THE ESSENCE OF THE SUCCESSFUL DEVELOPMENT OF THE TEXTILE INDUSTRIES IN PREWAR JAPAN: A REVIEW

ADSS Seminar at SEARCA
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Case Study vs. Historical Study

- Historical study (today), not included in my book.
  -- Merit: Possible to trace long-term process of development.
  -- Another merit: Possible to identify what types of industries are promising and what types of technologies are important at various stages of economic development.
  -- Demerit: Absence of information about characteristics of innovators and imitators.
- Case Study (March 7)
  -- Merit: Possible to identify innovations and characteristics of innovators and imitators.
  -- Demerit: Coverage of short period.
- Thus, case studies and historical studies are complementary.

Why was prewar Japan so successful in development?

- Japan started “modern” economic development in Meiji Restoration in 1868.

1. Catch-up Hypothesis: Japan successfully imported advanced technologies from Europe.

   Yes, but what technologies?

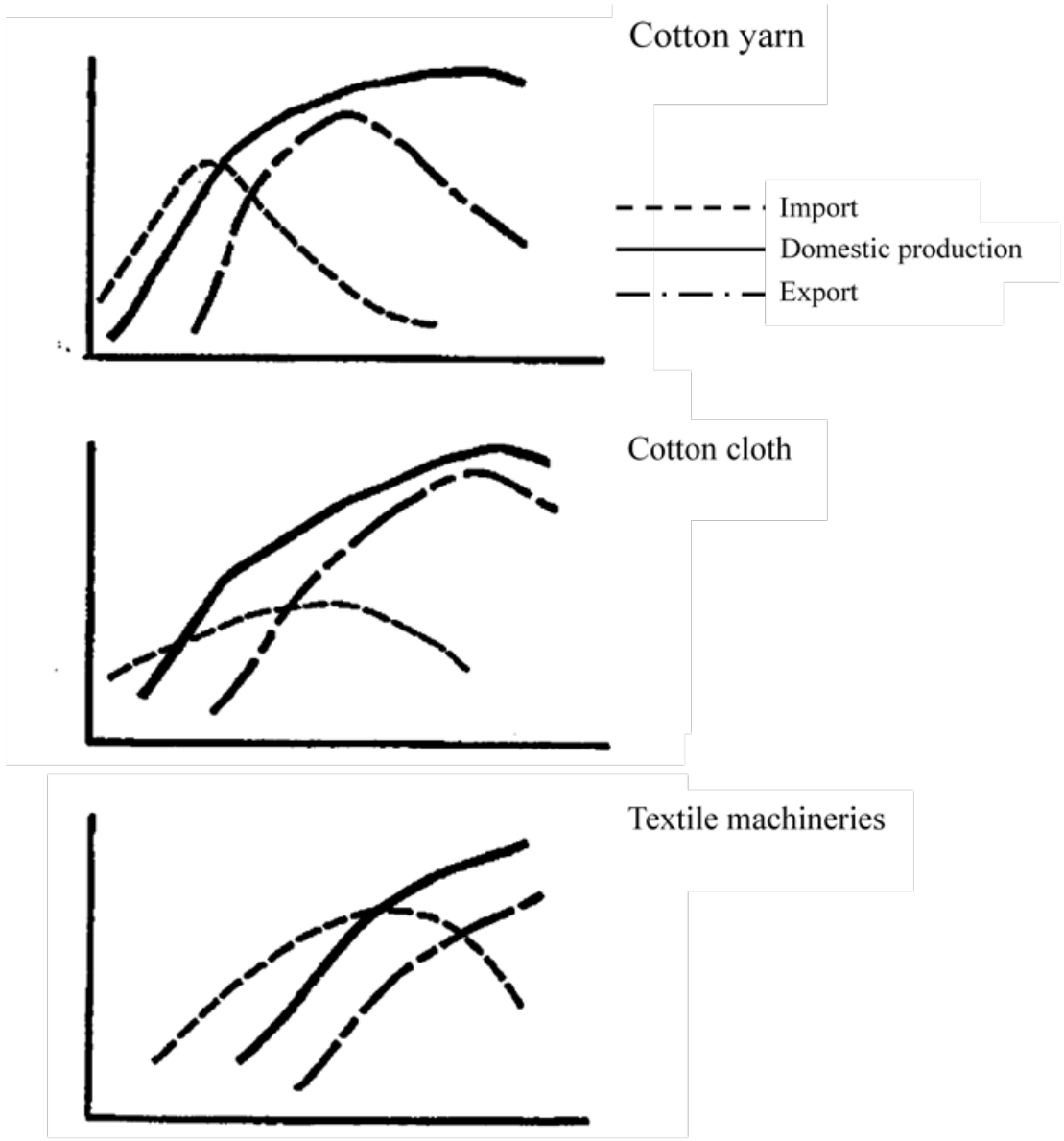
2. Flying Geese Model of Development by Akamatsu: Import ➔ Domestic production (import substitution) ➔ Export.

   Maybe yes, but what was role of technology import and its adaptations?

3. Success of labor-intensive industrialization by Sugihara.

   Probably yes, but why was only Japan successful in Asia?

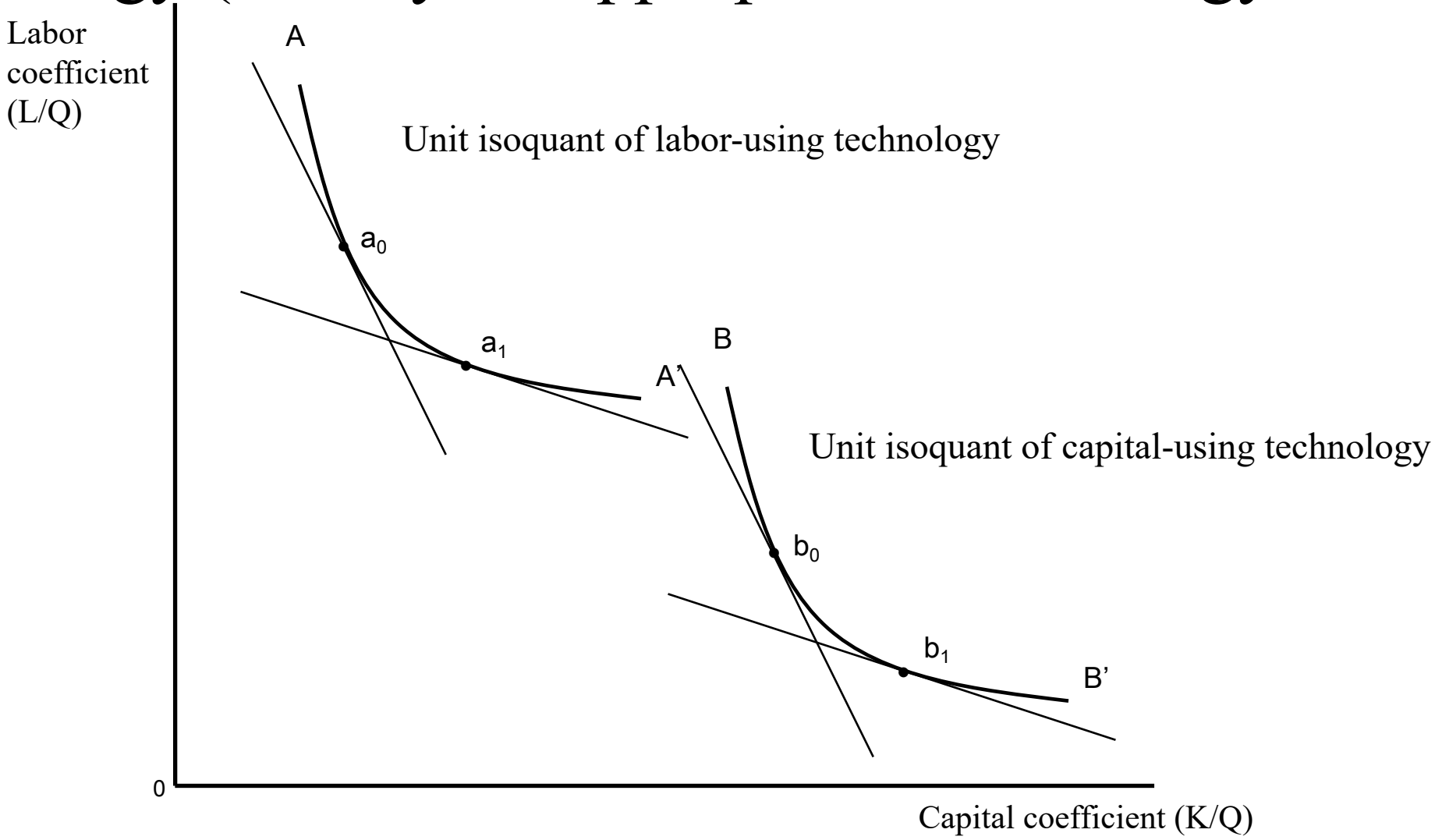
Figure I. Flying Geese Pattern of Development Proposed by K. Akamatsu



Factor Intensity and Comparative Advantage

- Three types of inputs: unskilled labor, capital, and skilled labor with high education and scientific knowledge.
- Typical growth paths follow changing comparative advantage: Labor-intensive industry → Capital-intensive industry → Knowledge-intensive industry.
- My fundamental hypothesis is that no country can develop without following changing comparative advantages described above.
- Japanese economy failed to grow for the last 35 years because of the failure to develop knowledge-intensive industries.

Figure II. Choice of labor-using vs. capital-using technology (Theory of Appropriate Technology Choice)



Empirical hypotheses: Selective Technology Choice and Adaptations

1. As in many developing countries, initially Japan imported modern capital-using technologies and failed to develop industries.
2. Gradually Japan selectively imported labor-using technology, or converted capital-using technology to labor-using technology, which is adaptations to labor-abundant factor endowment of the Japanese economy.
3. Japan adopted capital-using technology only after World War I when real wage rate began increasing.

* The purpose of this study is to prove the hypotheses above based on the review of the development of textile industries, which were leading industries in prewar Japan (see Table 1 next page).

Table 1. Export shares of textile products and number of workers in the textile industries in the prewar Japanese economy (selected years)

	1894	1910	1930
Export shares (%)			
Cotton yarn	0.8	9.9	1.0
Raw silk	34.8	28.4	28.3
Cotton fabrics	1.6	4.5	18.5
Silk fabrics	7.5	7.2	4.5
Number of workers (1,000)			
Cotton-spinning	10.2	29.0	43.0
Silk-reeling	117.6	n.a.[b]	509.1
Cotton-weaving	943.6[a]	761.3[a]	221.8
Silk-weaving			206.5

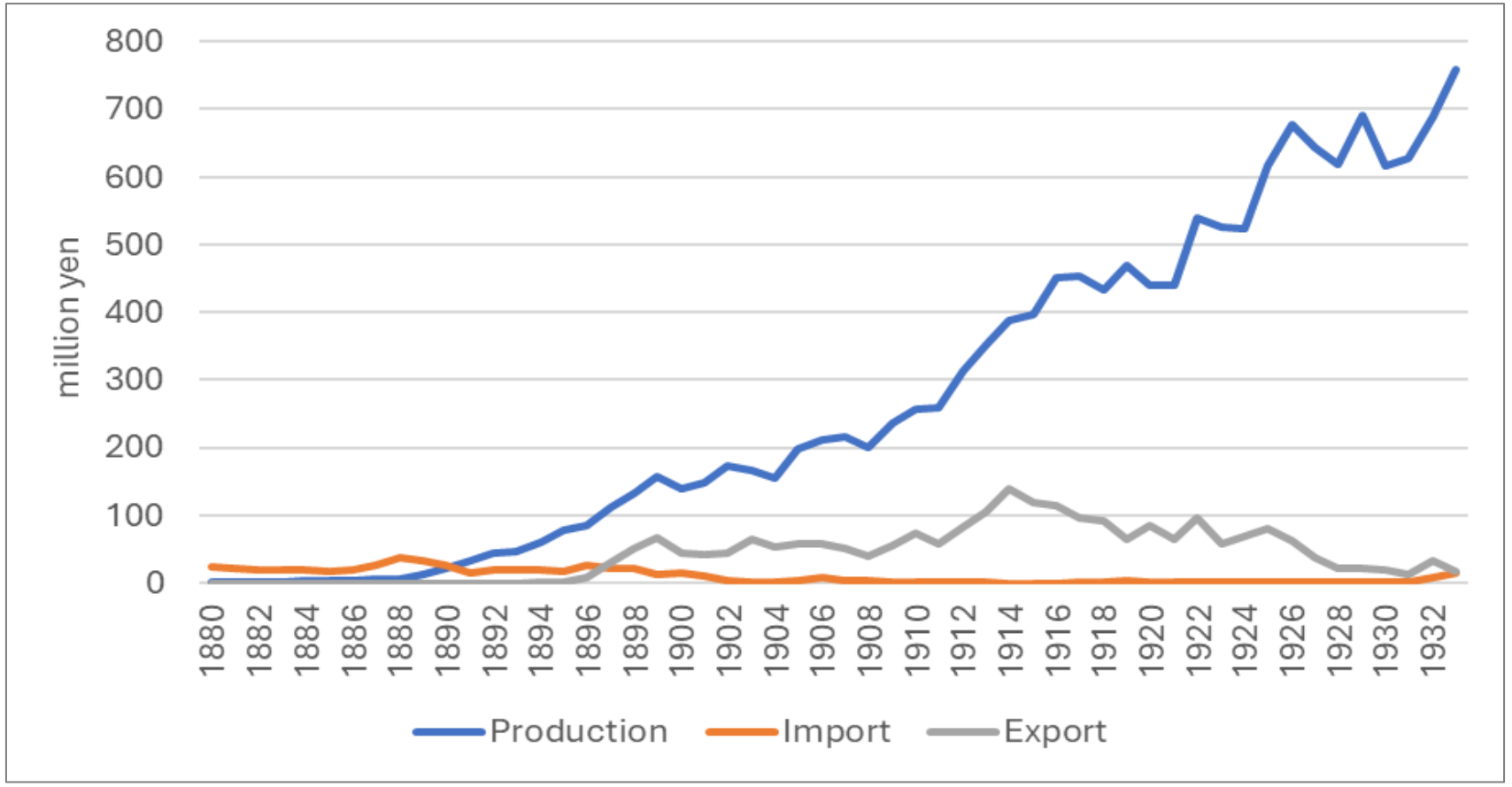
Structure of the textile industries in prewar Japan

1. Cotton Textile Industries
   1-1 Cotton spinning industry (to produce yarn): only modern sector.
   1-2 Cotton weaving industry (to produce cotton fabrics)
2. Silk Textile Industry
   2-1 Silk reeling industry (to produce raw silk or silk yarn)
   2-2 Silk weaving industry (to produce silk fabrics including *kimono*): only traditional sector.

* In this study, we review the development paths of the four types of industries.

1-1 Cotton spinning industry

Figure 1. Changes in the real value of import, domestic production, and export of cotton yarn, 1880–1933 (million yen)[a]

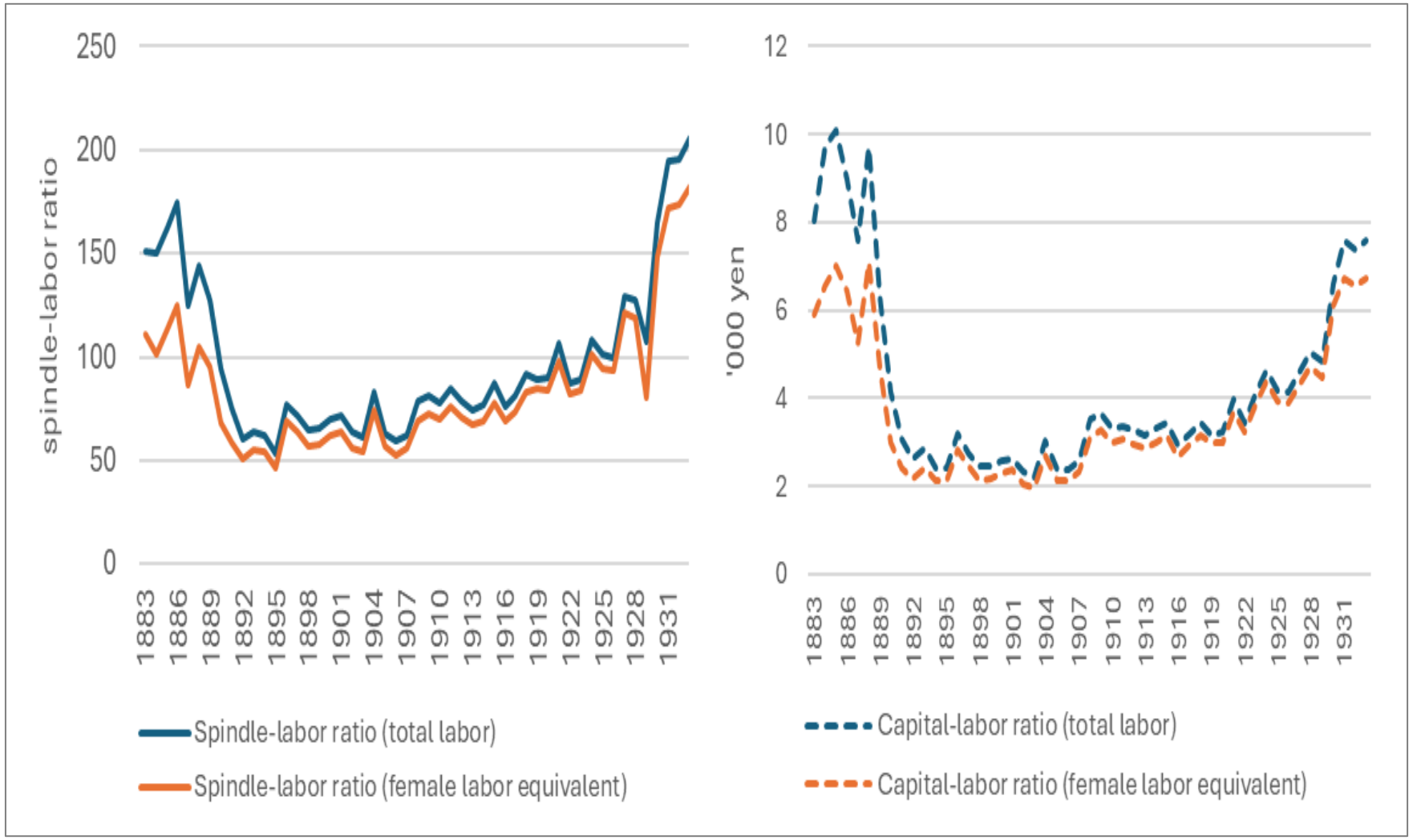


Puzzling observations

1. The government subsidized 10 private cotton mills in 1880-85, using capital-using mule spindles. Production, however, did not visibly increase in the 1880s. As predicted by my hypothesis, they failed to develop with a few exceptions
2. Flying geese pattern is not valid, particularly because of sustainable growth of domestic production with declining export. Why?
3. There were two spinning machines: mule and ring. Mule machine moves slowly and can use short-fiber cotton produced in many developing countries, including India. Ring machine moves quickly and cannot use short-fiber cotton, because of breakage of yarn. India, Russia, Brazil etc. all used mule. Only Japan used ring while using Indian cotton.

* India sent the mission to Japan in 1891 to inquire what was happening in Japan. Mission reported that the Japanese cotton spinning industry had no future because cotton mixing, which was not recommended in manual by spinning machine company, was practiced.

Figure 3. Changes in the spindle-labor ratio in the cotton-spinning industry (left) and real capital stock-labor ratio (right) in the modern cotton-spinning industry, 1883–1933



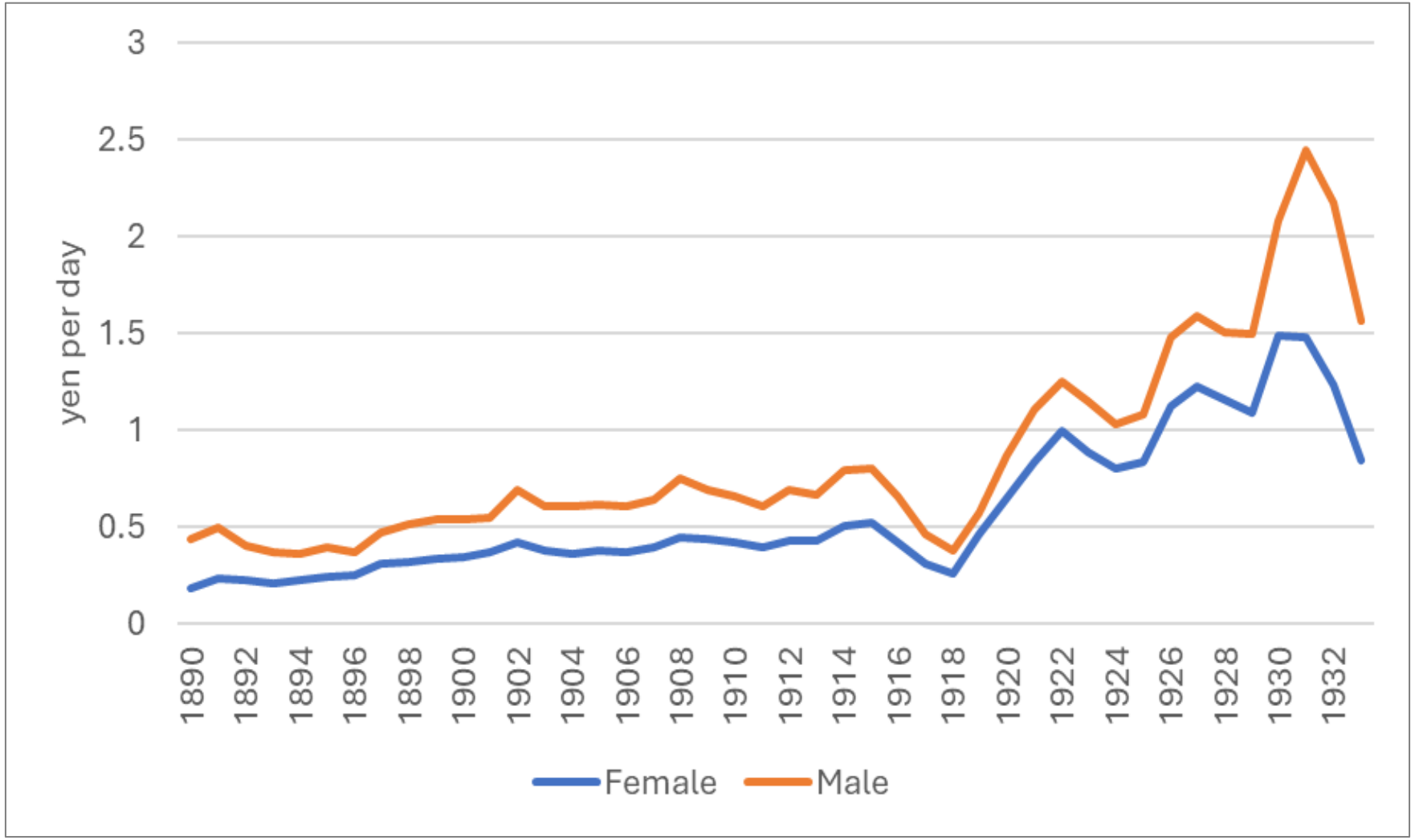
Cotton mixing technology

- Capital-labor ratio in the cotton spinning industry declined in the late 19th century due to the adoption of ring spindles and the development of cotton mixing technology, which employed large number of female workers to comb, sort out, and mix short and long fibers skillfully while using Indian cotton.
- Saxonhouse argued that cotton mixing technology is epoch-making technological progress. We regard this as significant adaptation. In terms of Figure II, the isoquant AA' was created. As a result, Japan outcompeted India in Asian cotton yarn market. By developing cotton mixing technology, Japan acquired comparative advantage in the spinning industry.
- Capital-labor ratio increased sharply after around 1920, which means that cotton mixing technology was no longer important. This is due to sharp increases in real wage rate, which is called "turning point." Shift from labor-using technology to labor-saving technology occurred only when wage rate increased.

Table 2. Import of cotton to Japan by county of origin in selected years

	Total Amount (thousand tons)	Composition (%)				
		China	India	US	Egypt	Others
1884	45	97.3	2.7	0.0	0.0	0.0
1890	333	73.6	21.0	5.3	0.0	0.0
1897	2,229	22.4	62.0	15.6	0.0	0.0
1902	3,386	23.1	53.3	21.6	2.0	0.0
1907	4,601	14.7	58.0	24.2	1.5	1.6
1914	7,839	4.7	70.1	21.7	3.2	0.3
1921	8,605	0.3	60.7	35.4	1.7	1.9
1930	9,573	7.3	49.4	40.6	1.9	0.8
1934	13,554	2.4	42.7	47.9	4.1	2.9

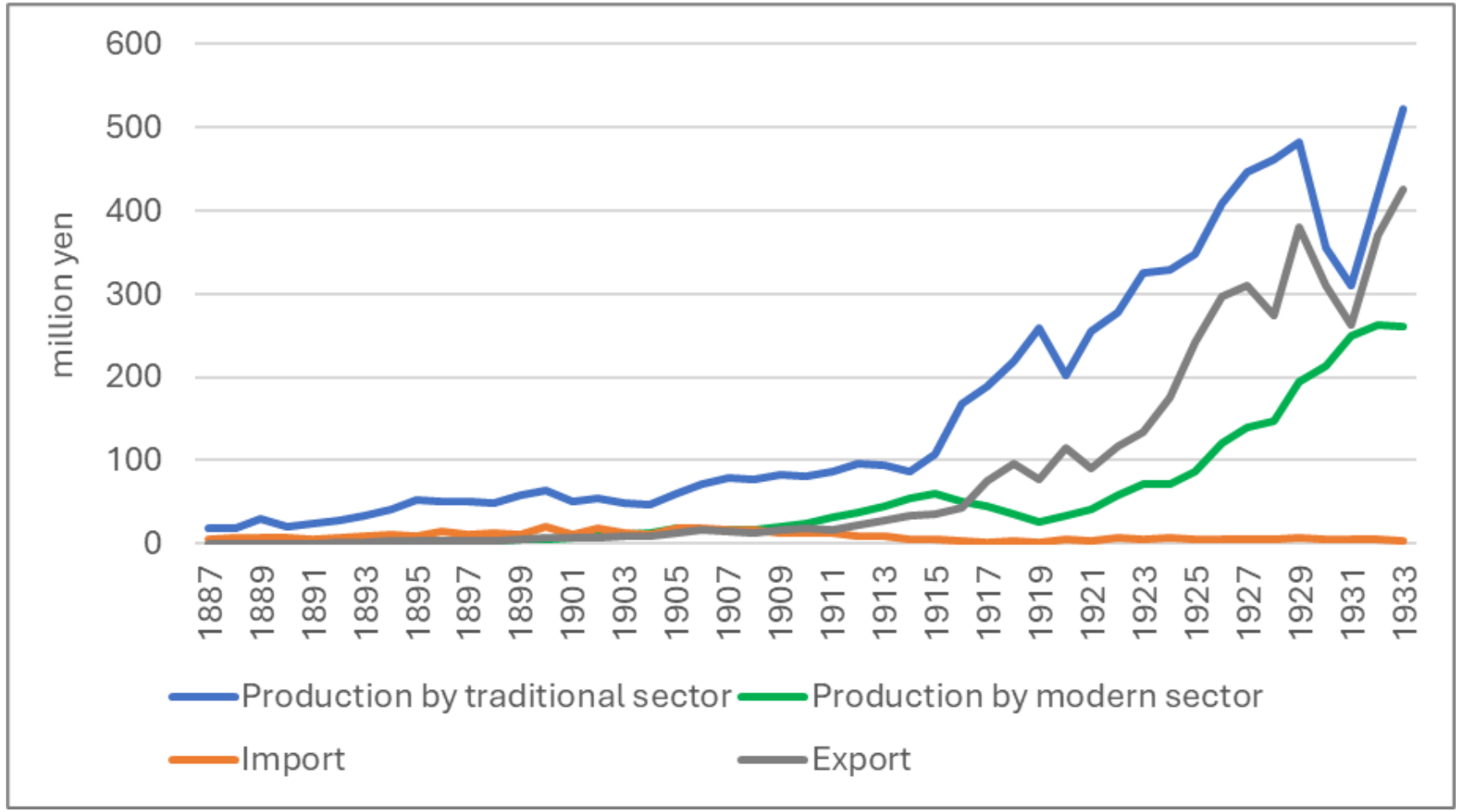
Figure 4. Changes in real wage rate by male and female workers in the cotton-spinning industry, 1890–1933 (yen per day)



1-2 Cotton weaving industry

Figure 2. Changes in the real value of import, domestic production by traditional and modern sectors, and export of cotton fabrics, 1887–1933 (million yen).

Which sector dominated, modern or traditional sector?



What happened?

1. There was negligible import of cotton fabrics, nullifying the flying geese model.
2. Modern cotton spinning mills introduced labor-saving iron powerlooms around 1890 to produce cotton cloth. Significant production began, however, a few decades later, which indicates that the powerloom was not appropriate technology.
3. The traditional cotton weaving industry, which used labor-using handlooms and yarns produced by the modern spinning industry, dominated until around 1915. This indicates that handloom was appropriate technology in Japan before WWI.
4. The traditional weaving industry began using wood-and-iron mixed powerlooms since around 1915, whose price is more or less 5% of the price of imported iron powerloom. The development of wood-and-iron mixed powerloom is an important adaptation.
5. There were 27 traditional cotton weaving clusters. Some of them were domestic marker-oriented (e.g., Shizuoka), and others were export-oriented (e.g., Saitama).

Figure 5. Real value of production of total and cotton fabrics in Saitama and Shizuoka prefectures, 1905–1933)

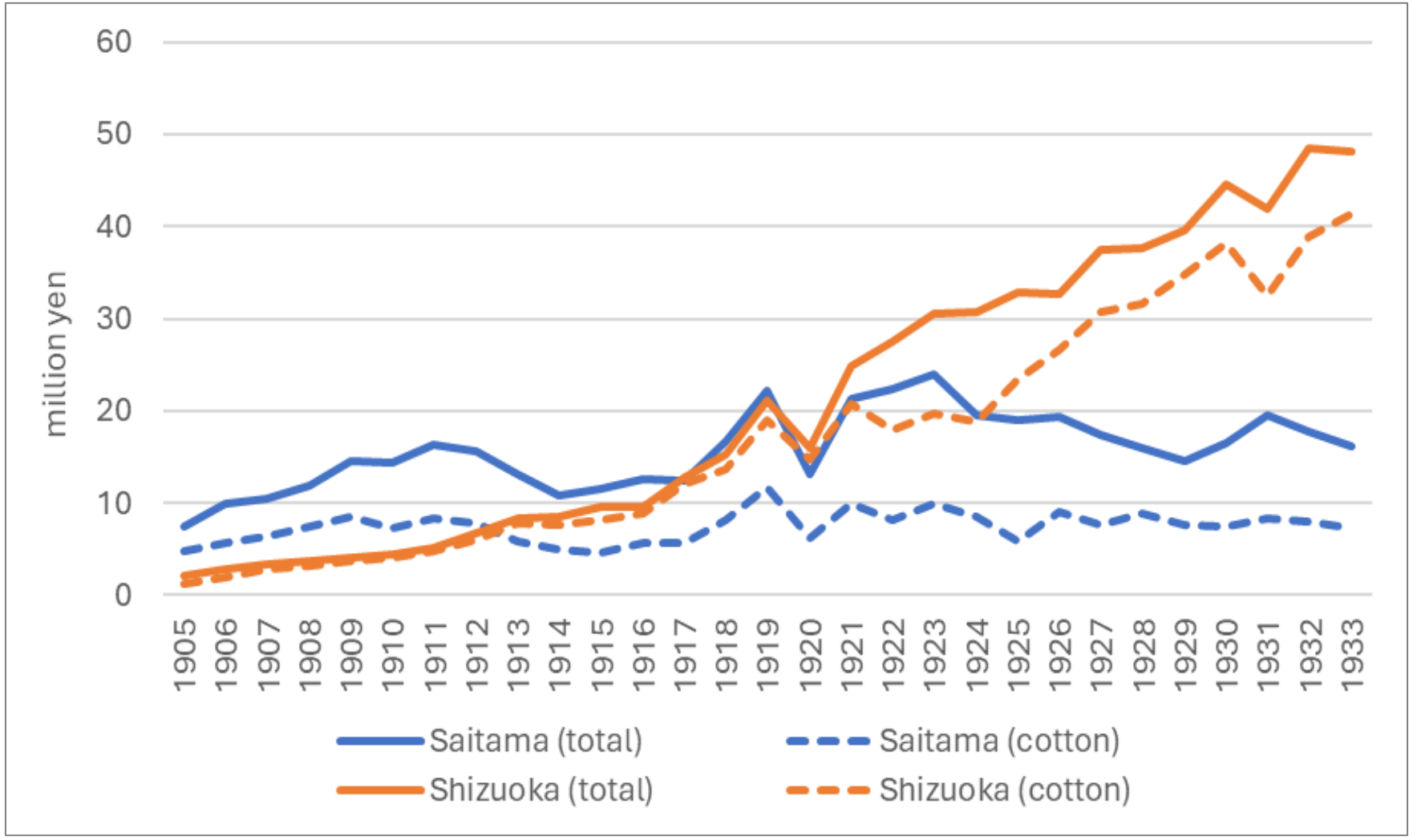
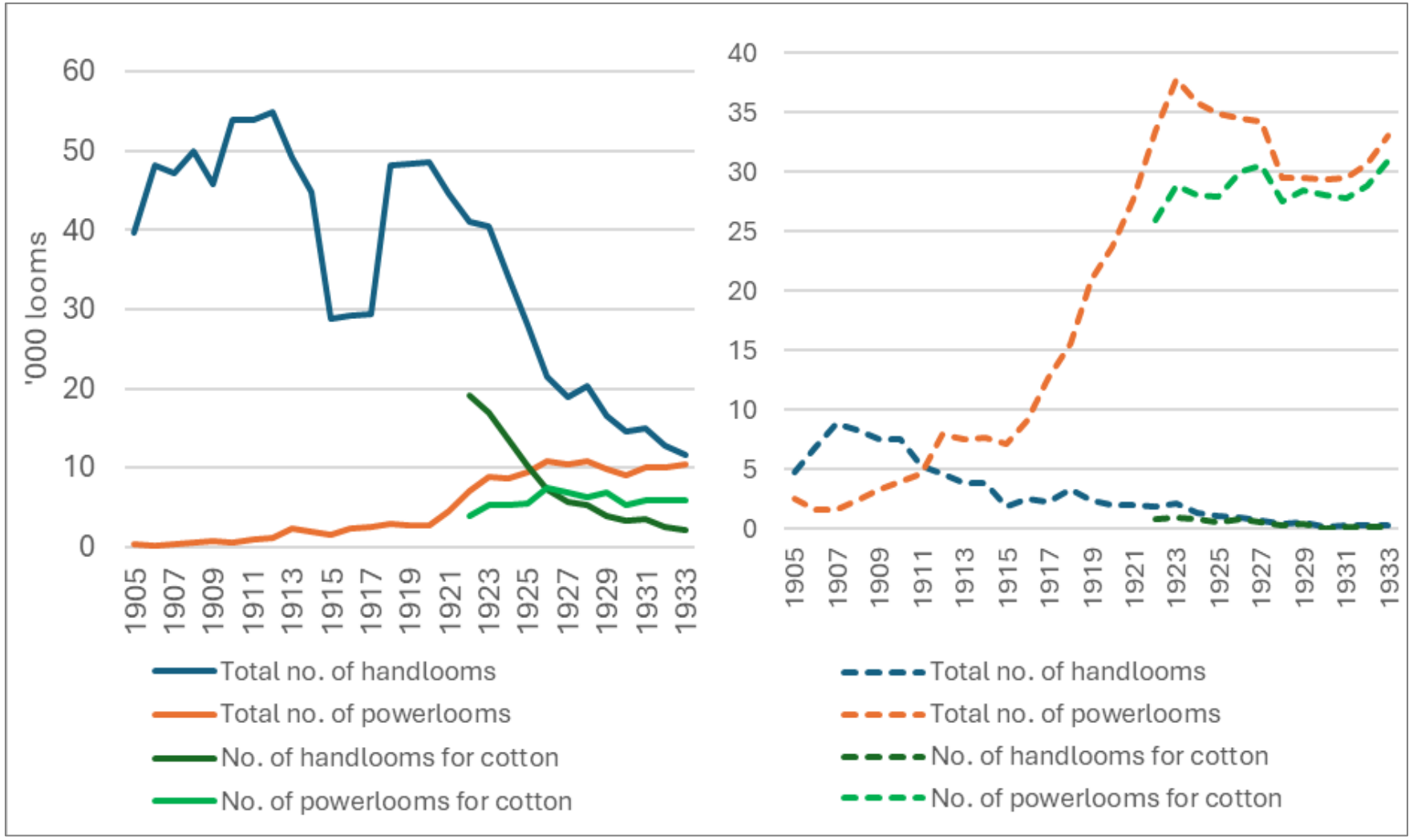


Figure 6. Adoption of handlooms and powerlooms in Saitama (left) and Shizuoka (right) prefectures, 1905–1933



Why did Saitama, which was larger producer in the beginning, failed to grow, while Shizuoka, which was small producer, succeeded to grow?

- Shizuoka was not endowed with skilled workers because of absence of the tradition of cotton weaving and so it selected the production of simple cotton fabric for export by using unskilled workers. Simple tasks can be performed by machines.
- Saitama was endowed with skilled workers because of the tradition of cotton weaving and so it selected the production of relatively sophisticated products for domestic markets. Such production cannot be mechanized easily.
- In Lumban embroidery cluster, too, sophisticated products are produced manually, whereas simple products are produced by machines.

2-1 Silk reeling industry

Figure 7. Changes in total raw silk production from 1878, production of machine-reeled silk from 1889 to 1993 (thousand kg), and export from 1868

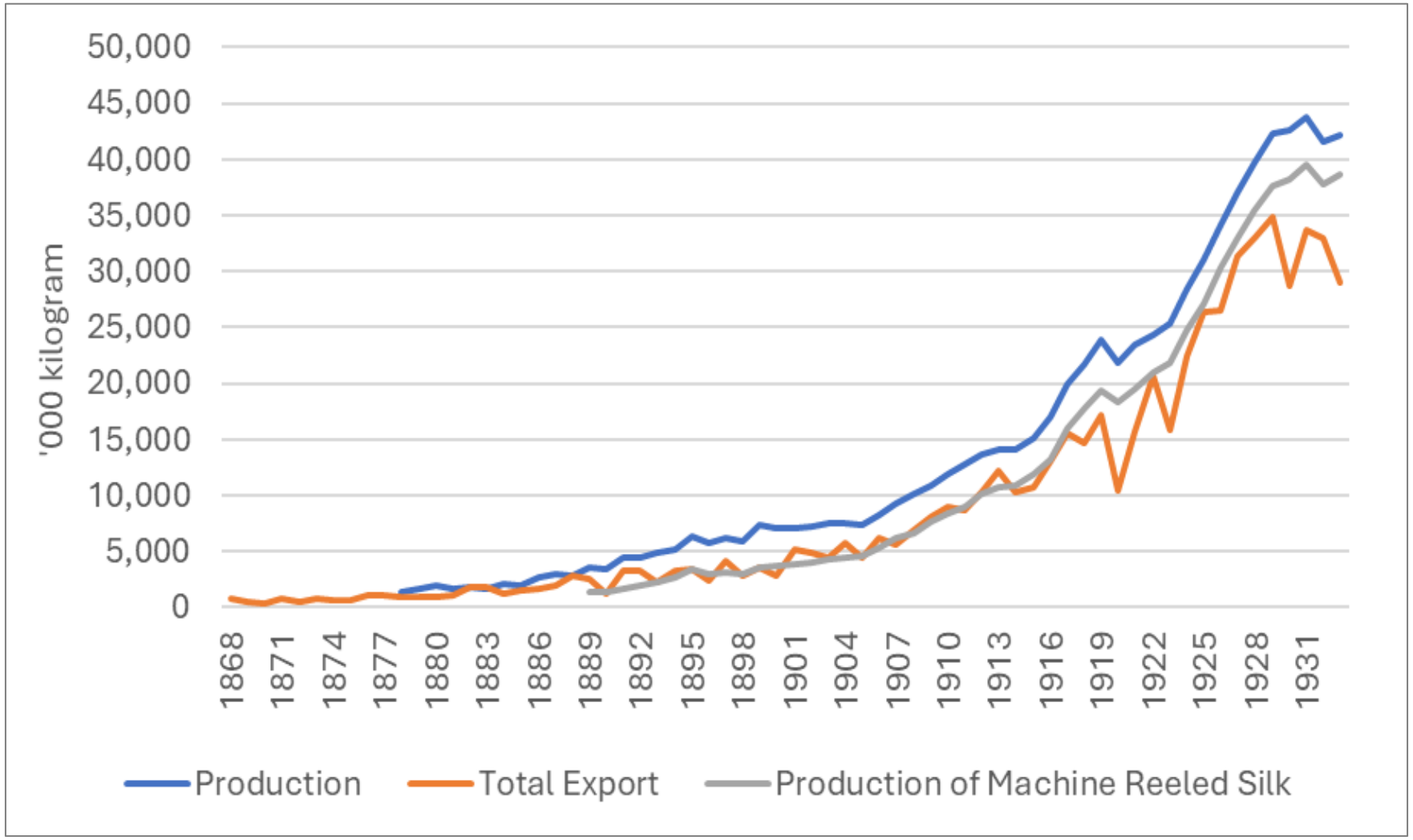
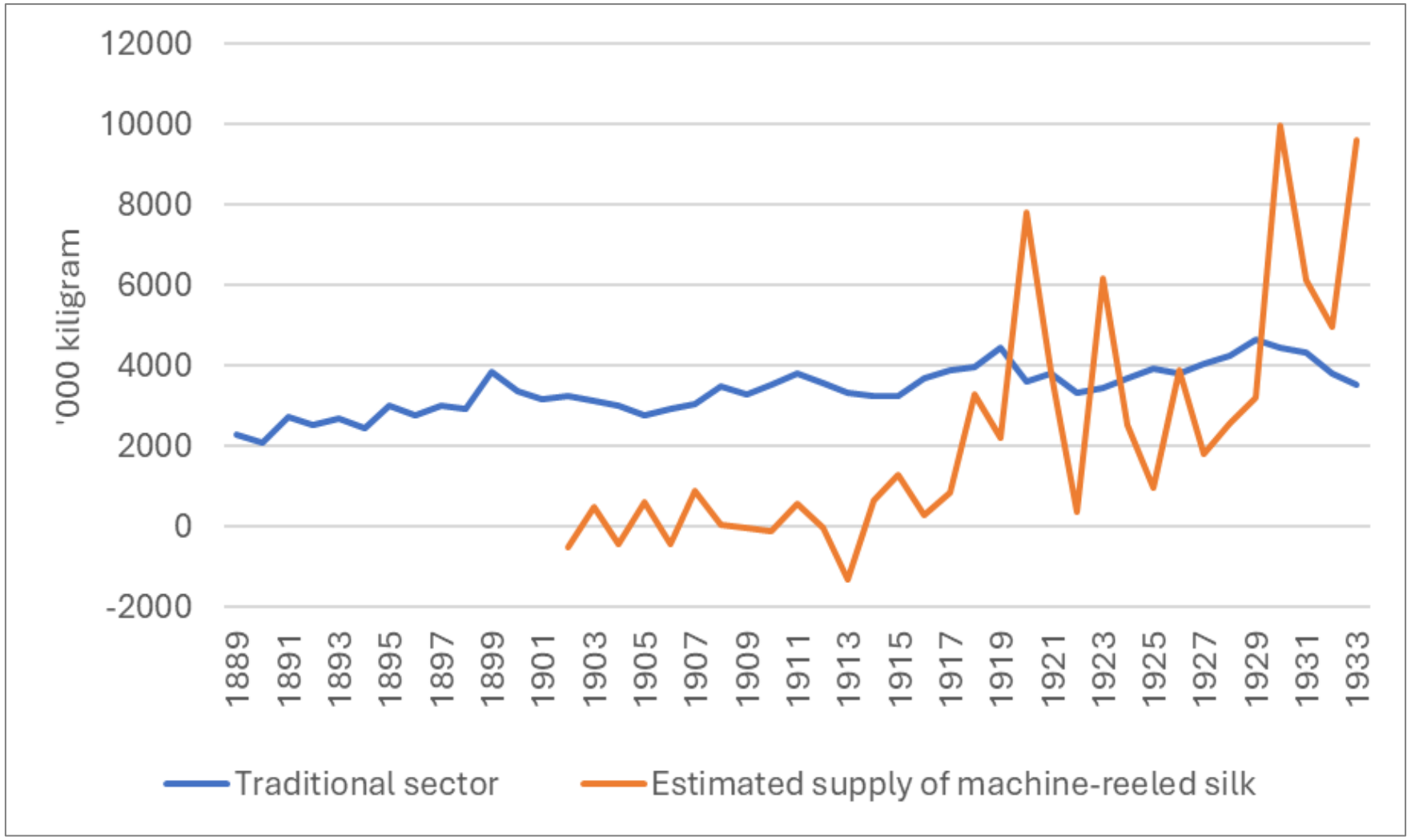


Figure 8. Changes in silk production in the traditional sector, 1889–1933, and estimated supply of machine-reeled silk to the domestic weaving industry, 1902–1933, (thousand kg)

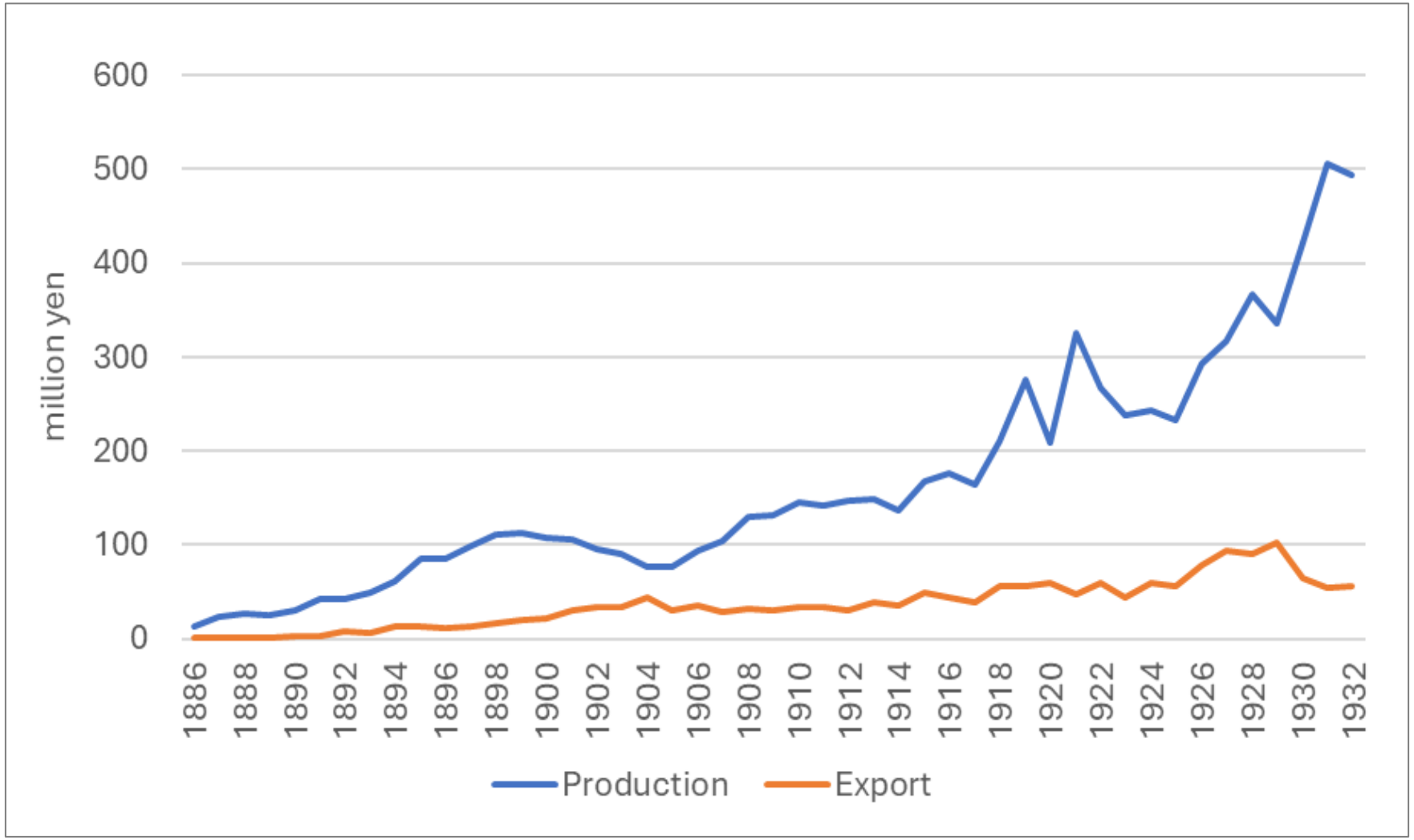


What happened?

- The government established the large-scale Tomioka silk mill by *directly* importing modern capital-using reeling technology from France with employment of French engineers and workers, without any regard to cost and benefit. The performance of the Tomioka was miserable. This direct technology import was failure.
- The traditional labor-using sedentary reeling industry dominated until WWI, and supplied raw silk to the domestic silk weaving industry.
- The modern mechanized silk reeling industry gradually developed and its growth of production accelerated particularly after WWI.
- While the traditional industry was not so active in improvement of technology, the modern industry was more active in *adaptive* technology improvement (e.g., multi-frame reeling machine). These contrasting changes explain stagnation of the traditional sector and accelerated growth of the modern sector.

2-2 Silk weaving industry

Figure 9. Changes in the real value of domestic production and export of silk fabrics, 1886–1933 (million yen)



Characteristics of Silk Weaving Industry

- While there was no import, amount of export was small, indicating no strong comparative advantage in the production of silk fabrics in prewar Japan.
- In 1872, three craftsmen from Nishijin district in Kyoto, the most advanced silk weaving district in Japan, were sent to Lyon, the most advanced silk weaving district in the world, to purchase powerlooms. They considered that powerlooms with steam engine was inappropriate in Japan. They purchased only flying shuttle and Jacquard which can be attached to handlooms. I strongly admire their decision.
- The two large-scale weaving firms established in 1882 and 1887 adopted powerlooms with steam engines. These firms *directly* imported labor-saving technologies and failed to develop.
- There were initial growth phase (1886-96), and subsequent slow and accelerated growth phase (1905-33).
- There were three large silk-weaving clusters; Nishijin (most advanced), Kiryu (imitator of Nishijin) and Fukui (new comer). Let us compare the performance of these clusters.

Figure 10. Changes in the real value of domestic production and export of silk fabrics, 1886–1930 (million yen)

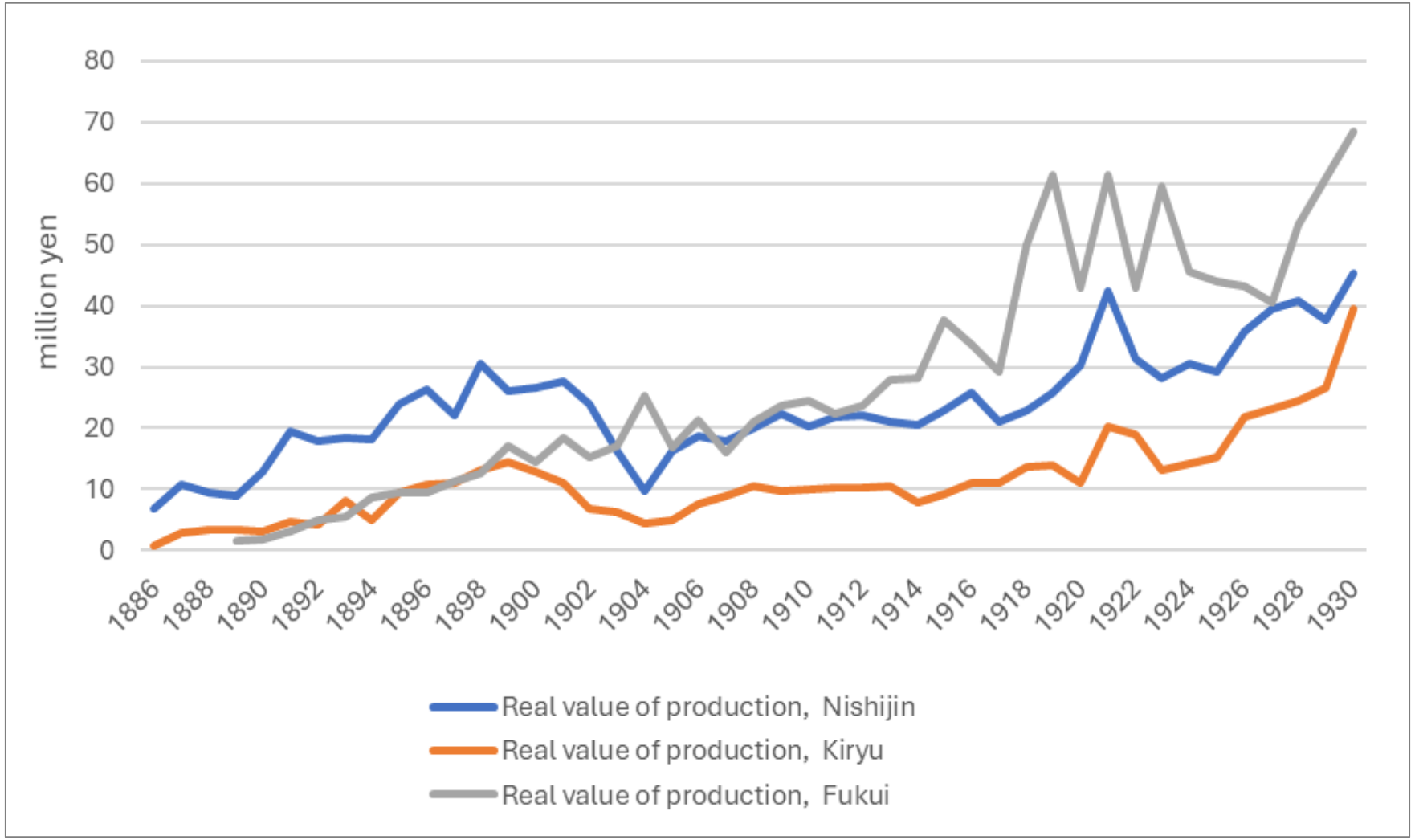
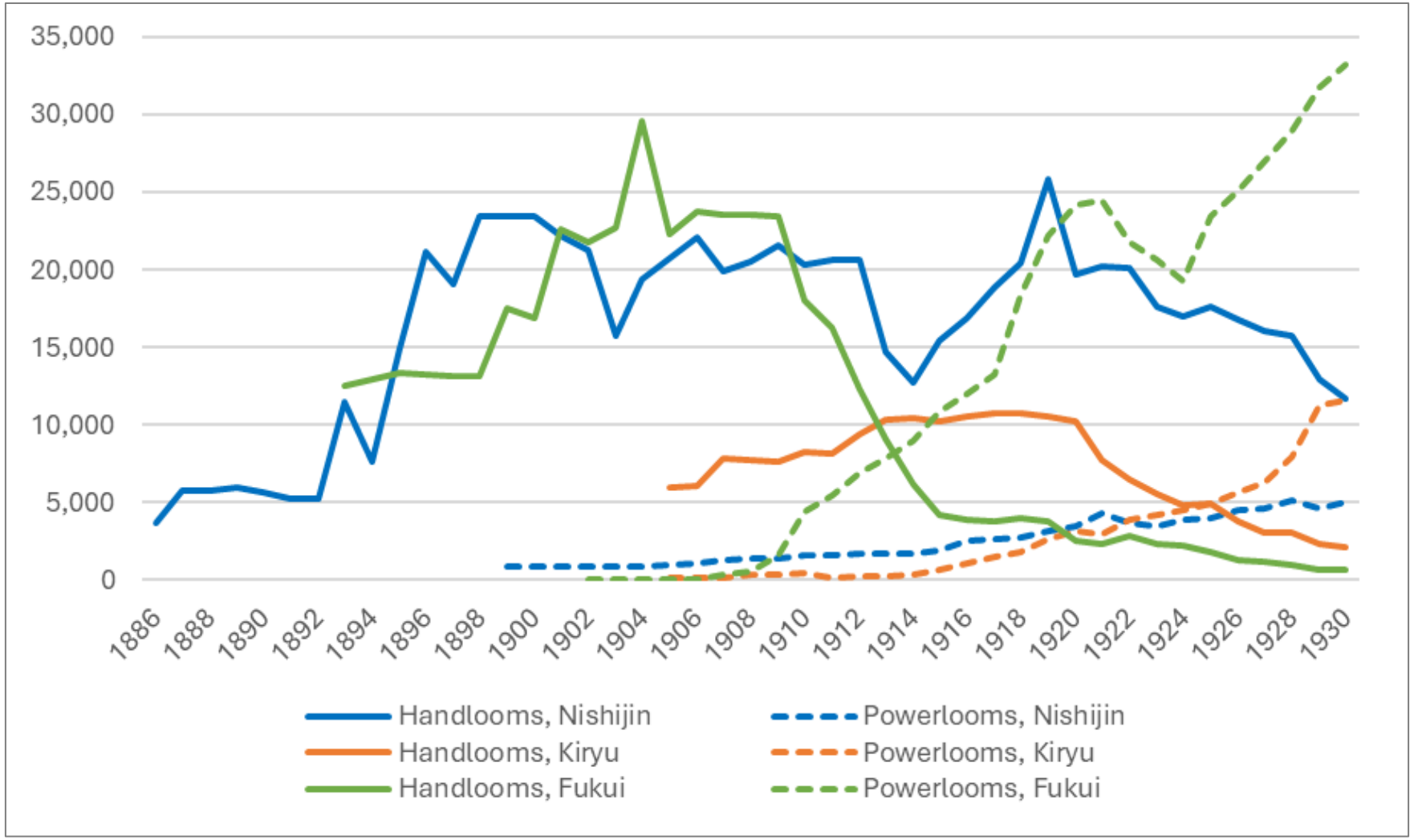


Figure 11 Changes in the number of handlooms (HL) and powerlooms (PL) in the three traditional silk-weaving clusters, 1886–1930



Similarity between the cotton and silk weaving clusters

- The adoption of powerlooms by cotton spinning firms and by large private silk weaving firms in the early phase did not lead to appreciable growth in the production of fabrics.
- Initially large clusters (Saitama in cotton and Nishijin in silk) failed to grow. Initially “negligibly small” clusters (Shizuoka in cotton and Fukui in silk) grew much faster.
- Initially large clusters relied on skilled workers, used handlooms, and produced sophisticated fabrics for domestic markets. Initially small clusters relied on unskilled workers, adopted powerlooms, and produced simple fabrics for export.
- Although I did not have time to discuss, particularly when handlooms were used, contractor-cum-merchants procure materials, decide designs, order small-scale weavers, and sell the final products at the market. This system is very similar to the one in Lumban embroidery cluster.

Concluding Remarks

1. In the early phase of development when labor was abundant, the adoption of capital-using technologies (e.g., mule spindles, premature adoption of powerlooms, large-scale silk reeling mills, and large-scale silk weaving factories with powerlooms and steam engines), which were largely *directly* imported technologies, failed to contribute to industrial development (see Table 3).
2. In the subsequent period, the choice of appropriate labor-using technologies and adaptations (e.g., ring spindles with cotton mixing technology, wood-and-iron mixed powerlooms, and contractor-cum-merchant system) significantly contributed to the development of the textile industries in prewar Japan (see also Table 3).
3. In the later phase of development after the turning point, labor-saving technologies (e.g., iron power looms) were introduced.

Table 3. A summary of technology choices and adaptations in the textile industries in the early period of prewar Japan

Sector	Choice of Inappropriate Capital-Intensive Technology in the Initial Phase	Choice of Appropriate Labor-Intensive Technology in the Late 19th Century	Major Adaptations
Cotton-spinning	Mule spindles	Ring spindles	Cotton mixing
Cotton-weaving	Premature adoption of powerlooms	Handlooms	Contractor-cum-merchant system Wood-and-iron powerlooms
Silk-reeling	Large-scale French-style mill	Sedentary reeling	Multi-frame reeling machine
Silk-weaving	Large-scale factories with powerlooms and steam engine	Handlooms with Jacquard	Contractor-cum-merchant system Wood-and-iron powerlooms

Concluding Remarks (continued)

- Flying geese model of development was not valid, partly because of the failure to consider selective technology choice and adaptations and partly because of the neglect of linkage between industries (e.g., the cotton spinning and weaving industries).
- Emphasis on successful labor-intensive industrialization is somewhat misleading partly because capital-intensive technologies were adopted in the initial phase of development and partly because shift from labor-intensive industrialization to labor-saving industrialization after the turning point must be duly appreciated.
- In short, appropriate choice of technologies and adaptations to changing factor endowments were the keys to the successful development of the textile industries in prewar Japan.

Thank you very much for your attention!