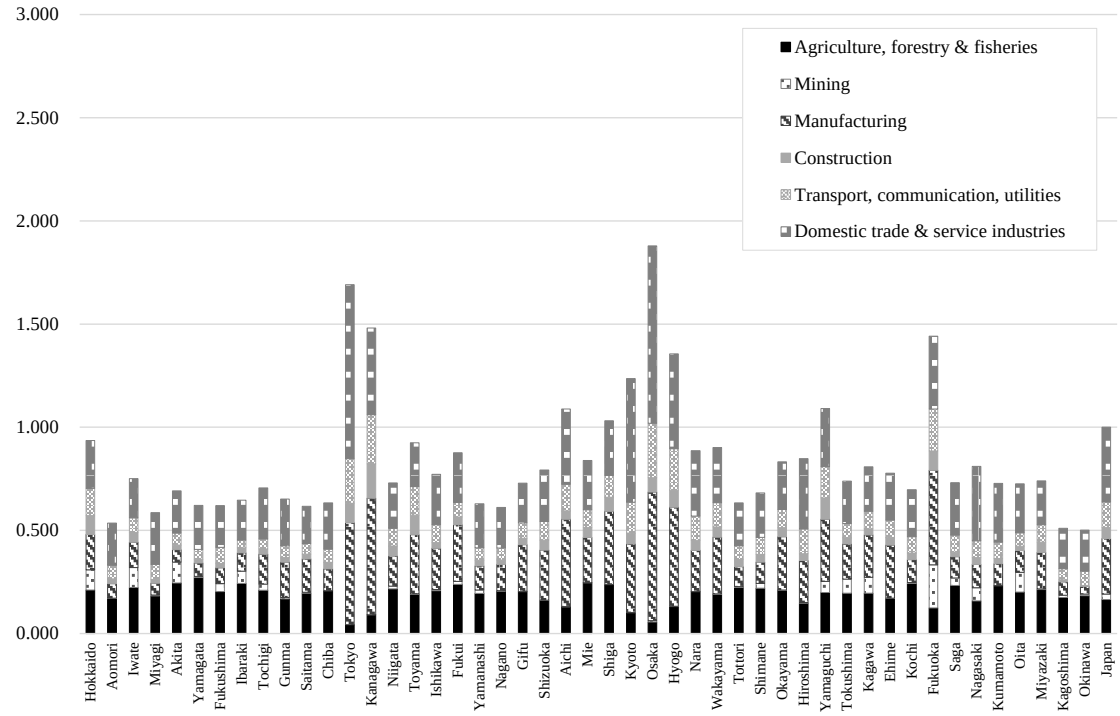
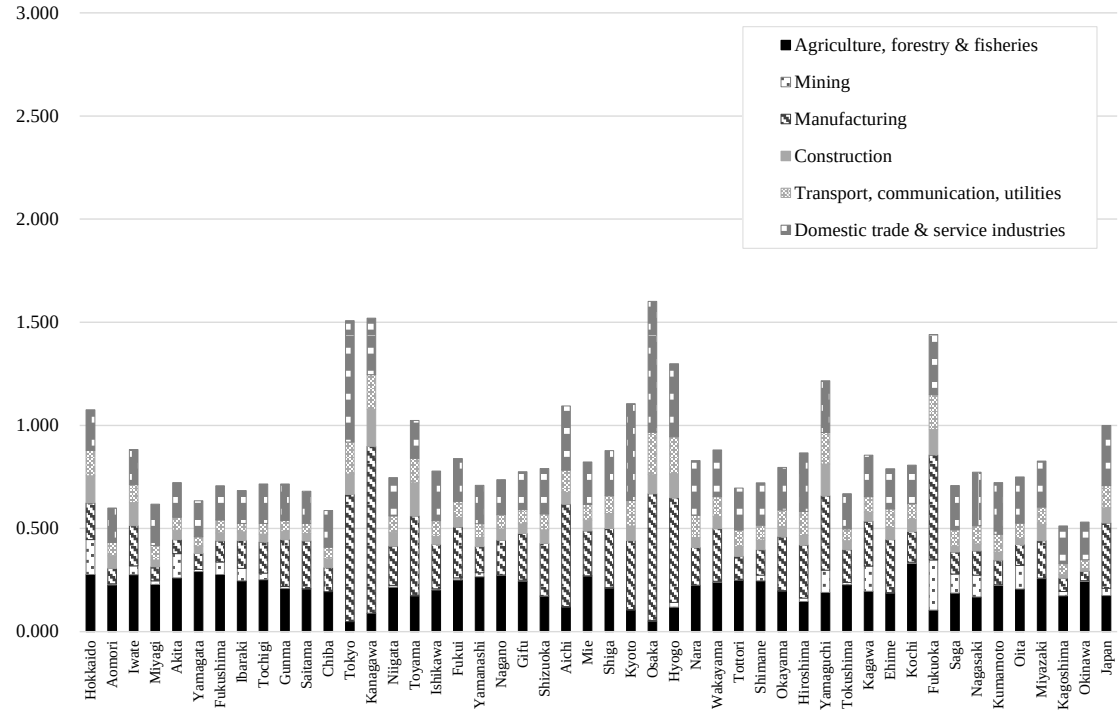


(f) 1940



3.2 Trends in prefecture-level manufacturing output

As in other countries, manufacturing industry was the main engine of growth in the economic development of modern Japan. However, industrialization did not proceed at an even pace across Japan, with important implications for prefectural income inequality. A key aspect in this regard is the fact that manufacturing and agricultural products tend to be tradable. This means that prefectures can specialize in manufacturing activities, which tend to be characterized by a higher gross value added per worker (for instance, as shown in Table 1(c), by 1909, labor productivity in manufacturing and construction was more than 70% higher than in agriculture and forestry), export manufacturing products and import agriculture products, and thereby raise the gross value added per capita. On the other hand, because the products and services of the construction and tertiary sectors tend to be non-tradable, it is relatively difficult for a prefecture to specialize in high value added activities in these sectors. Therefore, prefectures with a larger manufacturing sector share are likely to be better off, and the uneven spread of modern manufacturing activities at the start of modern economic development is likely to give rise to increasing spatial inequality.

Based on these considerations, let us start by comparing the manufacturing sector per capita gross value added expressed in national average prices across prefectures for each benchmark year. This is done in the various panels of Figure 2, where the vertical axis shows prefectures' per capita manufacturing gross value added relative to the average for Japan as a whole (i.e., Japan average = 1) as well as a breakdown into the various manufacturing sector industries. It should be noted that data for 1874 for Okinawa and Hokkaido are not available, since these regions had not been established as prefectures at the time.[10]

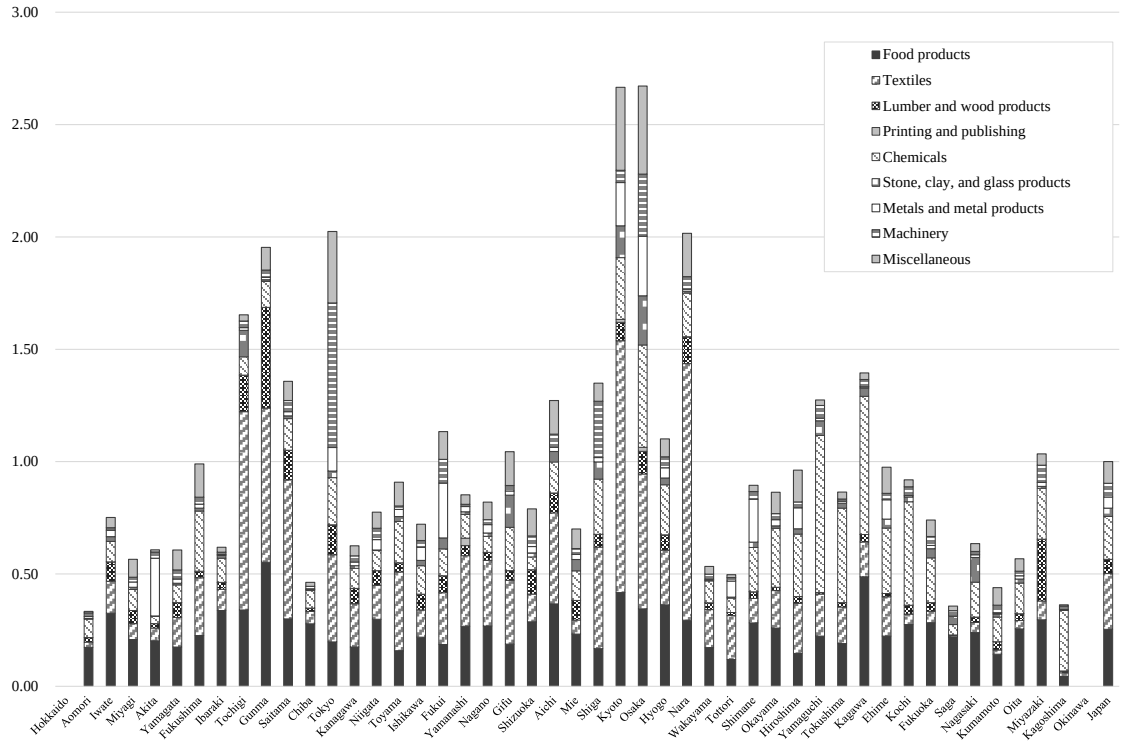
Starting with 1874, we find that manufacturing industry largely centered on prefectures that had already been the core regions of handicraft industry production during the Edo period, such as Kyoto, Osaka, and Nara. Other major manufacturing regions include Gunma, Tochigi, and Saitama, which had relatively large food and textile industries. Comparing the most industrialized with the least industrialized prefectures, manufacturing per capita gross value added in Osaka and Kyoto was 8.0 times that in Aomori, 7.5 times that in Saga, and 7.3 times that in Kagoshima. In the period that followed – the 1870s and 1880s – the Meiji government implemented its so-called industrial development policy, as part of which it pursued the introduction of foreign technology in areas such as railroads, mining, iron manufacturing, shipbuilding, silk reeling, and cotton spinning. In addition, the government built large-scale model factories, choosing locations in which a particular industry had flourished since the Edo period. (Examples include the 2,000-spindle cotton spinning plants built in major areas of cotton production in various prefectures; the

[10] As explained in Appendix 2 of Bassino et al. (2015), for 1874, we estimated manufacturing gross value added for Hokkaido and Okinawa through backward extrapolation using information on labor productivity in constant prices for prefectures nearby. This means that we cannot divide manufacturing gross value added into the manufacturing subsectors. For this reason, Hokkaido and Okinawa are included in the panel for 1874 in Figure 1 but are omitted in the panel for 1874 in Figure 2.

Kamaishi Iron Works in Iwate prefecture, where foot-bellow iron mills had been used since the Edo period; and the Tomioka Silk Filature in Gunma prefecture known for its sericulture and silk reeling.) However, while these government factories did play some part in the diffusion of technology, production did not always run smoothly and commercially they were often a failure.[11] Therefore, although there are some examples where government factories became viable after they were sold off, such as the Kamaishi Iron Works, the government's industrial development policy seems to have played only a limited role in Japan's industrialization and there is little in Figure 2 to suggest that it had any impact on developments in prefectural inequality at the time.

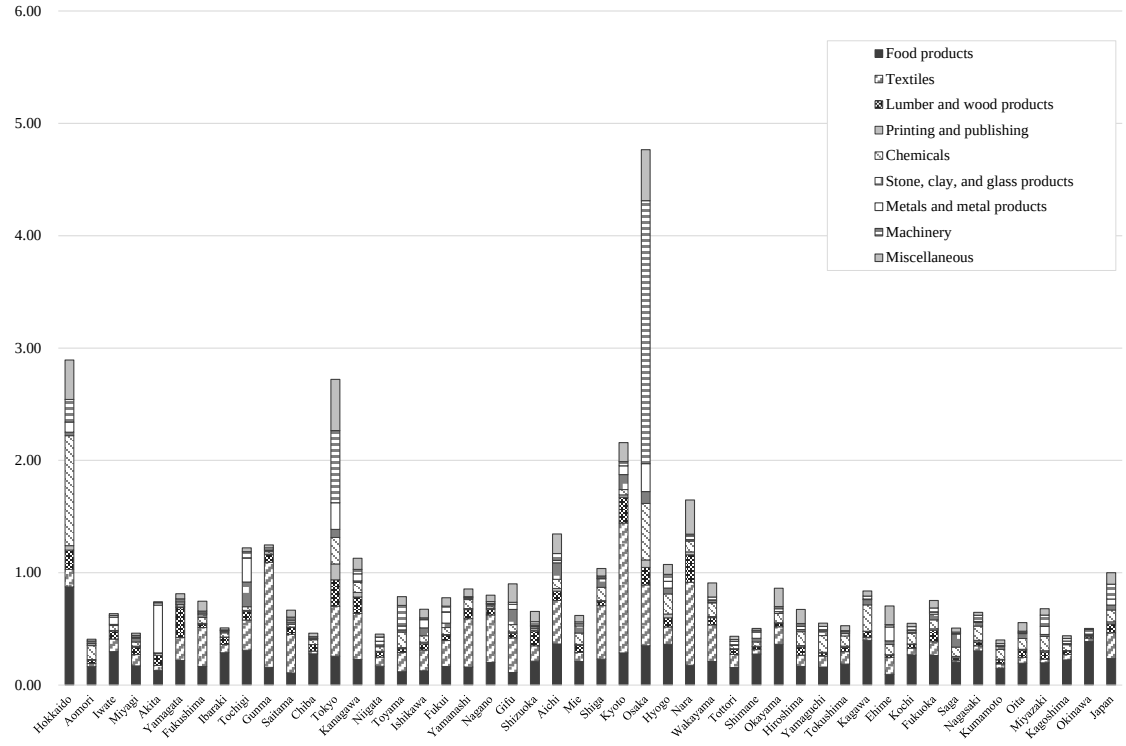
Figure 2 Manufacturing per capita value added by prefecture (in national average prices, Japan=1)

(a) 1874



(b) 1890

[11] For more details on the introduction of Western technology in modern Japan, see Morris-Suzuki (1994).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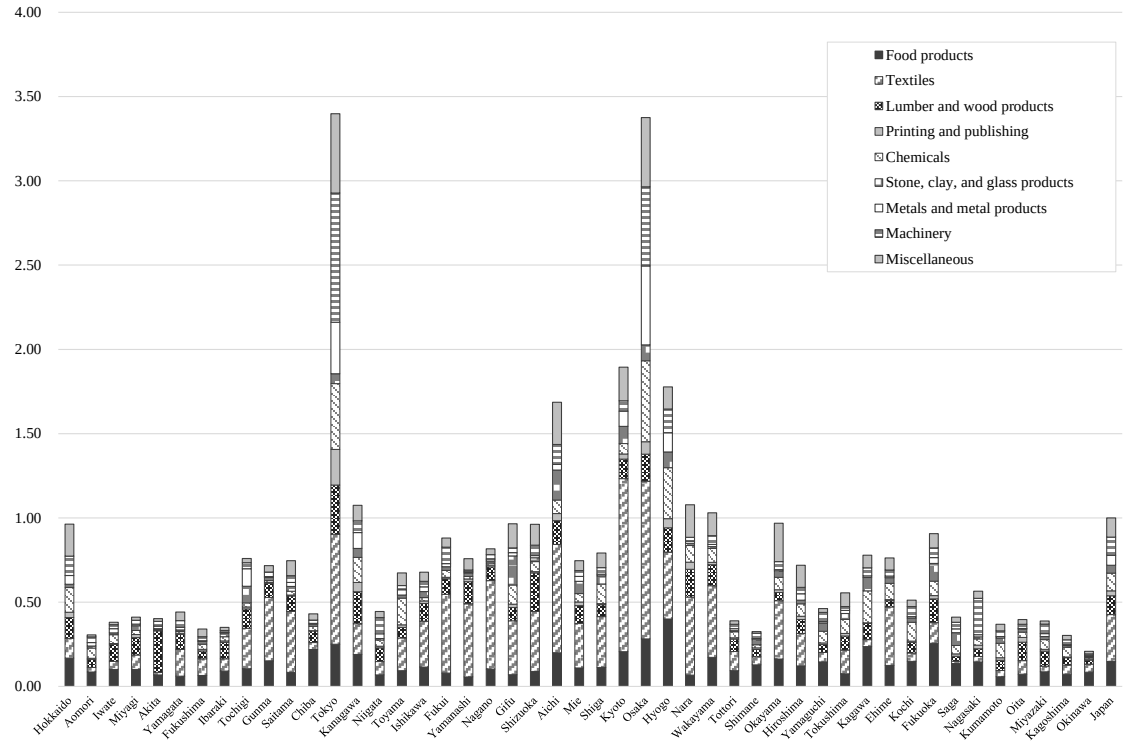
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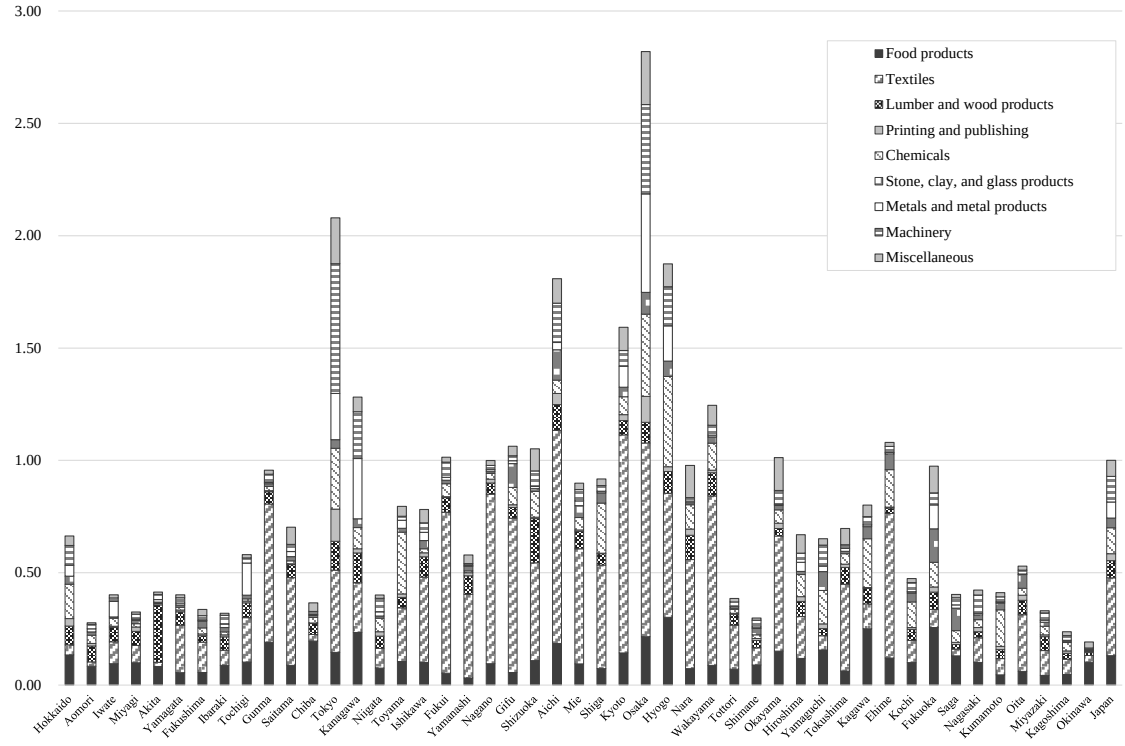
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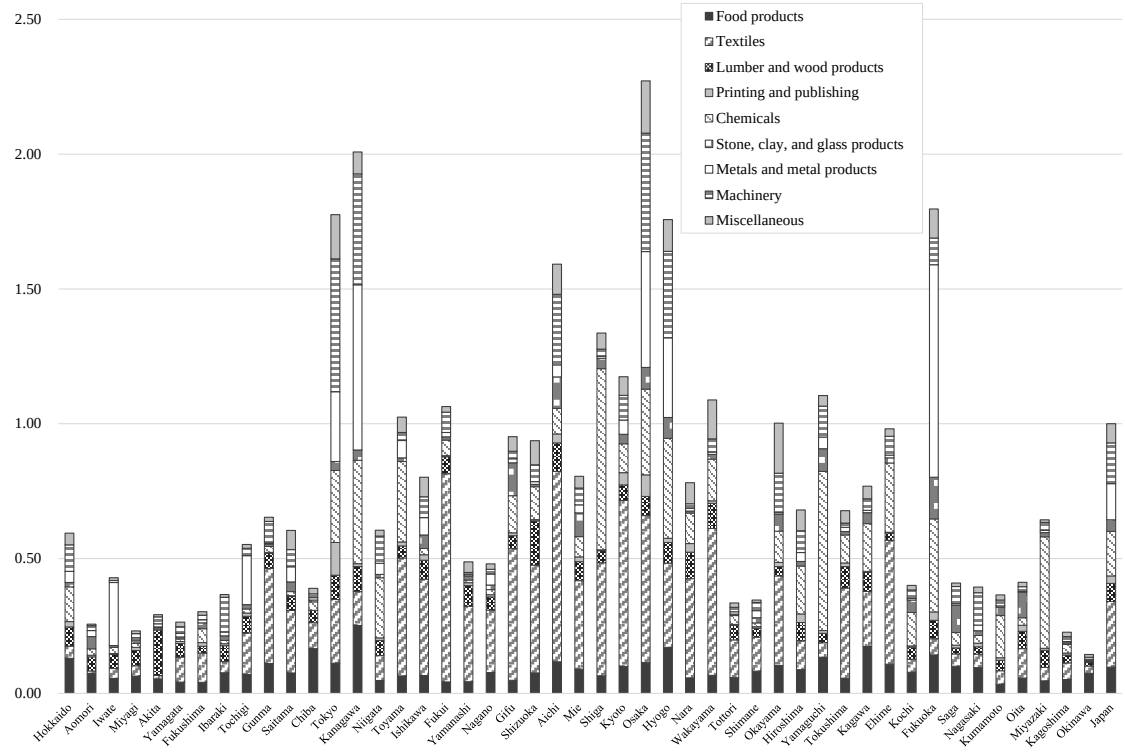
(e) 1935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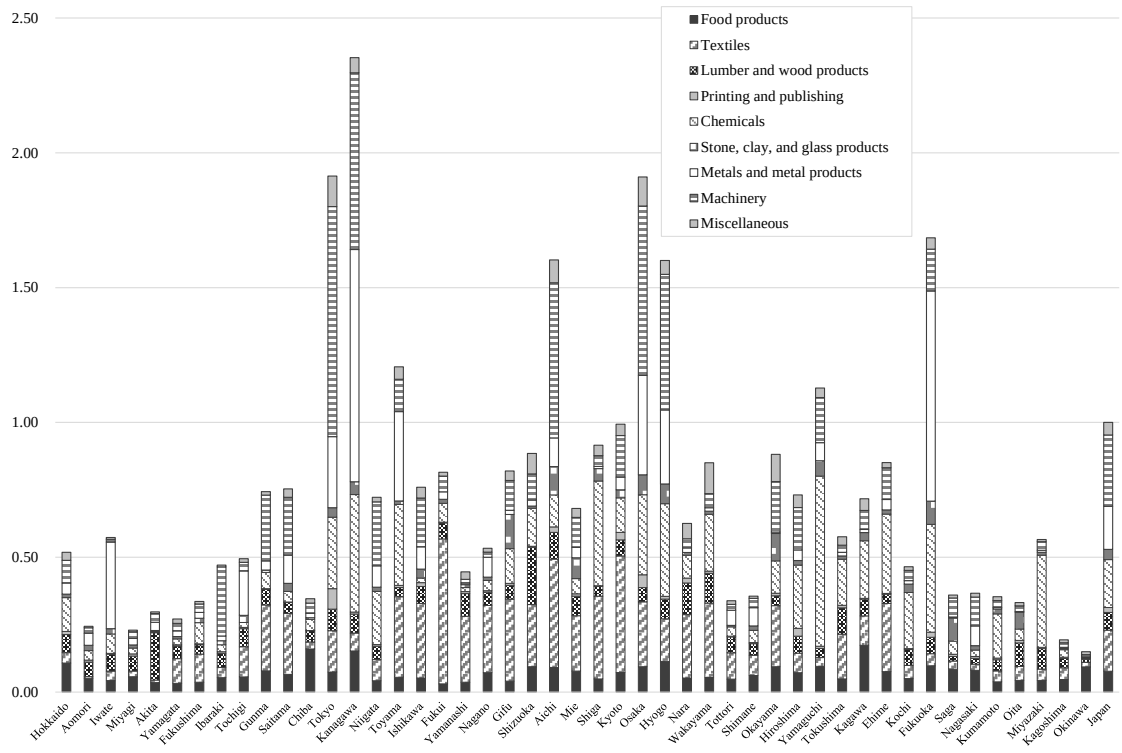
(f) 1940



Next, looking at the panel for 1890 shows that Osaka – which had become the center of the spinning industry, of which the Osaka Spinning Company (established in 1882) is the most famous example, and of machinery production such as arms and ships – took the top position. Other leading prefectures were Hokkaido, which produced foodstuffs and chemical goods, Kyoto, which saw an expansion of its textile industry, and Tokyo. Osaka's manufacturing per capita gross value added was 11.8 times that of Kumamoto and 11.7 times of that of Aomori.

By 1909, Tokyo had become a major manufacturing center alongside Osaka. Tokyo's manufacturing per capita gross value added was 16.3 times that of Okinawa and 11.2 times that of Aomori, indicating that the gap between the top and bottom prefectures in terms of per capita manufacturing gross value added had grown even further. Next, the figure for 1925 shows a growing agglomeration of manufacturing industry around the main manufacturing centers of Osaka and Tokyo, with neighboring prefectures such as Hyogo and Kanagawa showing substantial increases and Aichi emerging as another manufacturing center. In addition, industrialization, concentrating on textiles, had started spreading to the northern inland Kanto region (the region northwest of Tokyo), the Tokai region south-west of Tokyo on the Pacific coast, and Hokuriku, the region north-west of Tokyo on the Japan Sea side of Japan. Finally, by 1935 and 1940, with the importance of the textile industry beginning to wane and the heavy and chemical industries having gained a prominent role, the concentration of industry shifted again, with Kanagawa and Fukuoka becoming major manufacturing centers.

Finally, let us examine the pattern of industrialization in terms of Krugman's (1991a) index of regional specialization. The index of regional specialization is defined as

$$S = \frac{1}{R(R-1)} \sum_{r=1}^{R} \sum_{r'=1}^{R-1} SI_{r,r'}$$

where

$$SI_{r,r'} = \sum_{i=1}^{I} \left| \frac{Y_{i,r}}{Y_r} - \frac{Y_{i,r'}}{Y_{r'}} \right|$$

and $Y_{i,r}$ is the gross value added (in local prices) in prefecture r's industry i and Y_i is the gross value added (in local prices) for all manufacturing industries in prefecture r. Moreover, R is the number of prefectures and I is the number of industries. If S is 0, this means that the industry composition of the manufacturing sector in prefectures r and r' is completely identical. On the other hand, if S is 2, this indicates specialization where the industry composition in the two prefectures is completely different.

The results are shown in Figure 3 and indicate that regional specialization increased from 1909 to 1940, but industries became more evenly distributed after World War II. The increase in specialization after 1909 may, as in the case of the United States (see Kim, 1995), be related to the development of the railroad system. Japan's railroad network, as shown in Figure 4, rapidly expanded during the period from 1910 to 1930 (for details, see Minami, 1965).

In this context, it is interesting to note that the development of the railroad network is closely linked to political developments during this period. In 1900, domain factions and the political parties, which had hitherto opposed each other, joined forces when Hirobumi Ito, a four-time prime minister and leading figures of the domain factions, formed the *Rikken Seiyukai* [*Friends of Constitutional Government*] party. The *Rikken Seiyukai*, similar to the Liberal Democratic Party in the post-war era, stood for large public spending and sought to build and extend railroads in rural areas in order to gain rural votes (mainly landlords). Together with the domain factions (who controlled many bureaucratic posts), the *Rikken Seiyukai* remained in power until the arrival of the two-party system with the Constitutional Democratic Party (the former Constitutional Party) in the 1920s and continued to press ahead with patronage-driven politics favoring rural areas.[12] Although this brief description only scratches the surface and it is beyond the scope of this study to examine to what extent government policies during this period affected prefectural inequality,

[12] For more details on the political history of modern Japan, see, e.g., Banno (1992, 2014).

it clearly illustrates that in order to understand developments in prefectural inequality and the distribution of industries across Japan during this (or any other) period political aspects need to be taken into account.

Figure 3 Index of regional specialization (based on gross value added in local prices)

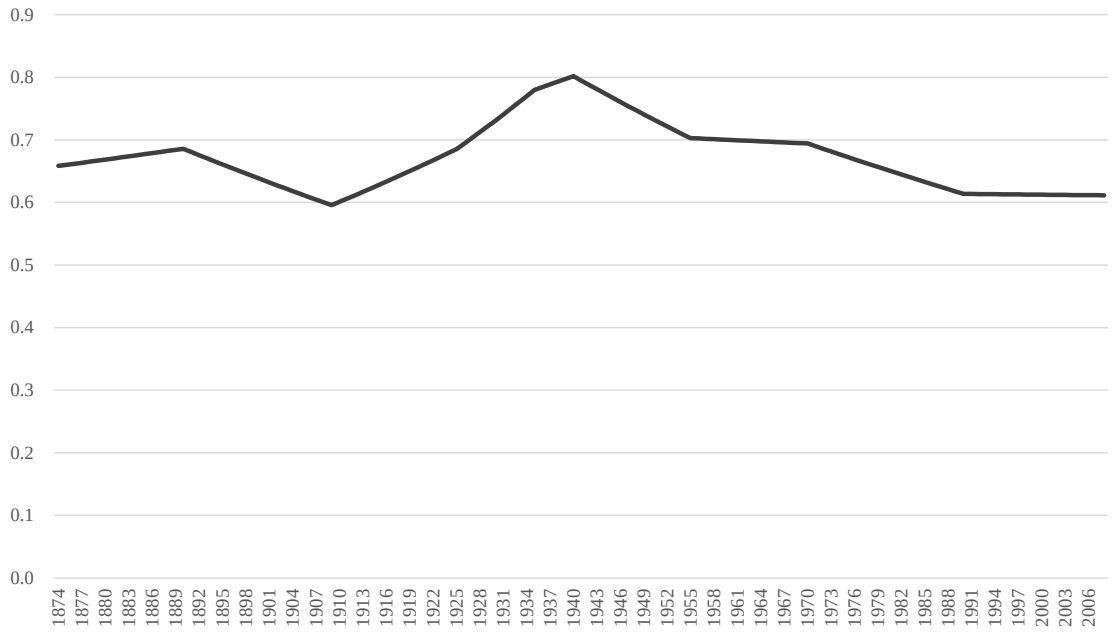
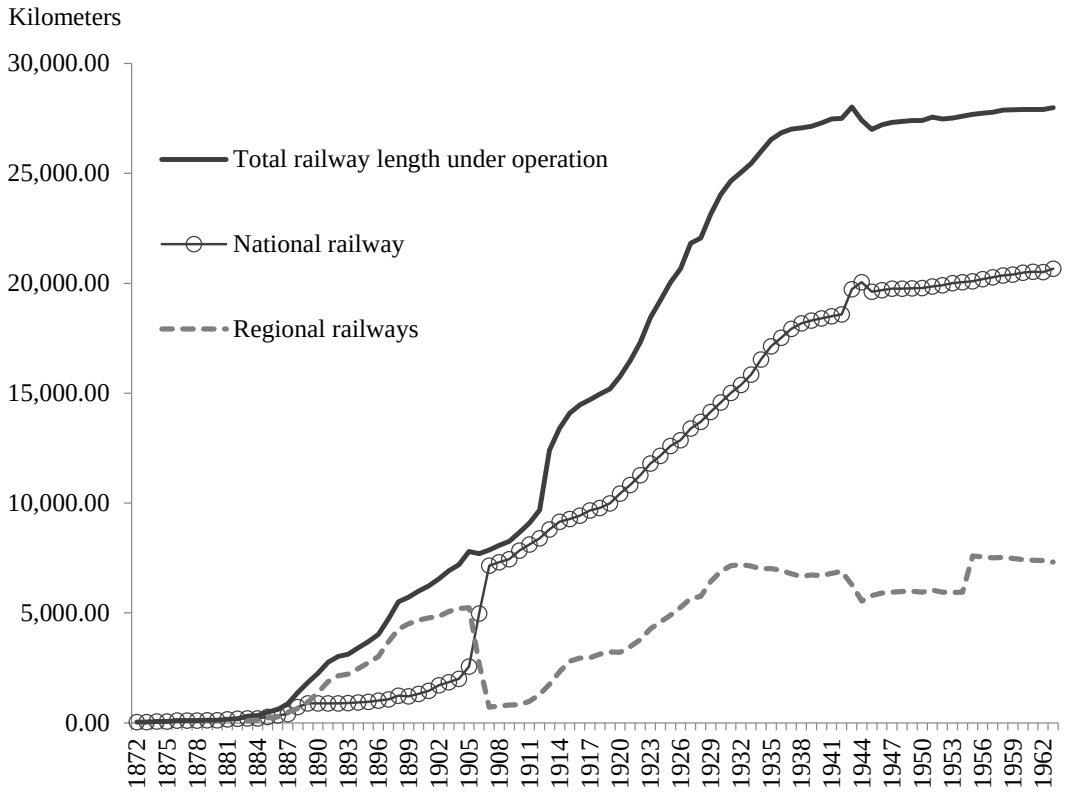


Figure 4 Expansion of Japan's rail network



Source: Minami (1965).

4 Decomposition of prefectural income inequality

Having looked at developments in Japan's industrial structure both at the national and the prefectural level, we next examine the role that prefectural differences in industrial structure have played in shaping prefectural income inequality, which is the main focus of this study. To do so, we decompose differences in prefectural income into the contribution of differences in the share of the gainfully occupied population, differences in industrial structure, and differences in labor productivity within the same industry.

Denoting the average of the wealthiest group of prefectures (the top 20% in terms of cumulative population) by subscript *T* and the average for Japan as a whole by subscript *J*, we can decompose the logarithm of the ratio of the per capita gross prefectural product (GPP) of the wealthiest group of prefectures, y_T, to the average per capita GPP for Japan as a whole, y_J, as follows:[13]

[13] We also examined the top and bottom 10% and top and bottom 50% of prefectures, and found that the

$$\ln\left(\frac{y_T}{y_J}\right) = \ln\left(\frac{\frac{L_T}{N_T}}{\frac{L_J}{N_J}}\right) + \ln\left(\frac{\sum_{i=1}^{I} v_{i,J}^{L} y_{i,T}}{\sum_{i=1}^{I} v_{i,J}^{L} y_{i,J}}\right)$$

$$= \ln\left(\frac{\frac{L_T}{N_T}}{\frac{L_J}{N_J}}\right) + \ln\left(1 + \frac{\sum_{i=1}^{I} \frac{1}{2}\left(y_{i,T} + y_{i,J}\right)\left(v_{i,T}^{L} - v_{i,J}^{L}\right)}{\sum_{i=1}^{I} v_{i,J}^{L} y_{i,J}} + \frac{\sum_{i=1}^{I} \frac{1}{2}\left(v_{i,J}^{L} + v_{i,T}^{L}\right)\left(y_{i,T} - y_{i,J}\right)}{\sum_{i=1}^{I} v_{i,J}^{L} y_{i,J}}\right)$$

$$= \ln\left(\frac{\frac{L_T}{N_T}}{\frac{L_J}{N_J}}\right) + \ln\left(1 + \frac{\sum_{i=1}^{I} \frac{1}{2}\left(y_{i,T} + y_{i,J}\right)\left(v_{i,T}^{L} - v_{i,J}^{L}\right)}{\sum_{i=1}^{I} v_{i,J}^{L} y_{i,J}}\right) + \ln\left(1 + \frac{\sum_{i=1}^{I} \frac{1}{2}\left(v_{i,J}^{L} + v_{i,T}^{L}\right)\left(y_{i,T} - y_{i,J}\right)}{\sum_{i=1}^{I} v_{i,J}^{L} y_{i,J}}\right)$$

$$+ \varepsilon_{T,J} .$$

In the above equation, N_T and L_T stand for the population and the gainfully occupied population of prefecture group T, $v^L_{i,T}$ is the share of those occupied in industry i in the total gainfully occupied population in prefecture group T, and $y_{i,T}$ represents labor productivity in industry i in prefecture group T (where labor productivity is gross valued added in national average prices divided by the gainfully occupied population). All variables with subscript J represent the average for Japan as a whole. $\varepsilon_{T,J}$ is the residual as a result of approximation.

Denoting the average of the poorest group of prefectures (the bottom 20% in terms of cumulative population) by subscript B, we can similarly decompose the logarithm of y_B/y_J using the same equation above. Consequently, we can decompose the logarithm of the ratio of the average per capita GPP of the wealthiest prefectures and of the poorest prefectures, y_T/y_B, as follows:

(1) Differences in the share of the gainfully occupied population

$$\ln\left(\frac{\frac{L_T}{N_T}}{\frac{L_B}{N_B}}\right)$$

(2) Differences in labor productivity due to differences in industrial structure

results were very similar.

$$\ln\left(1+\frac{\sum_{i=1}^{I}\frac{1}{2}\left(y_{i,T}+y_{i,J}\right)\left(v_{i,T}^{L}-v_{i,J}^{L}\right)}{\sum_{i=1}^{I}v_{i,J}^{L}y_{i,J}}\right)-\ln\left(1+\frac{\sum_{i=1}^{I}\frac{1}{2}\left(y_{i,B}+y_{i,J}\right)\left(v_{i,B}^{L}-v_{i,J}^{L}\right)}{\sum_{i=1}^{I}v_{i,J}^{L}y_{i,J}}\right)$$

(3) Differences in labor productivity due to within-industry differences in labor productivity

$$\ln\left(1+\frac{\sum_{i=1}^{I}\frac{1}{2}\left(v_{i,J}^{L}+v_{i,T}^{L}\right)\left(y_{i,T}-y_{i,J}\right)}{\sum_{i=1}^{I}v_{i,J}^{L}y_{i,J}}\right)-\ln\left(1+\frac{\sum_{i=1}^{I}\frac{1}{2}\left(v_{i,J}^{L}+v_{i,B}^{L}\right)\left(y_{i,B}-y_{i,J}\right)}{\sum_{i=1}^{I}v_{i,J}^{L}y_{i,J}}\right)$$

(4) Residual

$$\varepsilon_{T,J}-\varepsilon_{B,J}$$

For illustration, let us consider a simple example. Consider a country consisting of two prefectures, prefecture A and prefecture B, and two industries, industry X and industry Y. Labor productivity in industry X is assumed to be higher than in industry Y. Given this setting, let us examine under which circumstance per capita value added in prefecture A will be higher than in prefecture B.

First, if industries X and Y account for the same share of employment in both prefectures and labor productivity in industry X is the same in both prefectures and in industry Y also the same in both prefectures, then prefecture A will have higher per capita gross value added than prefecture B if the occupied population share in prefecture A is higher than in prefecture B (represented by term (1) above). Second, assuming alternatively that the occupied population share and labor productivity in industries X and Y are the same in both prefectures, per capita value added in prefecture A will be higher if X (where labor productivity is higher than in industry Y) accounts for a larger share of employment in prefecture A than in prefecture B (represented by term (2) above). Third and finally, assuming that the occupied population shares and the employment shares of industries X and Y are the same in the two prefectures, per capita gross value added in prefecture A will be higher if labor productivity in one or both of the industries – for example due to the use of new technology – is higher than in prefecture B (represented by term (3) above).

We decompose prefectural inequality for all benchmark years classifying industries into the following three groups: (1) agriculture, forestry, and fisheries; (2) mining, manufacturing, and construction; and (3) domestic commerce and services; transport, communication, and public

utilities. In addition, except for 1874, for which necessary data are not available, we conduct the same decomposition splitting the last group into (a) commerce and services and (b) transport, communication, and public utilities.

Before presenting the decomposition results, let us briefly look at the data on which the decomposition is based, namely the share of the gainfully occupied population in the total population, labor productivity by industry, and employment shares by industry. These are presented in Table 2 for the top and bottom 20% of prefectures and Japan as a whole. Labor productivity and employment shares are expressed relative to the national average for agriculture, forestry, and fisheries (i.e., Japan average in agriculture, forestry, and fisheries = 1). In the table, "Services" stands for domestic trade and services, and transport, communication, and public utilities.

Starting with Table 2(a), we find that the gainfully occupied population share in the pre-war period tended to be higher in the poorer than the wealthier prefectures. This likely reflects what is known as the "first Douglas-Arisawa law" (Douglas, 1934; Arisawa, 1956), namely that the lower the income level of household heads, the more likely it is that wives and other family members will be working.[14] Interestingly, the pattern reverses in the post-war period, with the occupied population share becoming higher in wealthier than in poorer prefectures. As will be discussed in greater detail in Bassino , this reversal reflects the migration of mainly younger workers from poorer rural to wealthier urban prefectures and the resultant impact on prefectural demographic structures.

Next, comparing labor productivity across sectors for Japan as a whole we find – in line with the results discussed earlier – that whereas labor productivity differences between agriculture, forestry, and fisheries on the one hand and mining, manufacturing, and construction as well as transport and communication on the other tended to increase, those between agriculture, forestry, and fisheries on the one hand and domestic trade and services on the other remained relatively stable. This reflects the fact that labor productivity in mining, manufacturing, and construction as well as transport and communication tended to grow faster as a result of capital accumulation and technological improvements than in domestic trade and services.

Table 2 Gainfully occupied population share, labor productivity, and employment by sector in the top and bottom 20% of prefectures

(a) Share of gainfully occupied population and labor productivity

[14] This implies that the employment ratio among women should be higher in poorer prefectures. Unfortunately, at present we do not have data that would allow us to examine this hypothesis.

	1874				1890				1909			
	(A) Top 20% average	(B) Bottom 20% average	Japan average	A/B	(A) Top 20% average	(B) Bottom 20% average	Japan average	A/B	(A) Top 20% average	(B) Bottom 20% average	Japan average	A/B
Share of occupied persons in population	59.53%	63.64%	62.41%		52.85%	59.94%	58.34%		42.45%	49.91%	47.60%	
Agriculture, forestry, and fisheries	1.30	0.78	1.00	1.66	1.13	0.82	1.00	1.38	1.20	0.86	1.00	1.39
Mining, manuf., constr.	1.59	0.84	1.04	1.88	2.12	0.67	1.05	3.18	3.20	1.03	1.81	3.10
Services	3.22	1.60	2.26	2.01	4.47	1.87	2.78	2.39	4.74	2.28	3.19	2.07
Domestic trade and services	--	--	--	--	4.91	2.02	3.02	2.43	4.61	2.27	3.12	2.04
Transport, comm., utilities	--	--	--	--	1.87	0.84	1.22	2.23	5.46	2.41	3.63	2.26

	1925				1935				1940			
	(A) Top 20% average	(B) Bottom 20% average	Japan average	A/B	(A) Top 20% average	(B) Bottom 20% average	Japan average	A/B	(A) Top 20% average	(B) Bottom 20% average	Japan average	A/B
Share of occupied persons in population	42.40%	48.04%	45.37%		42.44%	48.25%	45.48%		43.21%	47.62%	46.30%	
Agriculture, forestry, and fisheries	1.20	0.84	1.00	1.44	1.35	0.87	1.00	1.56	1.56	0.89	1.00	1.74
Mining, manuf., constr.	3.01	0.97	1.89	3.12	5.40	1.63	3.70	3.31	4.41	2.04	3.47	2.16
Services	3.62	2.28	2.88	1.59	4.79	2.91	3.90	1.65	3.69	2.31	2.99	1.60
Domestic trade and services	3.15	2.04	2.51	1.54	4.05	2.52	3.29	1.61	3.19	1.99	2.53	1.60
Transport, comm., utilities	6.44	3.82	5.03	1.69	10.91	6.23	8.71	1.75	7.24	4.50	5.91	1.61

	1955				1970				1990				2008			
	(A) Top 20% average	(B) Bottom 20% average	Japan average	A/B	(A) Top 20% average	(B) Bottom 20% average	Japan average	A/B	(A) Top 20% average	(B) Bottom 20% average	Japan average	A/B	(A) Top 20% average	(B) Bottom 20% average	Japan average	A/B
Share of occupied persons in population	45.69%	46.10%	45.66%		55.03%	51.37%	52.31%		64.09%	46.71%	51.99%		58.40%	44.10%	50.28%	
Agriculture, forestry, and fisheries	1.17	0.85	1.00	1.38	1.31	0.94	1.00	1.39	0.88	0.98	1.00	0.89	0.87	1.02	1.00	0.85
Mining, manuf., constr.	4.19	2.67	3.66	1.57	5.45	3.39	4.66	1.61	4.50	3.68	4.47	1.22	4.36	3.77	4.13	1.16
Services	3.15	2.11	2.67	1.49	3.78	2.66	3.25	1.42	4.13	2.96	3.44	1.40	4.05	2.84	3.33	1.42
Domestic trade and services	3.07	1.95	2.50	1.57	3.65	2.56	3.09	1.43	4.14	2.87	3.37	1.44	4.00	2.74	3.24	1.46
Transport, comm., utilities	3.65	3.31	3.74	1.10	4.70	3.43	4.39	1.37	4.09	3.82	4.08	1.07	4.60	3.90	4.32	1.18

(b) Number of gainfully occupied persons by sector

	1874				1890				1909			
	(A) Top 20% average	(B) Bottom 20% average	Japan average	A/B	(A) Top 20% average	(B) Bottom 20% average	Japan average	A/B	(A) Top 20% average	(B) Bottom 20% average	Japan average	A/B
Agriculture, forestry, and fisheries	0.90	1.08	1.00	0.83	0.80	1.10	1.00	0.73	0.61	1.18	1.00	0.52
Mining, manuf., constr.	0.20	0.14	0.18	1.49	0.41	0.31	0.35	1.31	0.50	0.29	0.38	1.73
Services	0.31	0.19	0.23	1.57	0.46	0.26	0.32	1.78	0.67	0.32	0.40	2.11
Domestic trade and services	--	--	--	--	0.40	0.23	0.28	1.75	0.57	0.28	0.35	2.06
Transport, comm., utilities	--	--	--	--	0.07	0.03	0.04	2.02	0.10	0.04	0.06	2.49

	1925				1935				1940			
	(A) Top 20% average	(B) Bottom 20% average	Japan average	A/B	(A) Top 20% average	(B) Bottom 20% average	Japan average	A/B	(A) Top 20% average	(B) Bottom 20% average	Japan average	A/B
Agriculture, forestry, and fisheries	0.41	1.26	1.00	0.33	0.32	1.35	1.00	0.24	0.24	1.41	1.00	0.17
Mining, manuf., constr.	0.66	0.43	0.52	1.54	0.74	0.46	0.58	1.59	1.03	0.49	0.70	2.12
Services	1.07	0.45	0.62	2.37	1.28	0.52	0.76	2.45	1.19	0.57	0.76	2.10
Domestic trade and services	0.92	0.39	0.53	2.34	1.14	0.47	0.67	2.44	1.04	0.50	0.66	2.11
Transport, comm., utilities	0.15	0.06	0.09	2.55	0.14	0.05	0.09	2.52	0.15	0.07	0.10	2.08

	1955				1970				1990				2008			
	(A) Top 20% average	(B) Bottom 20% average	Japan average	A/B	(A) Top 20% average	(B) Bottom 20% average	Japan average	A/B	(A) Top 20% average	(B) Bottom 20% average	Japan average	A/B	(A) Top 20% average	(B) Bottom 20% average	Japan average	A/B
Agriculture, forestry, and fisheries	0.27	1.42	1.00	0.19	0.10	1.86	1.00	0.05	0.17	1.87	1.00	0.09	0.30	1.51	1.00	0.20
Mining, manuf., constr.	0.98	0.37	0.60	2.65	2.14	1.16	1.76	1.85	3.77	3.43	3.81	1.10	5.05	4.80	5.21	1.05
Services	1.18	0.63	0.81	1.87	2.80	2.02	2.28	1.38	7.44	6.07	6.56	1.23	14.61	13.65	13.75	1.07
Domestic trade and services	1.02	0.55	0.71	1.85	2.46	1.79	1.99	1.38	6.71	5.51	5.91	1.22	13.37	12.46	12.59	1.07
Transport, comm., utilities	0.15	0.07	0.11	2.04	0.34	0.24	0.28	1.45	0.73	0.56	0.65	1.30	1.24	1.19	1.15	1.04

Next, comparing labor productivity between the wealthiest and poorest prefectures, we find that in the pre-war period labor productivity in agriculture, forestry, and fisheries in the wealthiest prefectures was about 1.5 times as high as in the poorest prefectures, while in the other industries it was about two to three times as high. What we are particularly interested in, however, is how these productivity differences within sectors developed over time, since these are an important determinant of developments in prefectural income inequality. Bassino et al. (2015) argued that in the initial stage of Japan's modern economic development – that is, between 1874 and 1890 – prefectural inequality increased. Table 2(a) allows to examine which sectors contributed to this increase. Specifically, we find that whereas in 1874, labor productivity in the top 20% of prefectures in agriculture, forestry, and fisheries was 1.66 times as high as that in the bottom 20%,

by 1890 the difference had shrunk to a factor of 1.38. On the other hand, the gap in both manufacturing, mining, and construction as well as services increased considerably, from a factor of 1.88 and 2.01 to a factor of 3.18 and 2.39, respectively. This result suggests that the increase in productivity differences in manufacturing played a large part in the increase in prefectural inequality during this period.

Looking at developments in productivity differences over the rest of the period, we find that in agriculture, forestry, and fisheries the relative gap – after the initial drop between 1874 and 1890 – increased slightly in the pre-war period and then decreased in the post-war period. On the other hand, in the manufacturing sector, the gap – after the initial jump between 1874 and 1890 – remained more or less unchanged (at a factor of about 3.1 to 3.3) until 1935, before steadily decreasing between 1940 and 2008. Meanwhile, in services, the relative gap declines more or less steadily from the peak in 1890, falling to a factor of 1.60 in 1940 and declining further in the post-war period.[15] Finally, looking at the two service sector categories separately, the relative gaps in labor productivity in domestic trade and services as well as transport, communication, and public utilities during the pre-war period closely mirror that in services overall (for instance, the top prefectures lead by a factor of about 2.2 to 2.4 in 1890, and this shrinks to a factor of 1.6 in 1940). The figures in Table 2(a) thus indicate that each of the sectors followed its own pattern in terms of productivity divergence and convergence.

Turning to Table 2(b), this shows differences in employment structures between the top and bottom 20% of prefectures. The table indicates that in poorer prefectures proportionately more persons were employed in agriculture, forestry, and fisheries than in wealthier prefectures. Moreover, while this pattern can already be observed at the start of our observation period in 1874, it became more and more pronounced over time (up until 1970).[16] Conversely, proportionately fewer persons were employed in manufacturing and services in poorer prefectures than in wealthier prefectures, and this pattern holds throughout the observation period. Thus, even before looking at the decomposition results, we already get a sense of why poorer prefectures were poorer: they had a larger share of the workforce employed in agriculture, which, as seen in Table 2(a), is characterized by lower productivity than manufacturing and services.

Table 2(b) also shows that developments in differences in employment structures differ considerably across sectors. Whereas differences in the agricultural employment share steadily increase over time, those in the manufacturing employment share show no clear trend until they

[15] Trends in relatively labor productivity gaps are somewhat different when comparing the top and bottom 10% of prefectures. Specifically, the gap in mining, manufacturing, and construction, following a large jump between 1874 and 1890, declines until 1909 before increasing again through 1935. On the other hand, in agriculture, forestry, and fisheries, labor productivity differences increased notably from 1890 to 1940.

[16] The convergence in agricultural employment structures after 1970 reflects the fact that while agricultural employment in the top 20% of prefectures was already so low that it did not decline any further, it continued to fall in Japan as a whole, including in the bottom 20% of prefectures.

jump in 1940, peak in 1955, and then gradually decline until, by 2008, the manufacturing employment share is almost identical in the wealthiest and poorest prefectures. Finally, differences in the service sector employment share gradually increase until 1935 before then gradually decreasing again. Interestingly, as seen in the last column of the Table, by 2008, the only major difference in employment structures between the wealthiest and poorest prefectures is the share employed in agriculture, which is about five times higher in the poorer prefectures.

Let us take a closer look at developments during the early phase of industrialization, which we are particularly interested in in this paper. Table 2(b) suggests that between 1874 and 1890, the employment share of the manufacturing sector increased in both the leading and the lagging prefectures, and although the gap between the two increased somewhat, this increase is not particularly pronounced. In other words, industrialization spread relatively evenly across Japan. This can be seen more clearly in Figure 5, which shows the coefficients of variation (CVs) for agriculture, manufacturing and service sector population-weighted employment shares and per capita value added. The figure shows that between 1874 and 1890, the CV for manufacturing employment shares actually decreased, thus confirming that in this sense industrialization spread relatively evenly. This, in turn, is consistent with the notion that rural industry – based on the foundations laid by proto-industrialization during the Edo period – played a key role in Japan's early industrialization process (see Appendix 1 in Bassino et al., 2015 and Saito, 1983, for more details). The figure also shows, however, that inequality in manufacturing per capita value added rose sharply between 1874 and 1890, meaning that prefectural differences in labor productivity increased substantially (as already seen in Table 2(a)). This implies that some prefectures specialized in manufacturing activities with high labor productivity, while others specialized in activities with lower labor productivity. Although data to examine this conjecture further unfortunately are unavailable,[17] it is in line with the increase in regional specialization shown in Figure 3, and it is not difficult to find concrete examples to illustrate this contrast, such as the Osaka Cotton Spinning Company on the one hand and small-scale silk-reeling in Gunma prefecture on the other.

Figure 5 further shows that no such increase in the CV of per capita value added in the service sector can be observed, which is in line with the finding in Table 2(a) that the increase in labor productivity differences between the top and bottom 20% of prefectures was much less pronounced than in the manufacturing sector. The figure thus confirms that it was the manufacturing sector that was mainly responsible for the increase in regional income inequality during the period 1874–1890.

Next, let us turn to developments from 1890 to 1909. This period is the time when the first

[17] Specifically, we would need estimates of the gainfully occupied population in each manufacturing industry, which are currently not available.

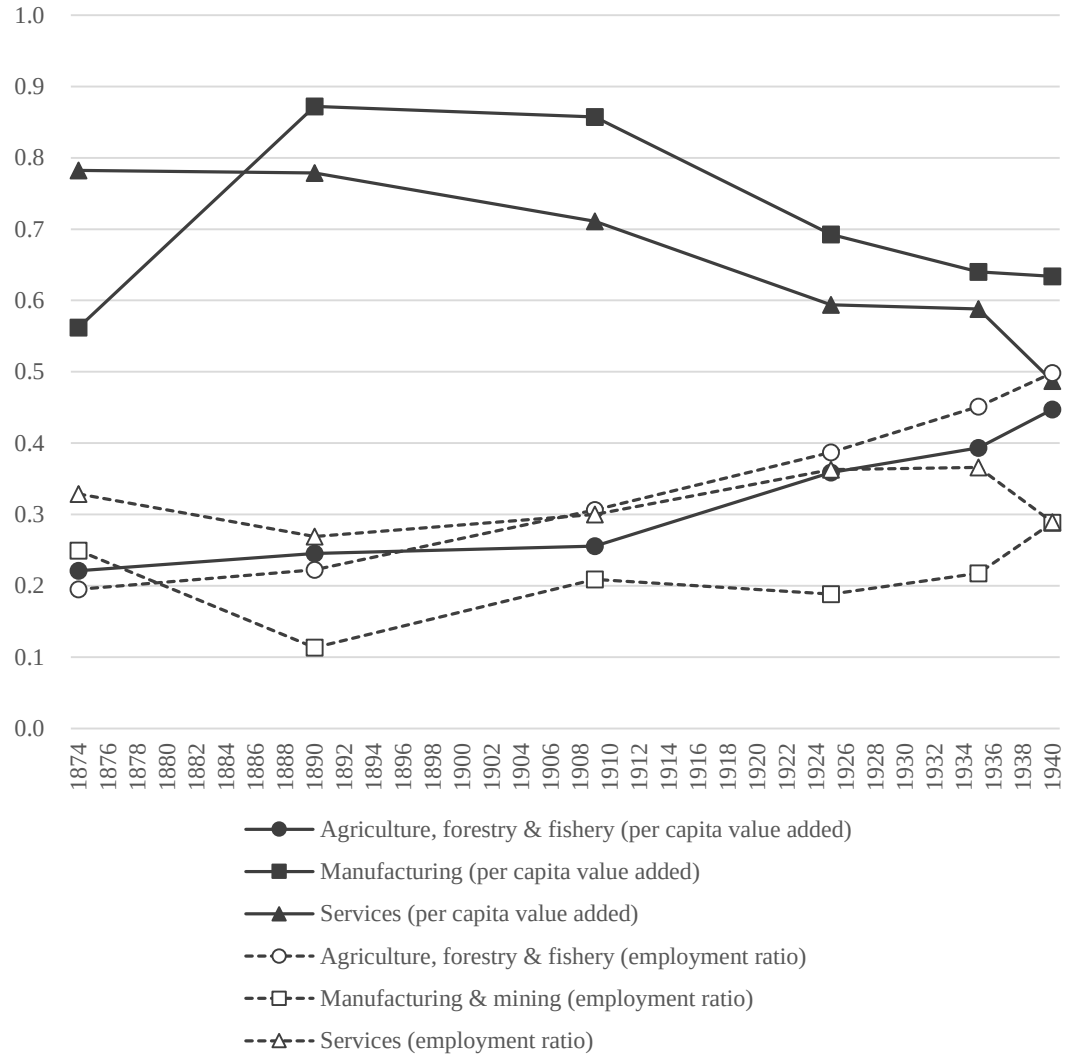
enterprise boom occurred and full-fledged industrialization concentrating on light industry made headway. As shown in Bassino et al. (2015), prefectural income inequality continued to increase during this period, but the increase was far more moderate than that in the preceding period from 1874 to 1890. The reason is that, as seen in Table 2(a), labor productivity differences in manufacturing, mining, and construction essentially remained unchanged between 1890 and 1909 and decreased in services, which is mirrored by the CV in per capita value added in manufacturing and services shown in Figure 5.

This finding is consistent with the argument by Nakamura and others that during the first enterprise boom rural industries played an important role. Specifically, Nakamura (2010) argues that the period from the mid-1880s, when industrialization started to take off, until around 1905 – that is, around the end of the Russo–Japanese War – can be considered as an era in which non-metropolitan regions, such as Fukuoka, Iwate, and the Sennan District in Osaka prefecture, were at the forefront of Japan's industrial revolution. Such industrial development in the regions was driven by wealthy individuals, local government officials, and politicians residing in these areas against the backdrop of a widely shared "regional industrialization ideology," which held that the development of Japan's regions would promote the economic development of Japan as a whole and was based on the fact that personal relationships in the regions lowered transaction costs and facilitated investment. However, as the cost of electricity in urban areas declined, industry subsequently started to increasingly concentrate in urban areas and industrialization in the regions lost steam.[18]

The active investment in Japan's regions as part of the "regional industrialization ideology" is likely to have prevented a more pronounced increase in prefectural income inequality after 1890. What is more, in this context it is important to note that this investment occurred not only in manufacturing, mining, and construction, but also in the service sector. Lastly, regarding the period between 1909 and 1925, we unfortunately at this point do not have sufficient data to examine Nakamura's argument that industry became increasingly concentrated in urban areas, but if this is the case, it would have worked in the direction of increasing prefectural income inequality during this period.

Figure 5 Population-weighted coefficients of variation of prefectural per capita gross value added and employment ratios by sector

[18] For more details, see Nakamura (2010) and, with regard to the investment behavior of wealthy individuals in the regions during this period, Tanimoto (1998).



Note: Employment ratios are calculated as the ratio of the gainfully occupied population in a particular sector to the prefectural population overall.

Having considered the underlying patterns and developments in the different components contributing to prefectural income inequality, let us finally turn to the decomposition results. Specifically, employing our estimates of per capita GPP on the basis of national average prices, we decompose the log of the ratio of the per capita GPP of the wealthiest prefectures to that of the poorest prefectures, y_T/y_B, into the four terms presented at the outset of this section. The results of the decomposition are presented in Table 3.

Starting with the difference in average per capita GPP between the wealthiest and poorest 20% of prefectures, we find that the development over time closely resembles the pattern for the coefficient of variation of per capita GPP shown in Bassino et al. (2015). That is, prefectural income inequality rises from 1874 to 1890, falls in 1925, and then increases again, peaking in

1935, before generally declining after that. The most notable difference in fact can be observed for the post-war period, for which Table 3 suggests that regional inequality declined steadily and continuously, while Bassino et al. (2015) suggests that it increased in the 1980s.

Next, looking at the contribution of differences in the gainfully occupied population share, we find that this has a negative sign throughout the pre-war period, before turning positive in 1970. This means that, during the pre-war period, a larger share of the population was gainfully occupied in the poorer than in the wealthier prefectures, and this helped to reduce the gap in per capita GPP. On the other hand, as seen earlier, the pattern reverses during the post-war period and especially from 1990 onward, the gainfully occupied population share becomes an important determinant of differences in per capita GPP differences, explaining more than 40%.

Turning to differences in labor productivity due to differences in industrial structure and within-industry productivity differences, the results suggest that both played a substantial role in prefectural income inequality. However, the size of the contribution of the two factors differs considerably over time and the trends they display provide some interesting clues with regard to the pattern of industrialization in Japan. Specifically, we find that in the early stages, up until around 1909, within-industry differences in labor productivity accounted for well over 80% of differences in per capita GPP. In absolute terms, the contribution of within-industry productivity differences increases between 1874 and 1890 (although it declines in percentage terms), but then declines more or less steadily over time. What this suggests is that in the early years, between 1874 and 1890, within-industry productivity differences across prefectures were extremely large and in fact increased as some prefectures introduced modern technology (from abroad) and/or were at the heart of infrastructure improvements, while others lagged behind. Over time, though, such differences diminished as technology and infrastructure dispersed across Japan.

On the other hand, the contribution of differences in industrial structure across prefectures displays an inverted U curve: in 1874, they accounted for only 16% of per capita GPP differences, but this contribution rose to about 41–47% during the first half of the 20th century, peaked at 53% in 1995, and then gradually declined to only 8% in 2008. This pattern closely mirrors the development in the index of regional specialization shown in Figure 4 and indicates that prefectures' industrial structures were quite similar in the early stages before the onset of industrialization. However, as industrialization proceeded, regional specialization in specific industries increased, contributing to growing prefectural income inequality. Following World War II, regional specialization then gradually diminished, and the contribution of differences in industrial structure to differences in per capita GPP decreased.

Table 3 Decomposition of differences in per capita GPP

(Figures in italics show the percentage contribution of each factor to differences in per capita

GPP)

	1874	1890	1909	1925	1935	1940	1955	1970	1990	2008
Difference in average per capita GPP (log)	0.602	0.753	0.834	0.810	1.072	0.863	0.823	0.774	0.706	0.612
	100	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*
(1) Contribution of differences in the gainfully occupied	-0.067	-0.126	-0.162	-0.125	-0.128	-0.097	-0.009	0.069	0.316	0.281
	-11.10	*-16.71*	*-19.41*	*-15.41*	*-11.96*	*-11.26*	*-1.09*	*8.90*	*44.83*	*45.92*
(2) Contribution of differences in labor productivity due	0.093	0.201	0.344	0.358	0.444	0.404	0.437	0.304	0.113	0.048
	15.53	*26.65*	*41.21*	*44.23*	*41.43*	*46.79*	*53.09*	*39.24*	*16.04*	*7.79*
(3) Contribution of differences in labor productivity within the same industry	0.587	0.719	0.716	0.611	0.681	0.567	0.390	0.383	0.272	0.284
	97.49	*95.53*	*85.88*	*75.45*	*63.49*	*65.61*	*47.38*	*49.48*	*38.52*	*46.42*
(4) Residual	-0.012	-0.041	-0.064	-0.035	0.075	-0.010	0.005	0.018	0.004	-0.001
	-1.92	*-5.46*	*-7.67*	*-4.28*	*7.03*	*-1.14*	*0.62*	*2.37*	*0.61*	*-0.13*

Notes:

1. Based on estimates in average national prices.

2. Based on the classification into three industry groups.

Let us take a slightly more detailed look at developments in the early stages of Japan's modern economic development. The results indicate that between 1874 and 1890 both within-industry productivity differences and labor productivity differences due to differences in industrial structure increased. By far the most dominant factor, as mentioned, is differences in within-industry labor productivity, which is in line with the results shown in Table 2 and Figure 5, which indicated that during this period labor productivity differences especially in manufacturing, mining, and construction increased substantially, with the productivity advantage of the wealthiest prefectures over the poorest prefectures jumping from a factor of less than two to a factor of more than three. Ideally, we would like to disaggregate this sector further in order to examine whether these labor productivity differences are the result of differences in industrial structure within the manufacturing sector or the result of within-industry differences within the manufacturing sector. To do so, however, we would need estimates of the gainfully occupied population in each manufacturing industry, which at present are not available.

During the period from 1890 to 1909, prefectural income inequality also increased, but not to the same extent as in the preceding period. Differences in industrial structure make a larger contribution to inequality overall, while the contribution of within-industry productivity differences remains essentially unchanged (and shrinks on a percentage basis), which is in line with the results in Figure 2 showing that there was little change in productivity differences in each of the sectors between 1890 and 1909. This possibly reflects the active investment in rural areas under the "regional industrialization ideology," which may have prevented labor productivity differences in both manufacturing and service industries from rising.

Prefectural income inequality declined slightly in the period from 1909 to 1925, driven mainly by a decline in within-industry productivity differences. Although within-industry productivity differences temporarily increased in 1935, they then declined again in 1940, falling to the same level as in 1874. Unfortunately, we are unable to examine why within-industry productivity differences declined, because we have been unable to estimate capital input and labor quality

(educational attainment) at the prefectural level. However, likely reasons for this decline in within-industry productivity differences include increases in the capital–labor ratio, human capital accumulation, and TFP increases in lagging regions reflecting factors such as internal migration and the continuing diffusion of technology. In particular, capital–labor ratios are likely to have been substantially affected by the migration of labor from poorer to wealthier prefectures. This issue is discussed in more detail in Bassino et al. (2015).

Finally, both productivity differences due to differences in industrial structure and within-industry productivity differences contributed to the increase in prefectural income inequality between 1925 and 1935. Regarding the increase in the contribution of differences in industrial structure, Table 2(b) suggests that changes in the employment structure between 1925 and 1935 actually were relatively small compared to changes in earlier periods. Thus, given that we measure labor productivity using gross value added per gainfully occupied person in terms of (national average) market prices, the increase in inequality as a result of differences in industrial structure likely reflects the substantial fall in the relative price of agricultural products during this period. Meanwhile, with regard to the contribution of within-industry productivity differences, Table 2(a) suggests that all three sectors saw an – albeit relatively minor – further increase in productivity differences, with differences in the manufacturing sector reaching their peak. Thus, the increase in prefectural income inequality likely was the result of substantial changes in relative prices between agricultural and industrial products as well as continuing regional specialization.

5 Conclusion

The aim of this paper was to examine changes in prefectural income inequality and industrial structure during the pre-war period. The findings of the analysis can be summarized as follows. Prefectural income inequality, which increased in the early stages of Japan's modern economic development, was mainly due to within-industry differences in labor productivity. From 1874 to 1890 labor productivity differences in the manufacturing, mining, and construction sector increased considerably. Although further analyses are necessary to draw firmer conclusions, conjecturing from Figure 2, it appears that the rise of major industrial centers such as Osaka during this period played a key role. Nevertheless, it is important to note that industrialization was not confined to urban centers, but also took place in other (rural) regions, where increases in employment in the manufacturing sector kept pace with the leading areas (as seen in Figure 5). In this sense, it could be said that industrialization during this period was not regionally biased.

Moreover, regional inequality increased only moderately in the following period from 1890 to 1909, when the industrialization process had gathered steam. The reason is that although

differences in labor productivity due to differences in industrial structure increased during this period, within-industry productivity differences in manufacturing and services did not rise further or in fact declined. A likely reason, it was suggested, was active investment in rural areas as part of the “regional industrialization ideology,” which mitigated labor productivity differences.

Finally, the period from 1909 to 1925 was characterized by a decrease in prefectural income inequality. However, because this period spans the World War I boom and subsequent recession and we do not have any detailed data, it is difficult to draw any firm conclusions regarding the role of structural change in changes in regional inequality. That being said, while the reasons may be unclear, what we can say is that within-industry productivity differences declined during this period.

Overall, the analysis in this paper suggests that changes in industrial structure and in within-industry differences in labor productivity played a key role in shaping trends in spatial income inequality in Japan. Of particular interest is the fact that the contribution of productivity differences as a result of differences in industrial structure – like income inequality overall – follows an inverted U curve, while the other two determinants we examined here, within-industry productivity differences on the hand and the gainfully occupied population share on the other, worked in opposite directions over time. That is, whereas the occupied population share initially worked in the direction of mitigating income differences and increasingly worked in the direction of adding to them, the contribution of within-industry productivity differences almost consistently declined, thus working in the direction of convergence. Thus, it could be said that the inverted U curve in prefectural income inequality is the result of the interplay of countervailing forces rather than one particular mechanism.

Finally, it is worth noting that in many regards the analysis here only represents the starting point of a detailed examination of the spatial pattern of industrialization in pre-war Japan. Much work remains to be done, for example, in terms of relating the trends in within-industry productivity differences observed here to existing research and historical sources on technology imports and the spread of technology. Such issues are left for future research.

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