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Abstract

Even after modern economic growth began in the Western world, the international market, which consists of a number of national and regional markets, has been more or less inefficient with respect to information. To calm this inefficiency, economic institutions have taken important roles. In addition, players in a society whose institutions are superior have earned information rent in the international market. The treaty port in Japan that was imposed by Western powers worked as such an efficient institution, and a Japanese export industry took advantage of it at the beginning of Japan's industrialization. This designed market provided useful information with the export industry in the inland, as, say, stock markets do with various industries in modern economic societies.

Key words: institutions, efficient market, exchange rate and prices, treaty port, development.
JEL: O19, N75, L11.

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I. Introduction: efficient markets and economic development

A. Efficiency with respect to information set

In the ideal world without asymmetry of information, "efficiency" literally means "efficiency" of resource allocation, the result being reached through the market mechanism. The process this result obtains does not matter.

However, the real world with asymmetry of information is always on the move toward a more efficient resource allocation. Going on this process, players who have more information make more money, and societies with less asymmetry of information develop faster.

In other words, we need to focus on the process rather than the result, and on information rather than resources, in order to understand the economic development, which took place in the real world.

We assume here that a market is efficient with respect to information set if the market suffices the conditions mentioned below:

> *In general terms, the ideal is a market in which prices provide accurate signals for resource allocation: that is, a market in which firms can make production-investment decisions, and investors can choose among the securities that represent ownership of firms' activities under the assumption that security prices at any time "fully reflect" all available information. A market in which prices always "fully reflect" available information is called "efficient."* [1]

In such a market, players acquire "normal returns." However, prices in markets of the real world do not "fully reflect" "all available information." Hence, in the real world, players who have more information could acquire abnormal returns.

This holds for national economies, too. The international market consisting of a number of local economies has not been perfectly efficient with respect to information. Because of the general existence of information asymmetry, institutions have affected the performance of each economy. The modern institutions developed in the Western world have been successful cases.

Indeed a widely shared idea about economic development is that market mechanism based on Western culture is essential, and empirical works have showed some evidence for this.[2] But, how can the Western style of market mechanism be maintained in the non-Western world? The modern civil law system and other governance mechanisms could be important instruments. Also, international "public goods" such as the mechanism of free trade and the international financial system established by the British empire seem to have prompted the development of areas incorporated into the empire.[3] On the other hand, institutions which are not consistent with market mechanism could be "barriers" to economic development.

However, those institutions which enhance market mechanism had been formed as the Western economies had developed, and did not exist from the very beginning in the Western

[1] Fama (1970), p. 383.

[2] Hall and Jones (1999). Acemoglu and Robinson (2000). Hayashi and Prescott (2005).

[3] O'Brien (2002), pp. 4-64.

world. Neither did they exist in non-Western economies at the exactly moment when they started to develop under the Western influence. Those economies progressed Westernization only gradually, in the face of competition with challenge from the Western world. It is relevant to note here that they did not have an "efficient" market inland at the time when they encountered the international market. We need to know what kind of instruments processed information and induced more efficient resource allocation at the beginning of modern development, in order to understand how the industrialization began.

The "treaty ports" in Asia offer an interesting case in this context. East Asian countries were forced to establish treaty ports as channels of free trade and allow Western merchants to settle there in the last half of 19th century. Those countries increased international trade through those channels.

This paper focuses on the role of a treaty port of Japan in the late 19th century because it had an institutional mix which allows us to test the importance of efficiency with respect to information set. Obviously Japan has been one of the most successful "Westernized" non-Western economies since it was incorporated into the global market by the imposed free trade in 1859 and started modern economic development in the mid 1880s. In Japan, however, the modern legal system was established as late as in the 1890s, while free trade boosted Japan's growth as soon as Japan opened its ports to foreign trade.[4] Hence the free trade of Japan from the 1860s to the 1880s gives an interesting example, where free trade worked well for economic growth at a time when Western institutions had not been introduced within Japan. How could free trade based on market mechanism work efficiently in the country, which had been ruled by Samurais for several centuries?

As a result of the commercial treaties signed between Japan and Western countries, free trade was completely guaranteed in the treaty ports, and transactions within the treaty port were governed by the courts of the Western consuls if the defendants were Western. All international trades were conducted within the treaty ports, so that the efficiency by Westernization there was critical to the growth of trades.

B. Industrialization and international trade

Another reason for studying the treaty port relates to the importance of international trade itself at the beginning of the modern economic development. The long-held view that traditional industry first grows in response to local or regional demand, and gradually develops into modern factory has been challenged for some time. One influential criticism of this view can be found in the literature on proto-industrialization. According to this literature, the primary demand for proto-industry generally came from outside the region where the industry was located, and in fact it frequently came from abroad.[5] In some cases, it was not just the demand but the supply of raw material that came from outside the region.[6] The emphasis on demand and supply from outside the region echoes the findings of the more recent literature on the

[4] Huber (1971), Bernhofen and Brown (2005).
[5] Mendels (1972).
[6] Hudson (1986).

industrial revolution in England. The principal demand for the English cotton industry during the period of the industrial revolution was foreign, while its raw material, raw cotton, came entirely from overseas.[7] Simple messages from these arguments are that both the demand for the product and the procurement of raw material could come from outside but that they need to be linked to the regional market for the development of a modern industry.

It is easy to see that regional and inter-regional markets can be potentially complementary to each other. In order for the proto-industry to develop into the modern industry, however, the both markets have to be coordinated, that is, the price changes must be adjusted simultaneously in both markets. This does not occur easily. Given that the transaction costs, for example the cost of acquiring information about the price in the respective factor market, can be high, those markets are not necessarily arbitraged at the same time. If they are not organized well and if they are not arbitraged simultaneously, it may affect the growth and development of the proto-industry. Indeed the paths of "proto-industry" regions had not been monotone. In the case of Europe, some regions were de-industrialized, while others were industrialized within a short space of time after proto-industries had grown.[8] Among the possible reasons for the different outcomes seems to be the coordination failure of potentially complementary markets. In other words, if there is an efficient instrument to synchronize related markets, it could accelerate the development of the modern industry.

C. Coordination supported by the treaty port

The hypothesis of this paper is that the treaty port of Yokohama took this coordinating role in late 19th century Japan, resulting in the development of the silk reeling industry. The Japanese modern silk reeling industry emerged in the mid-1880s and thereafter the exports of raw silk to the U.S. rose dramatically. The Japanese share in the U.S. raw silk market exceeded 50 percent in the late 1880s, 60 percent in the late 1900s, 70 percent in the 1910s, and 80 percent in the 1920s.[9] Indeed it was in the mid-1880s that the Japanese economy started modern economic growth.[10] The development of the modern silk reeling industry was the first experience in Japan of a strong export industry leading economic development, a pattern later followed by many other manufacturing industries.

As soon as Japan began to trade with Western countries under commercial treaties in 1859, traditional hand-reeled raw silk (*Hanks*) was exported to Europe, especially to France.[11] However, it had lost its competitive edge over Chinese traditional raw silk during the 1870s, and had further suffered the adverse effects of the depression in France in the mid-1880s. By contrast, the development of the American modern silk fabric industry since the late 1870s created a new international demand. This change in the structure of international demand urged the Japanese silk reeling industry to modernize itself, since the American modern fabric industry, in contrast to the French traditional one, demanded machine-reeled raw silk (*Filature*) as raw

[7] Crafts (1985), pp. 2-3, 141-152.
[8] Ogilvie and Cerman, eds (1996).
[9] Nakabayashi (2003), pp. 473-477, Appendix: Table 5-1, 5-2.
[10] Minami (1994).
[11] Nakabayashi (2003), pp. 473-483, Appendix: Table 6-1, 6-2.

material, and it would therefore be necessary to produce what was in demand in the U.S. if Japan was to switch its export destination.

At the same time, the development of the modern silk reeling industry required an efficient market of cocoon, its raw material. Railway lines were constructed in Eastern Japan from the 1880s to the 1900s, and it promoted the convergence of local cocoon markets. This convergence prompted the reorganization of sericulture, where farmers, who had been engaged both in sericulture and in hand reeling of raw silk, stopped the latter and came to supply cocoon to the modern silk reeling manufacturers.

Interestingly, this reorganization of sericulture progressed in the mid-1880s, at a time when international demand shifted from France to the U.S. There are several factors that helped boost modern industrial development at this critical moment. One of them was the falling exchange rate in the mid-1880s. The value of the Yen was linked to that of silver in those days, hence the falling price of silver in the mid-1880s meant the devaluation of the Yen.

The conventional view of the effects of falling exchange rate has been that Yen's fall depressed the price of Japanese commodities in the international market, thereby contributing to the growth of exports. This view assumes that there was a significant delay in the arbitrage of the product market. The reasoning behind this view is not difficult to see: the adjustment of price in the product market is usually substantially delayed after the exchange rate change occurs in the financial market. This view supposes that the product market is not efficient enough to immediately arbitrage price of the product market in accordance with exchange rate fluctuations. If it had been true, however, we should also expect a delay in the inflow of information about the structural change of international market since the change of relative prices of *Filature* to the US and *Hanks* to France in the international market could not be immediately reflected in the product market within Japan, in which case the knowledge that modern silk reeling should replace traditional silk reeling would not be rapidly transmitted. Therefore, if the market had not been efficient enough, traditional raw silk manufacturers should have increased its exports by taking advantage of its devaluated price. Thus the reorganization of the silk reeling industry should have been delayed rather than prompted by the falling value of silver.

Nothing is further from what actually happened. The devaluation was immediately arbitraged by an increase of the product price, so that the price of Japanese raw silk in the New York market even rose in the mid-1880s. Of course, it did not mean that the entire Japanese market was efficient. The arbitrage of prices for non-tradable goods, for example, was delayed for about a few years. But, as far as the product of the modern silk reeling manufacturer is concerned, its price in the international market did not fall, and his real income, equivalently his income compared with the domestic price level, rose during the fall of the exchange rate. Therefore, reflecting the structural change of international market, the price of *Filature* rose more than that of *Hanks*, and the falling exchange rate increased the real income of the modern silk reeling manufacturers, which prompted the reorganization of sericulture.

Why did such a thing happen? The answer is simple. The market in the treaty port of Yokohama was super efficient, while the Japanese domestic market was not necessarily so. By the prescription of the treaty, all trades with foreign countries were conducted within the treaty ports, each of which consisted of a very small area. Therefore, any information about

foreign trade tended to be shared by every player right away, so that the commodity price was adjusted to the change of exchange rate immediately. The domestic market was generally less efficient. However, the construction of railways integrated local cocoon markets, hence made the cocoon market more efficient. Both the integration of the market for raw materials and the changing international market were successfully communicated through the efficient treaty port market. Thus sericultural farmers near the trunk lines abolished hand silk reeling and began to supply cocoons to modern silk reeling manufacturers, responding to the increase of relative price of *Filature* to *Hanks* at Yokohama.

As Sugihara pointed out, East Asia increased the amount of trade since the 1880s and successfully utilized resources within the region after it was incorporated into the system of free trade, created and dominated by Western countries.[12] While the most important reason behind this success was the capabilities East Asians possessed themselves, it can be suggested that there was another factor that boosted its development, at least in Japan; the treaty port system was extremely efficient in contrast to the domestic market; hence it prompted export-oriented development.

In **Section II**, the structural change of the international market and the rise of modern silk reeling industry will be discussed. **Section III** compares the informational efficiency of raw silk market with that of exchange rate at the Yokohama market. **Section IV** shows that the efficiency of raw silk price was at least comparable with the exchange rate. In **Section V**, we'll go back to discussion of the historical role of treaty port, "imposed efficiency."

II. International market and the rise of silk reeling industry

A. Japanese silk reeling industry in the changing international market

Before the middle 1880s, most of Japanese raw silk was exported to France, first by the way of the U.K. in the early 1860s and directly from the late 1860s. Japanese exports of raw silk increased from 548 tons in 1860 to 1,253 tons in 1862. However, it almost stopped growing around 1863, and stayed between 400 tons and 1,100 tons during the 1860s and the 1870s,[13] when the total raw silk imports into France increased. And this trend became even stronger in the 1870s, when the price level generally fell in the Western world. While imports to France from China rapidly increased from 800 tons in 1870 to 2,670 tons in 1880, imports from Japan, which was 400 tons in 1870, rose only to 840 tons in 1880. In fact, the comparative advantage of Japanese traditional raw silk over Chinese one was being lost during the 1870s, when the price level was decreasing,[14] Especially, the fall of price and stagnation for a few years after 1882 severely affected sericultural farmers who were engaged in hand reeling.[15]

[12] Sugihara (1996).

[13] Nakabayashi (2003), pp. 470-473, Appendix; Table 4-1, 4-2. About the statistics of production and export of raw silk, see Nakabayashi (2003), pp. 461-463, Appendix: Table 1. An overview is also given by Hunter (2003), pp. 31-49.

[14] Nakabayashi (2006).

[15] Nakabayashi (2003). The financial crisis in 1882 heavily affected the trade of raw silk in Europe ("Commercial history and review of 1882." *The Economist*, no. 2,061, Feb 24, 1883, p. 26.), and then French economy

Meanwhile, the price of *Filature* (machine reeled raw silk) in the New York market rose relative to that of *Hanks* (hand reeled raw silk) in the Lyon market in the 1880s, because the demand from American silk fabric industry for *Filature* exhibited a strong growth (Figure 1).

The silk fabric industry in Lyon highly developed in the early 19th century and it retained the feature of "flexible specialization" as an industry for luxurious fashions using hand looms until the 1900s.[16] Thus, France needed various kinds of raw silk as raw materials for the silk fabric industry, ranging from Italian *Filature* of high quality to Asian hand reeled raw silk of low quality.

The American fabric industry, by contrast, began to produce goods for mass consumption in earnest in the late 1870s. As power throwing machines and power looms rapidly prevailed, the factory system equipped for mass production was established.[17] The American silk fabric industry kept up with the fashion in New York, as the French counterpart worked with the fashion in Paris. The American modern silk fabric industry, however, responded to new modes of fashion by creating a basic combination of colors and textures, which could be manufactured by the factory system. It was thus not necessary to resort to the putting-out system, with the use of hand-weavers, as was the case in France.[18] In addition, the industry pursued "the uniformity of goods" for mass consumption,[19] and low-skilled male workers were replaced by unskilled female workers.[20] Therefore, the American silk fabric manufacturers did not value hand-reeled Hanks, which was not suitable for power throwing machines and power looms, and actively sought less expensive *Filature* with even threads.[21]

B. Reorganization of sericulture and distribution of rent

This increase of demand for *Filature* with even threads led to a sharp rise of its relative price in 1885-1886 (Figure 1). It shows there was a gap between the sharply increasing demand

entered the depression until 1886 (Levy-Leboyer and Bourguignon (1990), pp. 1-13.). The silk fabric industry in Lyon was also stagnant during the depression (Bouvier (1960), pp. 235-249.).

[16]Duran (1913), pp. 72-77. Rawlley (1919), pp. 66-73. Piore and Sable (1984), pp. 28-35. Cottereau (1997). Federico (1997), p. 77. In France, there were 100,000 handlooms and 18,230 power looms in 1880, and 56,000 handlooms and 30,000 power looms in 1900. Federico (1994), p. 474.

[17]Wyckoff (1879), pp. 8, 29-30. In the U.S., there were 5,321 power looms and 3,153 handlooms in 1880, and 44,257 power looms and 173 handlooms in 1900. The Department of the Interior, *Report on the manufacturers in the United States at the tenth Census (June 1, 1880)*, Washington DC: Government Printing Office, 1883, pp. 928-929. The Department of the Interior, Census Office, *Twelfth Census of the United States, taken in the year 1900, manufacturers part 3, special reports on selected industries*, Washington DC: Government Printing Office, 1902, p. 206.

[18]Wyckoff (1879), pp. 8-9. D. George Dery, "Silk: a fabric of general use." *The American silk journal*, vol. 37, no. 8, Aug 1918, p. 40.

[19]Wyckoff (1879), p. 8.

[20]The Department of Labor, *Report on condition of woman and child wage-earners in the United States, vol. 9: history of women in industry in the United States*, Washington DC, Government Printing Office, 1910, p. 10. Mason (1910), pp. 130-131. Clark (1929), pp. 210-215. Matsui (1930), pp. 131-153. On differentiation of wages between female and male workers in the American silk fabric industry in the 1900s, see Aldrich and Albelda (1980), pp. 329-340.

[21]Wyckoff (1879), pp. 25-27. Wyckoff (1883), p. 18.

and the supply, which meant an opportunity for suppliers to acquire some rent. This gap was accurately found in the Yokohama market. The behavior of prices in New York and Lyon meant a sharp rise in the relative price of *Filature* to Hanks in 1885-1886. Accordingly, price of *Filature* relative to Hanks in the Yokohama market rose (Figure 2).

Grasping the increase of demand in the U.S., the modern silk reeling industry developed in Suwa County of Nagano Prefecture in Central Japan from the mid-1880s. Though respective reeling factories were equipped with only a few dozens of basins,[22] the silk reeling manufacturers organized cooperatives and established re-reeling factories. They cooperatively re-reeled raw silk, systematically inspected its quality, put the chop (trademark) of the cooperative on it, and shipped it to Yokohama. They guaranteed a particular quality by putting their chops, to acquire the quality premium. In 1884, exports of raw silk from Japan to the U.S. exceeded exports to France, and production and exports of *Filature* increased rapidly since.[23] The Japanese share of the U.S. raw silk market reached over 50 percent in 1887.[24] The opportunity to take rent clearly prompted the rapid development of the modern silk reeling industry.

Meanwhile, sericultural farmers, engaged in hand reeling, suffered from the French depression and the deflationary policy by the government, which coincided it.[25] They then stopped hand-reeling, and began to supply cocoons as raw materials for the modern silk reeling industry. Interestingly, a considerable portion of rent from a sharp increase of demand for *Filature* was shared by sericultural farmers. In the mid-1880s, the supply of cocoons became more profitable than the supply of traditional raw silk after hand reeling, and the gap in profits between the supply of cocoons and the hand reeling became significant enough to be widely noticed for about 1885-1886 (Figure 3). This rent encouraged sericultural farmers to switch quickly from hand reeling to the supply of cocoons in the areas where the modern silk reeling manufacturers could reach and buy cocoons.[26] The development of the modern silk reeling industry coincided with the reorganization.

This reorganization appears to have been accelerated by two conditions. The first was obviously the rent from the gap between the prices of *Filature* and Hanks in the international market or, more correctly, the relative price of *Filature* to Hanks in the international market being immediately reflected in the Yokohama market. Otherwise, the Japanese silk reeling manufacturers and sericultural farmers would not have recognized the structural change of the international market, and would have failed to acquire the rent from the change. Hence the reorganization would have been delayed. The second condition was the fall in the price of

[22] One basin was operated by one reeling worker.

[23] *Filature* amounted to 31 percent of total export of raw silk in 1880, and 50 percent in 1889. Nakabayashi (2003), pp. 96-97.

[24] Nakabayashi (2003).

[25] The Japanese government had adopted deflationary policy, that is, decreasing base money and increasing tax, for the transfer of income to the government sector. Patrick (1965), pp. 202-205.

[26] In Chubu/Nishi Kanto area, which is neighboring to Nagano Prefecture, the production of cocoons dropped to 32,165 kiloliter and the production of raw silk dropped to 728 tons in 1885 affected by the French depression. In 1889, though the production of raw silk recovered to 60,388 kiloliter, which was 188 percent of the production in 1885, the production of raw silk was 1,182 ton, 162 percent of the production in 1885.Nakabayashi (2003). The reorganization began in this area and farmers came to supply cocoons to the silk reeling manufacturers outside of their region.

silver in the international market. Japan was effectively under the silver standard from 1871 to 1897, and thus the fall in the price of silver meant the fall of the exchange rate against the U.S. and European countries, most of which were under the gold standard by that time. This fall of the exchange rate resulted in inflation, led by tradable goods represented by raw silk. It is important to recognize, however, that the main effect of the falling Yen was not a depreciated price of Japanese raw silk in the international market, which has been asserted by those who hold conventional views. In fact the fall of Yen was immediately arbitraged by a rise of raw silk price in the treaty port of Yokohama. The positive effect of falling Yen, therefore, was the price of raw silk sharply rising against the non-tradable goods in the Japanese domestic market, which meant the increase in the real income of silk reeling manufacturers and sericultural farmers.

In addition, this super efficiency of the treaty port market, which brought about the immediate arbitrage, was necessary for the first condition that the relative price in the international market was simultaneously reflected in the Yokohama market to be met. The next section deals with this issue.

C. Integration of cocoon markets

Exactly after the late 1880s, local cocoon markets in Eastern Japan converged at a remarkable speed(Figure 4). The rise of modern silk reeling industry entailed the integration of cocoon markets. It was related to a unique aspect of Japanese sericulture. In Italy, silk reeling factories were dispersed and silk reeling manufacturers procured cocoons from markets close by. In Japan, by contrast, silk reeling factories were concentrated in areas such as Suwa, while sericulture prevailed across the whole of Eastern Japan. In other words, the Japanese silk reeling industry was based on the mass procurement of material and on the mass production of raw silk, while the Italian counterpart retained a more moderate rural industry.[27] This had been the case in Japan since the late 1880s, when the modern silk reeling industry began to develop.

A necessary condition for the integration of local cocoon markets was the construction of trunk lines by a private company, Japan Railways Ltd., and the government in Eastern Japan since the 1880s. The integration there did not mean that the trunk lines of Japan Railways and the National Railways connected local markets themselves. Rather, local markets of cocoons were linked to silk reeling districts outside their regions. Links to Suwa County of Nagano Prefecture were especially important. In every section of Japan Railways Line and the National Railways Line of Eastern Japan, except for Nagano, shipment of cocoons exceeded their arrival, and this trade gap expanded in the 1900s. The trunk lines became channels for cocoons to flow from rural areas to Suwa.[28]

Those distribution channels shaped the geographical structure of sericulture. In the early 1880s, facing with the depression of France, production of cocoons and raw silk decreased in all areas. Since the mid 1880s, however, production of raw silk had exceeded that of cocoons in Nagano Prefecture, while production of cocoons had surpassed that of raw silk in growth

[27] Federico (1997).

[28] Nakabayashi (2003), pp. 124-134.

in other areas, which came to be specialized in the supply of material rather than modern silk reeling.[29] Building railways clearly progressed the integration and specialization of Japanese sericulture.

III. Efficient pricing of raw silk at Yokohama

A. Structure of the treaty port

The treaties of friendship and commerce with the US, the UK, France, Russia and Netherlands prescribed that Japan opened Yokohama and other four ports as treaty ports where free trades were guaranteed, and gave those four countries consular jurisdiction there. Those extraterritorial privileges had been effective until 1899, when the new treaties with the Western countries came into effect. Free trades were conducted under the Western legal system within the treaty ports. Impersonal exchanges in a price mechanism governed by the Western legal system was implanted into the treaty ports. Almost all of raw silk exports were traded in one of five ports, Yokohama.

In addition, the treaties prohibited foreign people from practicing business outside the concessions, and their property rights were protected by their consuls only within the concessions. Therefore they needed to trade with Japanese merchants who were specialized in selling exports to them or buying imports from them within the concessions. Those Japanese exporters and importers had channels to inside of the domestic market of Japan. All of the Western trading companies, Japanese exporters, and Japanese importers gathered in a very small space inside the concession of Yokohama and all trades were conducted there.

Silk reeling manufacturers shipped and consigned their products to Japanese exporters, and the Japanese exporters in turn sold them to Western trading companies on behalf of the silk reeling manufacturers. The price of exported raw silk was decided by the dealing between the Japanese exporters and the Western trading companies in confined space at Yokohama.

Another important point is that the relevant players were relatively few in number. The ten largest Japanese exporters and the ten largest Western trading companies dealt with 90 percent of all raw silk to be exported.[30] They had, however, no long-term relationship with each other. The trade between them was always a spot trade.

To sum up, the number of players was small, the place where they gathered was very small, they dealt with almost all raw silk exported from Japan, and all transactions were spot trades under the governance of the Western legal system. Those factors constituted a perfect market from the view point of information symmetry. In other words, any information about the raw silk trade were very quickly shared among all the players. The raw silk market of Yokohama was extremely efficient under the treaty port system. This artificially super efficient market mechanism played a significant role in the trade of raw silk.

[29] Nakabayashi (2003).
[30] Ikawa (1991).

B. An example of efficiency: perfect arbitrage of exchange rate by a commodity market

Protection of property rights under the Western legal system and the geographically dense structure of Yokohama realized a very efficient commodity market. In the context of contemporary international trades and international finance, financial market is generally much more efficient than commodity markets, so that the arbitrage of changes in exchange rates by commodity prices takes considerable time. If exchange rate of a currency falls against other currencies, the relative prices of commodities exported from the country in international markets fall for a while, so that the depreciation of a country's currency stimulates exports from the country. However, such thing never happened in the late 19th century Yokohama, because commodity market artificially created by Western powers enormously efficient.

The Japanese Yen was pegged to the value of the specific amount of silver until October, 1897, when Japan moved to the gold standard. It meant in the late 19th century when the international silver price fell down, the Yen depreciated against currencies pegged on gold accordingly. The first sharp falling was in 1885-1886 (Appendix Figure 1). However, price of Japanese raw silk in terms of the US dollar did not fall. Rather, the raw silk price arbitraged the falling exchange rate within a week, to keep its relative price in the international market stable (Figure 5).

Instead of providing fall of relative price of Japanese commodities in international markets, the efficient Yokohama market realized export-led inflation in Japanese domestic market immediately. The Japanese economy experienced the inflation affected by a fall in the exchange rate in the late 19th century, and the price of *Filature* led consumer prices with the lag of a few years (Figure 6).[31] This export-led inflation increased real income of silk manufacturers and cocoon growing farmers, thus accelerated mobilization of resources into the sector.

On the other hand, efficiency of international banking of Yokohama was not so efficient as the commodity market was. When raw silk exports boomed, export documentary bills fell in short, and the exchange rate appreciated accordingly. This inefficiency of international banking had not been resolved until the early 1900s, when Yokohama exchange market was fixed in the network of international finance centered at London (For a discussion in detail, see Appendix).

C. Speed and efficiency

how fast was the market adjusted? From January 1880 to September 1897 when Japan moved from the silver standard to the gold standard, autoregressions of the return of the raw silk price and the exchange rate at Yokohama by weekly data are as follows:

[31] Policy makers in those days correctly recognized that the falling exchange rate caused the increase of real income for the silk reeling. Noshomusho (Ministry of Agriculture and Commerce), "Hon nen no kiito soba ni jikka kyoka no betsu ari" (There is a difference between real price and nominal price in the raw silk quotations of this year), *Noshoko koho* (Bulletin on agriculture, commerce, and manufacturing), no. 18, August 15, 1886, pp. 682-684.

$$\Delta P_t^{YF} = \underset{0.297}{0} - \underset{7.910^{**}}{0.262}\Delta P_{t-1}^{YF} - \underset{-3.193^{**}}{0.110}\,\Delta P_{t-2}^{YF} - \underset{-0.745}{0.026}\Delta P_{t-3}^{YF} - \underset{-0.613}{0.021}\Delta P_{t-4}^{YF} - \underset{-1.192}{0.040}\Delta P_{t-5}^{YF}, \tag{1}$$

and

$$\Delta E_t = -\underset{-1.608}{0.133} - \underset{-4.014^{**}}{0.133}\,\Delta E_{t-1} + \underset{2.738^{**}}{0.092}\Delta E_{t-2} + \underset{2.093^{*}}{0.070}\Delta E_{t-3} + \underset{1.066}{0.036}\Delta E_{t-4} - \underset{-1.141}{0.038}\Delta E_{t-5}, \tag{2}$$

where P_t^{YF} is the price of *Filature* at Yokohama and E_t is the exchange rate at time at the tth week, $\Delta P_t^{YF} = \ln(P_t^{YF}) - \ln(P_t^{YF})$, and $\Delta E_t = \ln(E_t) - \ln(E_{t-1})$. The $**$ and $*$ stand for 1 5 percent significance respectively.[32] In both of above equations the first order and the second order of differences are significant. This shows that public information of any event was reflected on both of the exchange rate and the raw silk price within three weeks, and efficiency of the raw silk price with public information set was comparable to that of the exchange rate.

IV. Benefit from efficient market

A. Rent from the New York market

This efficiency of the Yokohama commodity market was the channel to catch up with rent taking opportunities in international markets. Grenger's causality between the raw silk prices in the Yokohama market and the New York market from 1881 to 1885 in monthly data is shown by[33]

$$\Delta P_t^{YF} = -\underset{-0.957}{0.005} - \underset{-1.563}{0.222}\Delta P_{t-1}^{YF} + \underset{0.244}{0.039}\Delta P_{t-2}^{YF} + \underset{0.061}{0.010}\Delta P_{t-3}^{YF} - \underset{-0.714}{0.105}\Delta P_{t-4}^{YF} - \underset{-0.084}{0.465}\Delta P_{t-1}^{NF} + \underset{0.613}{0.122}\Delta P_{t-2}^{NF} - \underset{-0.346}{1.783}\Delta P_{t-3}^{NF} - \underset{-2.336^{*}}{0.444}\,\Delta P_{t-4}^{NF}, \tag{3}$$

and

$$\Delta P_t^{NF} = -\underset{-0.539}{0.002} + \underset{3.107^{**}}{0.363}\Delta P_{t-1}^{YF} + \underset{2.428^{*}}{0.321}\Delta P_{t-2}^{YF} + \underset{0.999}{0.132}\Delta P_{t-3}^{YF} - \underset{-0.128}{0.016}\Delta P_{t-4}^{YF} - \underset{-3.348^{**}}{0.499}\,\Delta P_{t-1}^{NF} + \underset{1.027}{0.168}\Delta P_{t-2}^{NF} + \underset{0.007}{0.043}\Delta P_{t-3}^{NF} - \underset{-0.235}{1.499}\Delta P_{t-4}^{NF}, \tag{4}$$

where P_t^{YF} and P_t^{NF} stand for prices of *Filature* at the tth month at Yokohama and New York respectively. While the New York prices strongly depended on past few-week prices

[32] Akaike Information Criterion is $-5,617.930$ for (1) and $-5,617.830$ for (2).

[33] The number of samples is 55, Adjusted R^2 is 0.124, and F value is 1.974 for (3), and 55, 0.299, and 3.933^{**} for (4).

at Yokohama, the Yokohama prices also partially depended on few-week past prices at New York.

However, the causality changed after 1885. The results from 1885 to 1903 is,[34]

$$\begin{aligned}\Delta P_t^{YF} = &-\underset{-0.647}{0.003} - \underset{-2.467^{**}}{0.182}\,\Delta P_{t-1}^{YF} - \underset{-0.474}{0.037}\Delta P_{t-2}^{YF} - \underset{-0.656}{0.052}\Delta P_{t-3}^{YF} + \underset{0.263}{0.020}\Delta P_{t-4}^{YF} \\ &+ \underset{1.702}{0.188}\Delta P_{t-1}^{NF} + \underset{0.146}{0.016}\Delta P_{t-2}^{NF} + \underset{0.469}{0.050}\Delta P_{t-3}^{NF} + \underset{0.039}{0.004}\Delta P_{t-4}^{NF},\end{aligned} \tag{5}$$

and

$$\begin{aligned}\Delta P_t^{NF} = &-\underset{-0.605}{0.002} + \underset{3.309^{**}}{0.163}\Delta P_{t-1}^{YF} + \underset{2.601^{**}}{0.135}\Delta P_{t-2}^{YF} + \underset{2.133^{*}}{0.112}\Delta P_{t-3}^{YF} - \underset{-0.014}{0.001}\Delta P_{t-4}^{YF} \\ &- \underset{-0.520}{0.038}\Delta P_{t-1}^{NF} - \underset{-1.291}{0.094}\Delta P_{t-2}^{NF} + \underset{0.532}{0.038}\Delta P_{t-3}^{NF} + \underset{2.129^{*}}{0.148}\Delta P_{t-4}^{NF},\end{aligned} \tag{6}$$

where the Yokohama prices did not depend on the past New York prices at all while the New York prices still did on the past Yokohama prices. That is the Yokohama market came to lead the New York market since the late 1880s. In other words, the prices at the Yokohama market reflected any public information at the New York market within a week. It is this "fastness" of the Yokohama market that gave Japanese silk reeling industry opportunities to acquire rent at the New York market, before other markets did.

B. Response to prices

However, even if prices at Yokohama reflected rent taking opportunities at New York sufficiently fast, it should not provided real opportunities with Japanese silk reeling industry unless production and shipment could respond to the prices sufficiently fast. Let us inquire the Grenger's causality between prices of *Filature* at Yokohama and its arrivals to Yokohama by weekly data from 1888 to 1903.[35]

$$\begin{aligned}\Delta A_t^{YF} = &\underset{0.363}{0.007} - \underset{-8.824^{**}}{0.327}\,\Delta A_{t-1}^{YF} + \underset{0.247}{0.010}\Delta A_{t-2}^{YF} + \underset{1.979^{*}}{0.076}\Delta A_{t-3}^{YF} - \underset{-0.476}{0.017}\Delta A_{t-4}^{YF} \\ &+ \underset{2.309^{**}}{1.325}\Delta P_{t-1}^{YF} + \underset{0.309}{0.179}\Delta P_{t-2}^{YF} - \underset{-0.237}{0.137}\Delta P_{t-3}^{YF} - \underset{-0.986}{0.562}\Delta P_{t-4}^{YF},\end{aligned} \tag{7}$$

$$\begin{aligned}\Delta P_t^{YF} = &\underset{0.715}{0.001} - \underset{-1.566}{0.008}\Delta A_{t-1}^{YF} + \underset{0.124}{0.001}\Delta A_{t-2}^{YF} - \underset{-0.894}{0.005}\Delta A_{t-3}^{YF} - \underset{-1.129}{0.006}\Delta A_{t-4}^{YF} \\ &- \underset{-3.211^{**}}{0.117}\,\Delta P_{t-1}^{YF} - \underset{-0.902}{0.033}\Delta P_{t-2}^{YF} - \underset{-0.611}{0.023}\Delta P_{t-3}^{YF} - \underset{-1.752}{0.065}\Delta P_{t-4}^{YF},\end{aligned} \tag{8}$$

where A_t^{YF} stands for the amount of arrivals of *Filature* at Yokohama at tth week.

[34]The number of samples is 212, the adjusted R^2 is 0.000, and the F value is for 1.008 for (5), and 212, 0.078, and 3.228^{**} for (6).

[35]The number of samples is 753, the Adjusted R^2 is 0.103, and the F value is 11.824^{**} for (7), and 753, 0.012, and 2.166^{*} for (8).

On the other hand, Grenger's causality between arrivals and stocks of *Filature* at Yokohama is[36]

$$\begin{aligned}\Delta A_t^{YF} = \underset{0.401}{0.007} - \underset{-8.390^{**}}{0.320}\,\Delta A_{t-1}^{YF} + \underset{0.464}{0.019}\Delta A_{t-2}^{YF} + \underset{1.494}{0.061}\Delta A_{t-3}^{YF} - \underset{-0.448}{0.017}\Delta A_{t-4}^{YF} \\ + \underset{1.107}{0.094}\Delta S_{t-1}^{YF} - \underset{-1.431}{0.119}\Delta S_{t-2}^{YF} + \underset{1.296}{0.106}\Delta S_{t-3}^{YF} - \underset{-1.686}{0.133}\Delta S_{t-4}^{YF},\end{aligned} \tag{9}$$

and

$$\begin{aligned}\Delta S_t^{YF} = \underset{0.217}{0.002} + \underset{4.613^{**}}{0.079}\Delta A_{t-1}^{YF} + \underset{6.125^{**}}{0.113}\Delta A_{t-2}^{YF} + \underset{3.643^{**}}{0.067}\Delta A_{t-3}^{YF} + \underset{0.536}{0.009}\Delta A_{t-4}^{YF} \\ + \underset{3.490^{**}}{0.133}\Delta S_{t-1}^{YF} + \underset{1.641}{0.062}\Delta S_{t-2}^{YF} + \underset{0.813}{0.030}\Delta S_{t-3}^{YF} + \underset{0.710}{0.025}\Delta S_{t-4}^{YF},\end{aligned} \tag{10}$$

where S_t^{YF} stands for the amount of *Filature*'s stock at Yokohama at the tth week.

These results show that the arrivals of *Filature* at Yokohama followed its prices at Yokohama while it did not responded to the changes of stocks. This indicates that silk reeling manufacturers responded to prices themselves at Yokohama, not to the rested stock there. A straight forward price mechanism worked there.

However, this simple logic did not hold for raw silk hand-reeled by peasants. Let us track the behavior of a traditional raw silk, *Re-reeled*. The Re-reeled silk was raw silk hand-reeled and then reeled again and inspected. The threads of *Re-reeled* was relatively even compared with ordinary raw silk called *Hanks*, so that it was also demanded by the US market from the 1880s to 1890s.

The Grenger's causality between arrivals and prices of *Re-reeled*, which was hand-reeled at peasants' houses is ass follows:[37]

$$\begin{aligned}\Delta A_t^{YR} = \underset{-1.282}{-0.036} - \underset{11.645^{**}}{0.439}\,\Delta A_{t-1}^{YR} - \underset{-0.617}{0.025}\Delta A_{t-2}^{YR} + \underset{1.644}{0.066}\Delta A_{t-3}^{YR} + \underset{1.684}{0.062}\Delta A_{t-4}^{YR} \\ - \underset{0.452}{0.266}\Delta P_{t-1}^{YR} - \underset{-0.005}{0.003}\Delta P_{t-2}^{YR} + \underset{0.670}{0.417}\Delta P_{t-3}^{YR} - \underset{0.025}{0.015}\Delta P_{t-4}^{YR},\end{aligned} \tag{11}$$

and

$$\begin{aligned}\Delta P_t^{YR} = \underset{0.918}{00.2} + \underset{2.480^{*}}{0.006}\Delta A_{t-1}^{YR} + \underset{1.785}{0.005}\Delta A_{t-2}^{YR} + \underset{0.607}{0.002}\Delta A_{t-3}^{YR} + \underset{0.617}{0.001}\Delta A_{t-4}^{YR} \\ - \underset{-9.248^{**}}{0.347}\,\Delta P_{t-1}^{YR} - \underset{-5.310^{**}}{0.214}\,\Delta P_{t-2}^{YR} - \underset{-2.817^{**}}{0.114}\,\Delta P_{t-3}^{YR} - \underset{0.482}{0.027}\Delta P_{t-4}^{YR},\end{aligned} \tag{12}$$

where A_t^{YR} and P_t^{YR} stands for the amount of arrivals and prices of *Re-reeled* at Yokohama at tth week.

The Grenger's causality between arrivals and stocks of *Re-reeled* is,[38]

[36]The number of samples is 753, the adjusted R^2 is 0.104, and the F value is $11.876^{**}$for (9), and 754, 0.128, and 14.876^{**} for (10).

[37]The number of samples is 714, the adjusted R^2 is 0.173, and the F value is 19.617^{**} for (11), and 714, 0.107, 11.726^{**} for (12).

[38]The number of samples is 719, the adjusted R^2 is 0.180, and the F value is 20.720^{**} for (13), and 719, 0.161, 18.337^{**} for (14).

$$\Delta A_t^{YR} = \underset{-1.230}{-0.034} - \underset{-11.461^{**}}{0.434}\Delta A_{t-1}^{YR} - \underset{-0.265}{0.011}\Delta A_{t-2}^{YR} + \underset{1.289}{0.054}\Delta A_{t-3}^{YR} + \underset{1.420}{0.054}\Delta A_{t-4}^{YR} + \underset{0.714}{0.101}\Delta S_{t-1}^{YR} - \underset{-1.312}{0.183}\Delta S_{t-2}^{YR} + \underset{2.209^{*}}{0.298}\Delta S_{t-3}^{YR} + \underset{0.055}{0.007}\Delta S_{t-4}^{YR}, \tag{13}$$

and

$$\Delta S_t^{YR} = \underset{-0.545}{-0.004} + \underset{2.620^{**}}{0.026}\Delta A_{t-1}^{YR} + \underset{6.355^{**}}{0.069}\Delta A_{t-2}^{YR} + \underset{4.706^{**}}{0.053}\Delta A_{t-3}^{YR} + \underset{2.046^{*}}{0.021}\Delta A_{t-4}^{YR} + \underset{0.806}{0.031}\Delta S_{t-1}^{YR} + \underset{3.834^{**}}{0.143}\Delta S_{t-2}^{YR} + \underset{3.514^{**}}{0.127}\Delta S_{t-3}^{YR} + \underset{2.180^{*}}{0.078}\Delta S_{t-4}^{YR}, \tag{14}$$

where S_t^{YR} stands for the stock amount of *Re-reeled* at Yokohama at the tth week.

The results above can be summarized that the arrival of *Re-reeled* at Yokohama never followed its prices at Yokohama, while it followed its stocks at Yokohama. Indicated is that hand-reeling peasants did not respond to efficient prices at Yokohama at least immediately. Thus they arguably fail to catch opportunities to take rent by fast responding to international market.

C. Imposed efficiency of the commodity market and created efficiency of financial market

Because there was a strong demand for *Filature* with even threads in the US, and because the silk reeling industry in the world could not immediately adjust to this changing condition, there existed an opportunity to acquire some rent by producing such a *Filature* in the mid 1880s. This opportunity was exploited by the Japanese manufacturers, who could take advantage of the extremely efficient market of treaty port where prices gave the relevant information (Figure 1 and 2). The sooner they acquired the information, the more rent they could got. Information about the international market was efficiently processed in that market, and was shown to manufacturers. The supply of Filature indeed quickly responded to prices at Yokohama that reflected information at New York, and this is why they did not fail to catch up the rent-taking opportunities.

However, while *Re-reeled* silk that was hand-reeled by peasants was also demanded in the US market from the 1880s to the 1890s, supply of the traditional raw silk did not responded to prices at Yokohama. This indicated that peasants could not acquire a rent-taking opportunity when they produced their cocoon into hand-reeled silk and shipped it to Yokohama by themselves.

Quick responses to prices by silk reeling manufacturers were shown as their cocoon purchasing activity. Once prices at Yokohama rose, they borrowed large amount of money quickly and then went cocoon growing areas for purchasing. In other words, the raw silk market at Yokohama could affect raw silk production only if it was accompanied by an efficient financial market. By the early 1880s, the modern financial market had been created by developed under the strong support from the government. The modern silk reeling industry was one of industries that massively utilized this created modern financial market. Peasants economy

was, however, almost isolated from the modern financial market from the 1880s to the 1890s. Therefore, selling their cocoon to silk reeling reeling manufacturers as raw material was virtually the best way to access rent taking opportunities in the international market, through silk reeling manufacturers's purchasing activity that quickly responded to prices at the Yokohama market, which correctly reflected relevant information in the New York market.

V. Conclusion: imposed efficiency

A. Factory industry with high-performing financial market

Given infrastructures such as trunk roads, rail roads, and telecom built by the government, the efficient treaty market imposed by Western powers with the efficient financial market created by the government accelerated modernization of silk reeling industry of Japan, that is, industrialization of Japan. Prices at Yokohama reflected relevant information from New York sufficiently fast, and silk reeling manufacturers could exploited opportunities to acquire rent from shortage of *Filature* of even threads in the US, by utilizing financial market to efficiently mobilize resources.

However, for traditional silk reeling, which lacked a channel to access the financial market, could not take advantage of the efficient Yokohama market.

The structural change of sericulture proceeded very rapidly in the 1880s, mainly because machine-reeled *Filature* was strongly demanded by the US market then, but also because peasants who grew cocoon and hand-reeled raw silk could not responded to information reflected on prices because they lacked access to the financial market. Both of high relative price of *Filature* against hand-reeled raw silk in the US market and inability of under-financed peasant economy to respond to the US market prompted change of industrial organization of sericulture.

For a peasant economy with dysfunctional financial market, the most liquid resource is labor that obeys to the order of the master of family, not money. Because of lack of financing, a peasant economy does not necessarily show a "rational" behavior from a neoclassical view given a perfect financial market, rather behave as if it has some "unique" moral economy that is a little different to a neoclassical market economy. On the other hand, different from financing, family labor can be easily mobilized by the master of family. Therefore, a peasant family seems to fully optimize its family labor allocation while it does not necessarily seem to do that in the relation with outside world of family economy. When such behaviors were aggregated, appeared a situation where supply of hand-reeled raw silk to Yokohama market did not respond to its prices at Yokohama, even in the 1880s when the US market demanded high-quality hand-reeled raw silk.

B. Coordination failure avoided by the treaty port

It is worth noting that all relevant factors discussed above, that is, the rise of modern silk reeling industry, reorganization of the sericulture, and the integration of local cocoon markets

coincided with the period, the mid-1880s, when the structure of international market changed in earnest. Each phenomenon was not particularly surprising, but it is impressive that their simultaneous emergence was well coordinated. The Japanese raw silk reached the 50 percent share in the US market within the space of a few years. For this marvelous experiment to materialize, an excellent processing of information in the treaty market, the crossroad of silk trade, was critical.

North and Thomas (1973) emphasized the importance of institutions, which enables the "invisible hand" to work. They argued that in order for the market, which is close to perfection assumed by Adam Smith, to work, institution matters, and that if an institution does not work properly, the rent-seeking behavior could bias the direction of growth. The market, however, is always imperfect, and there exists an opportunity to seek rent everywhere, even in the modern economy. Indeed, rent-seeking behavior always determines the direction of development, not only in unsuccessful economies, but also in successful ones. The difference between them lies in that rent-seekers are properly coordinated in the latter.[39] In other words, in order to avoid coordination failure, there needs to be some place where the rent is efficiently allocated. As Hudson (1986) pointed out, a well organized regional community could satisfy this necessity, while proto-industrial areas without such a function might lead to coordination failure and underdevelopment.

C. Junction of information and multiple paths

In the case of Japan, a well established institution of the treaty port took this role. Rent generated by the sharp increase of demand for *Filature* was accurately reflected in the relative price at the real market of Yokohama, and silk reeling manufacturers and sericultural farmers responded to it, hence the reorganization of sericulture proceeded at a speed which made it possible for them to exploit some rent. While this super efficient mechanism of treaty port was imposed by Westerners, it probably worked better than they had expected.

However, it was not the only possible outcome. China was also forced to accept the institutional framework of potentially "efficient" treaty ports. But mainly because of problems in the political system, the government's efforts to develop the inland, hence the ports, did not play the role of connecting international business opportunities with inland development. Instead, it was Chinese merchants that exploited the establishment of new institutions. They connected those "efficient" treaty ports in East Asia with each other, formed strong networks among them, and dominated local and regional trades. This mercantile development in China was another important outcome, together with the industrial development in Japan, arising from the establishment of treaty ports in East Asia in the 19th century.

[39] Aoki (2001).

Appendix: Arbitrage of exchange rate by raw silk price

It is straightforward to deduce that the Yokohama market with the structure above could be very efficient with respect to information. However, the existing literature have assumed otherwise.

Japanese currency had been under the silver standard until October 1897. In the mid 1880s, when the modern silk reeling developed, and again in the mid 1890s, the foreign exchange rate fell sharply, as the silver price in the London market dropped (Appendix Figure 1).

Given this fact, Researchers have previously assumed that this weak Yen in the mid 1880s and in the mid 1890s devalued the price of Japanese exports in the Western world under the gold standard. The fall in the middle decades is especially important for the understanding of how it effected the rise of modern industries after 1887. They have reasoned that the falling price of silver depressed the relative price of Japanese exports in the international market, and this prompted the growth of Japanese exports, which in turn inspired modern economic growth. They have assumed that the arbitrage by the price in the market of real commodities was delayed for a considerable period after a change in the foreign exchange market took place.[40]

In order for this view to hold, it is necessary that the Yokohama market had to be sufficiently inefficient that the adjustment of raw silk price there was considerably delayed, and that the Japanese raw silk became cheaper for a while. However, they have not presented any quantitative evidence based on data of the price of exports and exchange rate to prove this hypothesis of "the lower relative price caused by the falling exchange rate".

In the long term, this hypothesis obviously does not hold. For instance, the terms of trade had improved from the 1880s to the 1890s, while it deteriorated in the 1900s when Japan was under the gold standard.[41] Moreover, the world prices of raw silk converged during the period from the late 1860s to the late 1930s, which meant the prices of raw silk from Japan and China, both of which were under the silver standard, did not deviate from the international price in the 1880s and the 1890s, when the silver price sharply dropped.[42] Those pieces of evidence show that the export price was adjusted to the change in the foreign exchange market in the long term.

Therefore, what remains to be clarified is whether or not the change in the foreign exchange market was adjusted by the change of the price of exports, in the short term. If it was delayed, the hypothesis that falling exchange rate depressed the relative price of exports from Japan can be thought of as true. If, on the other hand, adjustment was sufficiently rapid, the hypothesis can be considered as fault, and the only effect of the change in the exchange rate would have been the inflation led by exportable goods in the domestic market.[43] Since raw silk was the most important export of Japan, amounting to about 30 percent of its total export, an examination of the short-term effect of exchange rate on the price of raw silk is essential for

[40] Nugent (1973), pp. 1122-1129. Nakamura (1983), pp. 29-31.

[41] Shinohara (1961), pp. 275-351. Yamazawa and Yamamoto (1979), pp. 85-89. Japan joined the gold standard in October 1897.

[42] Ma (1996), pp. 347-352.

[43] Nugent (1973), p. 1113.

the understanding not only of the development of the modern silk reeling industry but also of the beginning of modern economic growth of Japan.

Now suppose E_t: the foreign exchange rate of Japanese Yen against the US dollar (dollar par 100 Yen) in time t; $P_t^{YF}(E_t)$: the price of Japanese *Filature*, machine reeled raw silk as a function of E_t; P_t^{YFUS}: the price of *Filature* in terms of the US dollar, independent of E_t. Then, $P_t^r(E_t)$: the relative price of Japanese raw silk in the international market, is defined as follows:

$$P_t^r(E_t) = E_t P_t^{YF}(E_t)/P_t^{YFUS}. \tag{15}$$

And $e_t(E_t)$: the exchange rate elasticity of $P_t^r(E_t)$ as a function of $P_t^r(E_t)$, is defined as follows:

$$e_t(E_t) = \frac{\partial P_t^{YF}(E_t)}{\partial E_t} \Big/ \frac{E_t}{P_t^{YF}(E_t)} \tag{16}$$

When E_t changes, the direction of change of $P_t^r(E_t)$ can be shown from (15) as follows,

$$\frac{\partial P_t^r(E_t)}{\partial E_t} = \left[P_t^{YF}(E_t) + E_t \frac{\partial P_t^{YF}(E_t)}{\partial E_t} \right] \Big/ P_t^{YFUS} = (1 + e_t) \left[P_t^{YF}(E_t)/P_t^{YFUS} \right]. \tag{17}$$

Therefore, if and only if arbitrage of change of $E_t P_t^{YF}(E_t)$ is sufficiently slow, or equivalently, the value of (17) is negative, thus,

$$-1 < e_t, \tag{18}$$

then the direction of change of $P_t^r(E_t)$ coincides with the direction of change of E_t. That is, the relative price of Japanese raw silk in the international market P_t^r also decreases when E_t decreases, and thus does hold the hypothesis of "the lower relative price caused by the falling exchange rate."

If $e_t > 0$, then P_t^{YF} would fall when E_t falls. The hypothesis of "the lower relative price caused by the falling exchange rate," however, does not think about such a dumping. Thus, in order for the hypothesis to hold, e_t must satisfy

$$-1 < e_t < 0. \tag{19}$$

Now we show whether (19) holds or not, by using the weekly data of price of raw silk and exchange rate.

The trend of the foreign exchange rate from January 1880 to September 1897, when Japan was under the silver standard, can be classified into nine periods as below. Japan entered the gold standard in October 1897, and the relationship between the foreign exchange rate and the price of raw silk during the period from October 1897 to December 1903 is examined to compare with the term under the silver standard.

1. **January 1880 to December 1880**: the period of sharp fluctuating.

2. **January 1881 to December 1881**: the period of stability. Because trade of raw silk was almost stopped by the dispute about Niazukarisho (Trading and Inspection House of Raw Silk in Yokohama),[44] this period should be separated from the period before and after.

3. **January 1882 to December 1884**: the period of stability.

4. **January 1885 to August 1886**: the period of falling trend.

5. **September 1886 to March 1890**: the period of stability.

6. **April 1890 to December 12**: sharply fluctuating (because of the introduction of the U.S. Sherman Silver Purchase Act).

7. **January 1891 to December 1893**: falling.

8. **January 1894 to September 1897**: fluctuating.

9. **October 1897 to December 1903**: stable under the gold standard.

Appendix Table 1 shows elasticity e_t given by regression of $\ln(P_t^{YF})$ to $\ln(E_t)$. During the 1st, 6th, and 8th periods, when the exchange rate was sharply fluctuating, the price of raw silk and the exchange rate were not correlated. Also in the 2nd period, when the raw silk trade was almost stopped, there was no correlation between them.

On the other hand, in the 4th and the 7th periods, when the exchange rate was falling, $e_t < -1$. Thus, (17) and (18) did not hold when the exchange rate fell, which means the change in the foreign exchange market was followed by the price of raw silk within a week. The super efficient Yokohama market arbitraged the change of exchange rate right away.

Therefore, the hypothesis of "the lower relative price caused by the lowering exchange rate" no longer holds, and the only effect from the fall of the foreign exchange rate in the 1880s was the inflation led by export commodities. This effect was important for the reorganization of sericulture.

In addition, e_t should satisfy $e_t = -1$ in case of perfect arbitrage. Thus $e_t < -1$ means that P_t^{YF} even "overshot."

Why did the commodity price overshoot? On Appendix Table1, both in the 3rd and 5th periods, when the exchange rate was stable, and in the 10th and 11th periods when the exchange rate was stable under the gold standard, $0 < e_t$, which does not satisfy (18) at all. The positive sign means that P_t^{YF} and E_t moved in the same direction. It came from another special feature of Yokohama market in two periods. Whereas exchange rate was efficient in

[44]The trade association of Japanese exporters, backed by the Japanese government, required that all trade of raw silk be dealt in "Niazukarisho," a Conditioning House established by the association. Western trading companies and consuls of Western countries opposed to that because they thought it violated the principle of free trade under the trade. Eventually, the opposition by Western trading companies succeeded and Niazukarisho was abolished.

terms of information, international financial market was not efficient enough in terms of real allocation of resources.

That is, when the trade of raw silk is active, the amount of trade increases and the price rises. Moreover, since raw silk occupied a considerable part of Japanese export and the shipping of it showed a sharp rise seasonally in the Summer and Fall, the demand for drawing documentary bills for exports expanded sharply, straining the capacity of foreign exchange banks at Yokohama. The inefficient Yokohama financial market was not fit for absorbing such a rapid increase of demand for drawing documentary bills Thus, when the silver price in the international market was stable, the exchange rate rose with the raw silk price. This phenomenon was seen in the 3rd period (January 1882 to December 1884) and the 5th period (September 1886 to March 1890), as shown in Figure 5.

The fall of foreign exchange rate was immediately adjusted by the rise of raw silk price, and a new equilibrium was soon reached. We can find such a dynamic adjustment taking place, for instance, during the 4th period, moving equilibrium points from the area on the right side of Figure 6, prevalent in the 3rd period, to the left side which prevailed in the 5th period. In contrast to the assumption behind the conventional views, the arbitrage by the price of goods was sufficiently fast, because of the efficiency in the price mechanism of the real market within the treaty port.

On the other hand, the foreign exchange market was not efficient enough to arbitrage the rapid increase of trades as fast. In fact arbitrage in the international financial market was slower than that in the market of real exports. This inefficiency was gradually overcome by the development the international financial network, centered on London, and the participation of the Yokohama Specie Bank, which was a large foreign exchange bank invested by the Japanese government, in that network.[45] Appendix Table 2 shows a regression of the exchange rate to the raw silk price, where β_1 shows the tightness of foreign exchange when the raw silk business is buoyant. The β_1 became smaller after Japan entered the gold standard in October 1897 than it had been in the 1880, which indicates that the global adjustment of the financial market had been working faster.

[45] Saul (1960). Ishii (1994).

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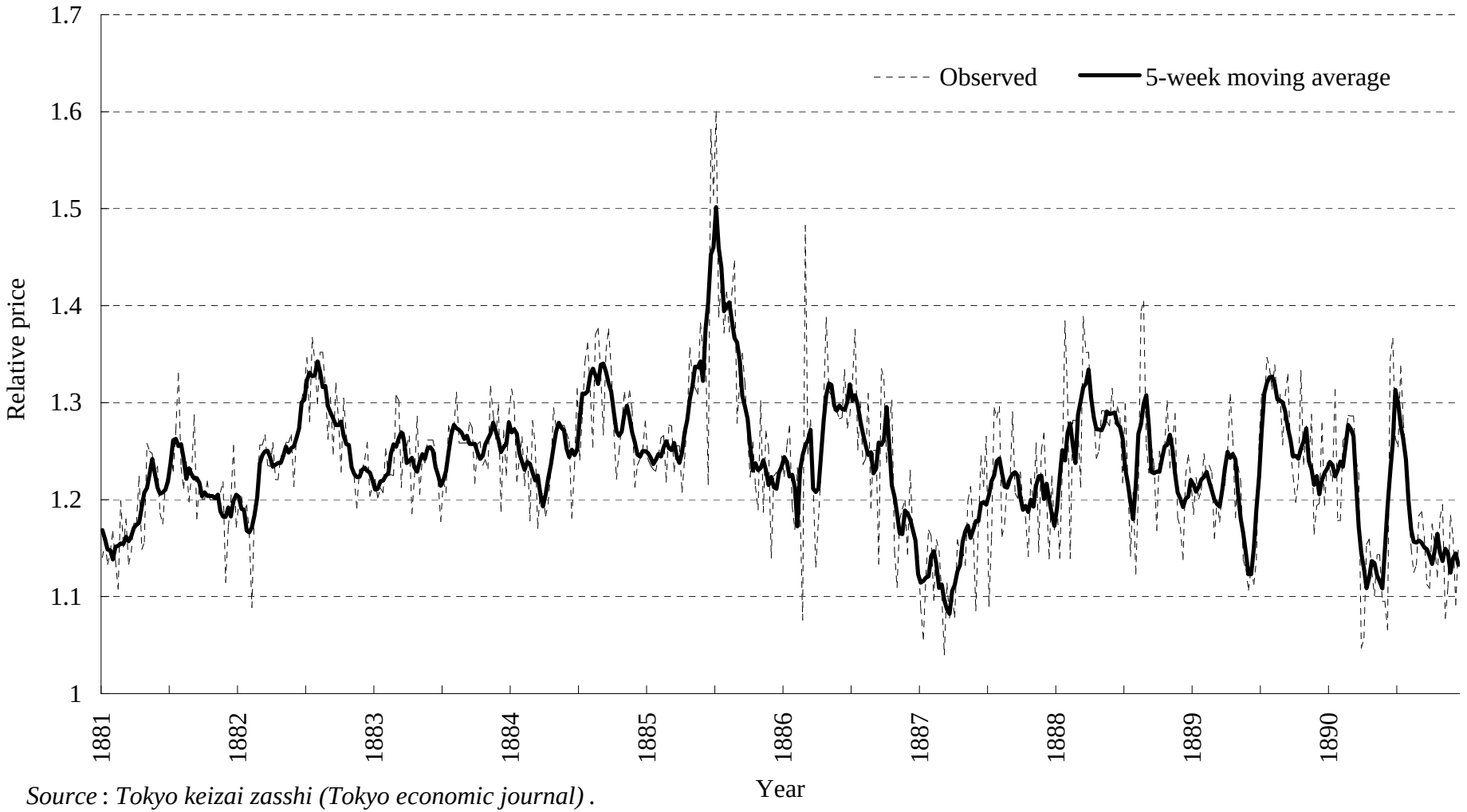
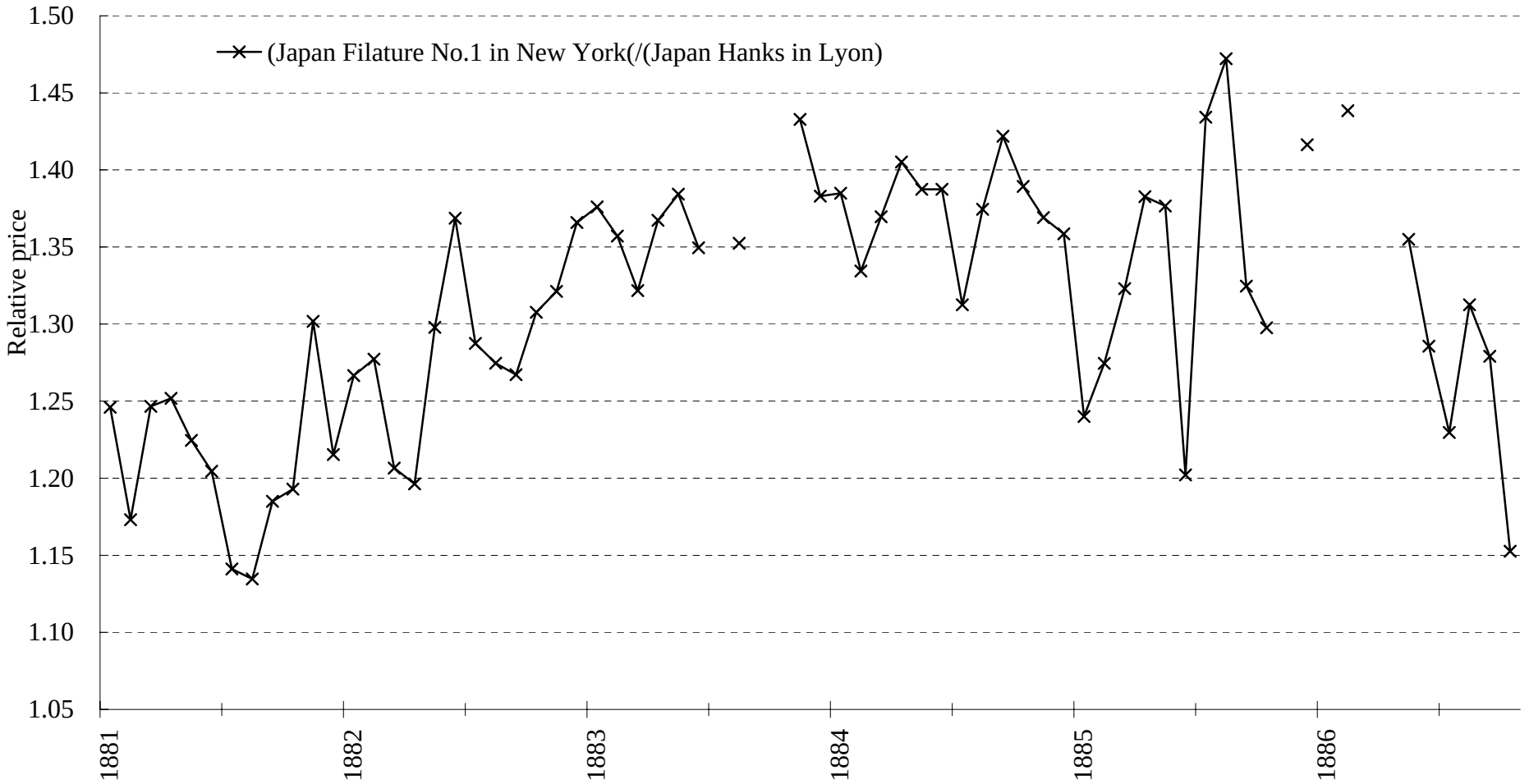
Figure 1 Relative price of Filature over Hanks: 1881-1890



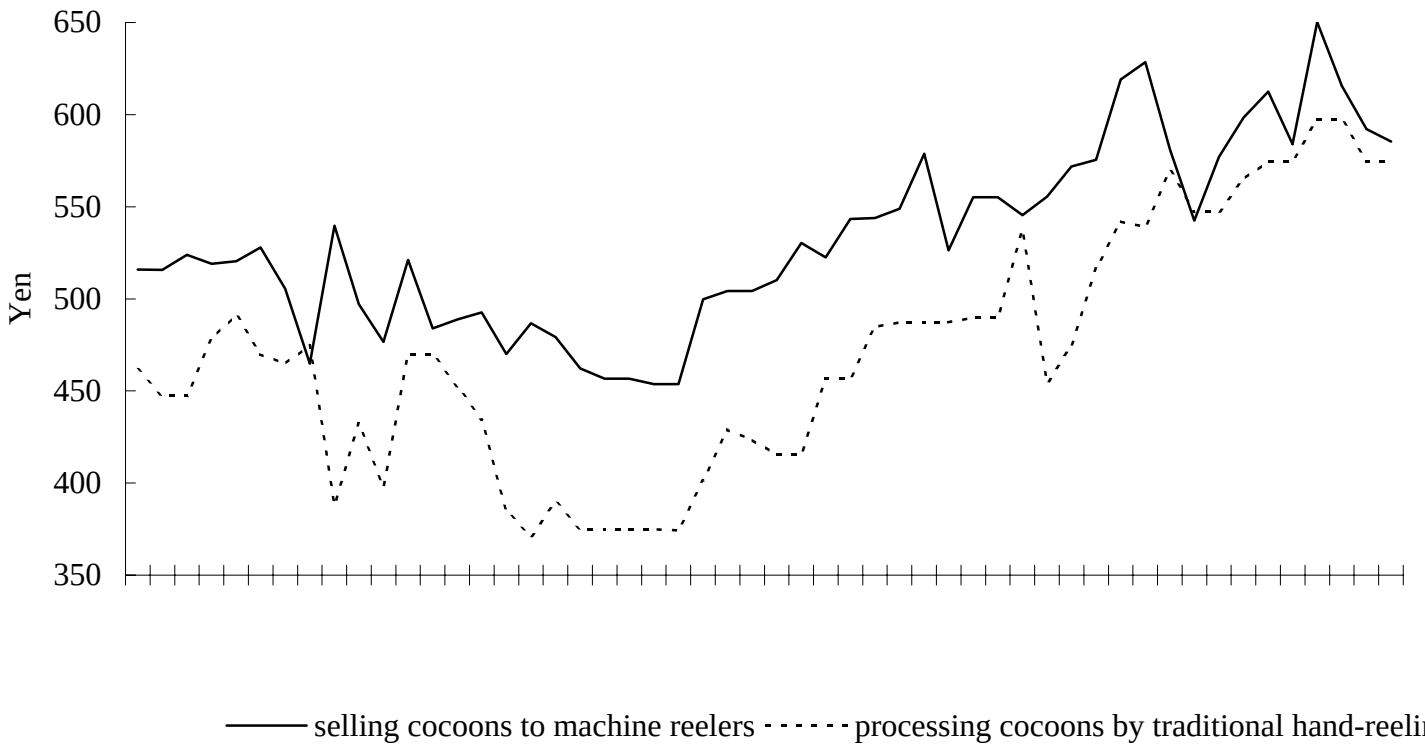
Source : *Tokyo keizai zasshi (Tokyo economic journal)* .
Note : Weekly data.

Figure 2 Relative Price of *Filature* : (Japan *Filature* No.1 in New York) / (Japan *Hanks* in Lyon)



Source : Nakabayashi (2003), p. 90.
Note : Monthly data.

Figure 3 Gross Margins of Pesants per 1 picul (60kg) of Silk in 1886



Source : Nakabayashi (2003), p. 100.

Figure 4 Coefficient of variation of cocoon prices in East Japan

Source : Nakabayashi (2003), p. 135.
Note : Yearly data.

Figure 5 Exchange rate and raw silk price at Yokohama: Jan 1882-Mar 1890

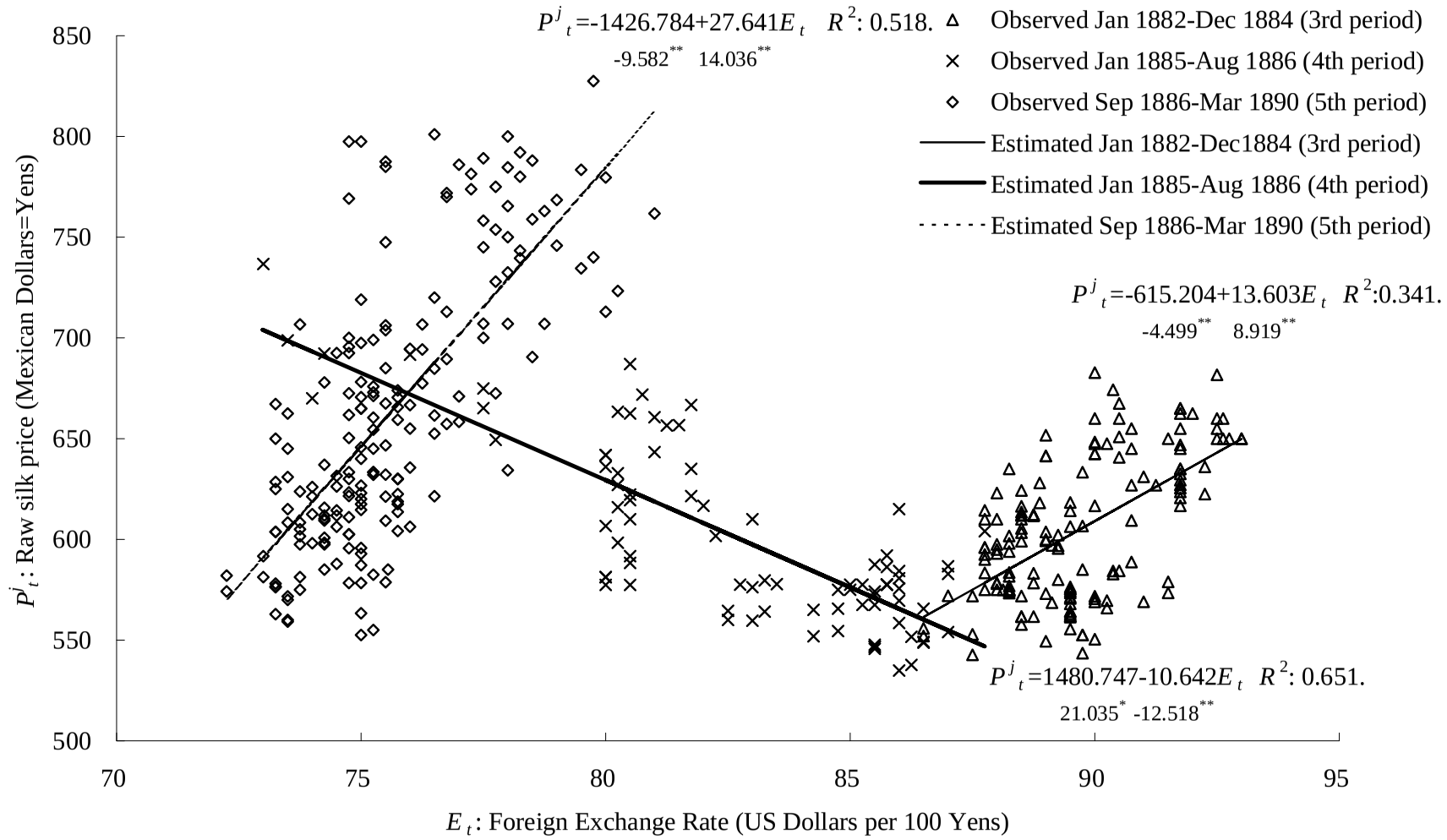
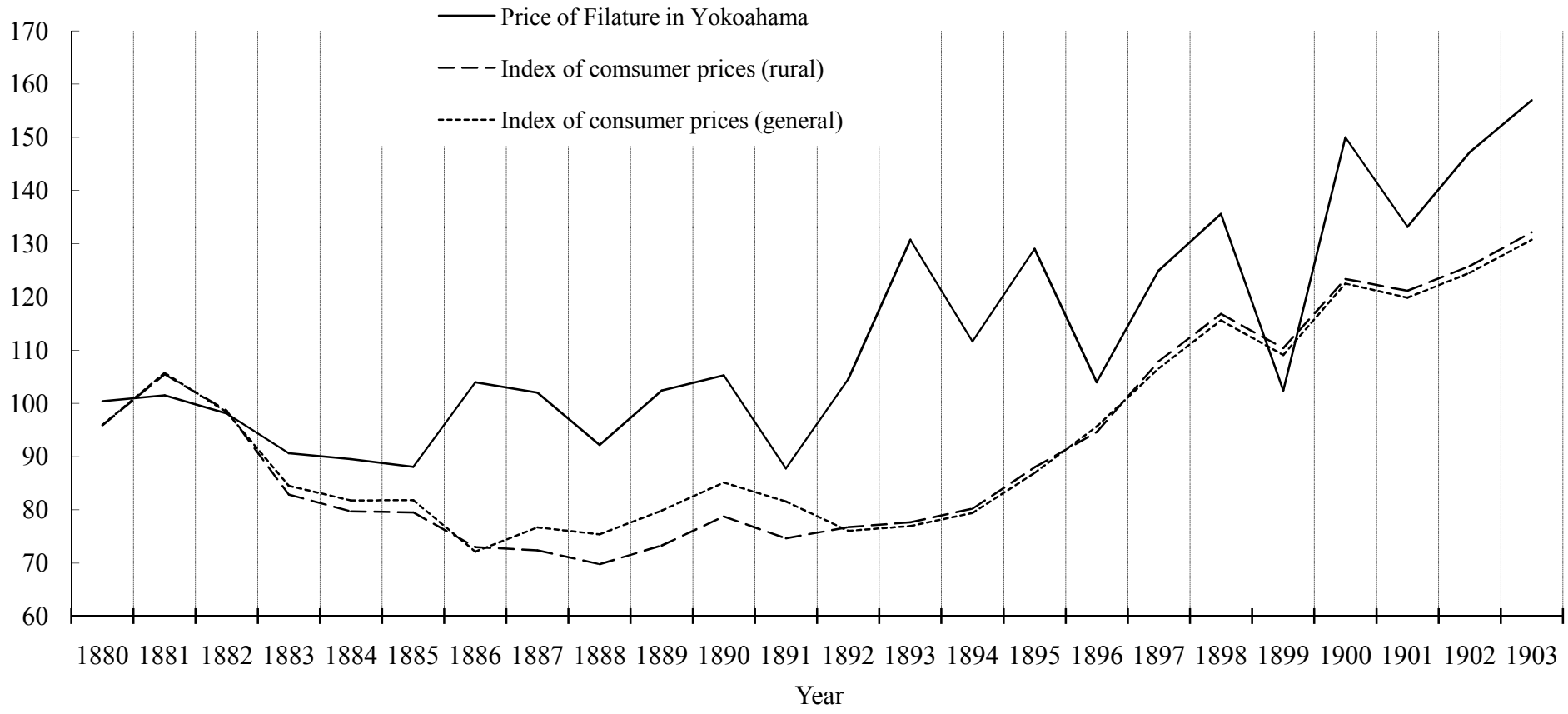


Figure 6 Price of Filature and the index of consumer price avarage: 1880-1903 (1880−1903=100)



Sourse: Nakabayashi (2003), p.113.
Note: Yearly data.

Appendix Table 1 Effect of the foreign exchange rate on the price of *Filature* (machine reeled raw silk) in the Yokohama market: weekly data in 1880-1903

$P^{YF}{}_t$: Raw silk price at the Yokohama market. E_t: Exchange rate (US dollars per 100 yens).

Regression model: $\ln(P^{YF}{}_t)=\beta_0+\beta_1\ln(E_t)+\varepsilon_t$.

Term		estimated elasticity			Number	R^2	F value
		β_0	$\beta_1=e_t$		of samples		
null hypothesis for t test			$\beta_1=0$	$\beta_1=-1$			
1st	Jan 1880-Dec 1880	-0.546	1.558		52	0.560	2.948†
	t statistics	-0.134	1.717†				
2nd	Jan 1881-Dec 1881	-0.678	1.594		52	0.300	1.542
	t statistics	-0.117	1.242	2.022*			
3rd	Jan 1882-Dec 1884	-2.545	1.990		156	0.333	76.823**
	t statistics	-2.493*	8.765**				
4th	Jan 1885-Aug 1886	12.561	-1.397		86	0.642	153.579**
	t statistics	25.243**	-12.393**	-3.513**			
5th	Sep 1886-Mar 1890	-7.014	3.122		185	0.519	197.640**
	t statistics	-7.301**	14.058**				
6th	Apr 1890-Dec 1890	7.901	-0.320		39	0.056	2.185
	t statistics	8.247**	-1.478	3.148**			
7th	Jan 1891-Dec 1893	12.006	-1.290		154	0.679	130.271**
	t statistics	25.038**	-11.414**	-2.566**			
8th	Jan 1894-Sep 1897	8.552	-0.485		191	0.050	9.846**
	t statistics	14.044**	-3.138**	3.323**			
9th	Oct 1897-Dec 1903	-22.196	7.447		319	0.234	96.717**
	t statistics	-7.511**	9.834**				

Sources: Tokyo Keizai Zasshi (Tokyo Economic Journal), Chugai Buuka Shimpo (News on Domestic and International Prices), Chugai Shogyo Shimpo(News on Domestic and International Businesses).

Notes: Japan had been under the silver standard until September 1897, under the gold standard since October 1897. **:significan at 1%. *: significant at 5%.

Appendix Table 2 The effect of *Filature* (machine reeled raw silk) price on the exchange rate in the Yokohama market

$P^{YF}{}_t$: Raw silk price at the Yokohama market. E_t: Exchange rate (US dollars per 100 yens).

Regression model: $\ln(E_t) = \beta_0 + \beta_1 \ln(P^{YF}{}_t) + \varepsilon_t$

Term			estimated elasticity	R^2	F value
		β_0	β_1		
3rd	Jan 1882-Dec 1884	3.425	0.167	0.333	76.823**
	t statistics	28.036**	8.765**		
5th	Sep 1886-Mar 1890	3.246	0.166	0.519	197.640**
	t statistics	42.267**	14.058**		
9th	Oct 1897-Dec 1903	3.687	0.031	0.234	96.717**
	t statistics	168.197**	9.834**		

Sources: Tokyo Keizai Zasshi (Tokyo Economic Journal) , *Chugai Buuka Shimpo (News on Domestic and International Prices)* , *Chugai Shogyo Shimpo(News on Domestic and International Businesses).*

Notes: **:significan at 1%. *: significant at 5%. The numbers of samples are the same as those on Table 1.