

Transition to a Modern Regime and Change in Plant Lifecycles:

A Natural Experiment from Meiji Japan *

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Abstract: This paper examines how political, social and economic regime change affects lifecycles of manufacturing plants. To do that, we exploit Japan's transition from a feudal regime to a modern regime in the late nineteenth century as a natural experiment. Using the plant-level data for 1902 including the information on the foundation year of each plant, we examine how age-size profiles of plants differ between before and after the regime change. It was found that plants grew much faster after the regime change, and that the acceleration of growth after the regime change is much larger for the plants in exporting industries, the industries intensively using steam power, and plants adopting the corporate form. These findings suggest that access to export market, access to modern technologies and availability of the modern corporate form were the channels through which the regime change affected the age-size profile of plants.

Keywords: Plant lifecycle, Market access, Trade reform, Natural experiment, Economic History, Japan

JEL Classification Number: D22, L25, O14, O43, N65.

* Comments welcome. We gratefully acknowledge Asuka Imaizumi, Kaori Ito, Yutaka Arimoto, and Kentaro Nakajima for their guidance and encouragement. We also thank seminar participants at FSI Shorenstein APARC (Japan Lunch), Stanford University, The University of Tokyo, Institute of Developing Economies (IDE-JETRO). Financial support was provided by JSPS, Japan (Grant-in-Aid for Scientific Research (B) 21330064).

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1. Introduction

Size distributions of plants are heterogeneous across countries, in particular, between developed and developing countries (Tybout 2000, 2014; Hsieh and Olken 2014). In recent years, a thick lower tail of plant size distribution and slower growth of plants in developing countries have been attracting interests as a source of low total factor productivity of those countries at the macro-level (Hsieh and Klenow 2009, 2014; Jones 2016; Bento and Restuccia 2017; Restuccia and Rogerson 2017).

Concerning the reasons for the difference in plant size distribution and plant growth, most literature focus on various distortions in the market. For instance, Hsieh and Klenow (2014), which compares the age-size profiles of plants in the United States, Mexico and India, suggest that in the latter two countries, plants grow more slowly as they age, because larger plants in India and Mexico, face barriers such as financial frictions, higher tax burdens on larger firms, contractual frictions in hiring nonfamily labor, especially skilled managers and costs of shipping to distant markets. Meanwhile, Restuccia and Rogerson (2017) classify the distortions into (a) features of statutory provisions including tax code and regulations, (b) discretionary provisions by the government or other entities including preferential loans by banks, and (c) market imperfections including monopoly power and market frictions.

Some studies attempt to identify the distortions in developing economies empirically. By a randomized experiment granting money to microenterprises in Sri Lanka, de Mel, McKenzie, and Woodruff (2008) find that credit constraints affect smaller and young firms to reduce their growth opportunities. Jensen and Miller (2017) exploit the spread of mobile phones to fishermen in Kerala, India as a natural experiment, to show that after the spread of mobile phones the highest quality boat builders gained market share and grew in size, while lowest quality builders lost market share and exited, because fishermen learned more about the non-local builders and began buying non-locally.

This paper is in the same vein as these empirical studies, especially Jensen and Miller (2017), but we take a different strategy. That is, we attempt to identify the distortions that hinder plant growth in developing economies, by exploiting the transition from a feudal regime to a modern regime in late nineteenth century Japan, as a natural experiment. In 1859,

under the military threat from the US fleet, Japan opened the country and abolished the seclusion policy that lasted for more than 200 years. Opening the country itself was a great regime change, but it was a start of the broader regime change, that is the transition from a feudal regime under the Tokugawa government to a modern regime under the Meiji government, namely Meiji Restoration in 1868 and subsequent institutional reforms. By the end of the 1870s, the Meiji government abolished most feudal regulations, and introduced various modern institutions.

The case of late nineteenth century Japan is important in the context of the foregoing literature, because manufacturing plants that were found before the regime change and survived through it experienced two essentially different environments, namely the closed economy with feudal regulations under the Tokugawa government, and the open and free economy under the Meiji government. This exogenous regime change after 1859 provides a valuable opportunity for a natural experiment. While Bernhofen and Brown (2004) focuses on the trade regime change for a direct test of the Heckscher-Ohlin Theorem, we use this opportunity to identify the conditions which explain the difference in size distribution and lifecycle of manufacturing plants between developing and developed economies.

For this purpose, this paper documents how plant lifecycles of size varies across the experiences of traditional and modern periods. We use the plant-level data of the manufacturing censuses for 1902, which provide information on foundation year, employment (the number of workers), geographic location, industry, sources of power, and corporate form for each manufacturing plant. It is remarkable that the data include substantial number of plants that were founded before the regime change. These plants operated under two different environments before and after the regime change, which provides us an opportunity to test whether 1-year experience of operation under the modern regime had a larger effect on plant growth than that under the feudal regime. The main finding is that size-experience profiles became steeper if experiences in the modern periods increased. This is not true even if experiences in the feudal regime increased. Furthermore, by interacting the regime change with three attributes of plants, i.e. export industry/non-export industry, technology intensity, and corporate/non-corporate plants, we attempt to identify the channels that the regime change affected the growth and lifecycle of plants.

As briefly discussed, these results relate to several different literatures. First, this paper is also closely related to the literature on the short- and long-run impacts of access to foreign markets on firm growth. As existing empirical results have shown that knowledge transfers behind exporting increase quality of products (Atkin, Khandelwal, and Osman 2017), our analysis also tests the importance of access to foreign markets by looking at a wider range of industries. While the existing experimental studies have to have short-term impacts of trade gains, our study shows long-term dynamic effects of trade gains based on the combination between detailed micro-level census of plants and historical natural experiments. Along with other long-term studies on estimating the persistent effects of access to foreign knowledge and markets for developing economies (Gioceli 2018), our analysis also shows the dynamic gains of changes in access to foreign markets. Furthermore, our analysis based on historical experiences of early industrial development stage during the late nineteenth century and early twentieth century could be comparable to the literature on labor market reallocation and international integration in the context of current developing economies (McCaig and Pavcnik 2018).

Second, our results also relates to the literature on the returns to adopting modern management practices for the establishments in developing economies. Many existing studies have shown that adopting modern management practices has higher returns by using observable and experimental data (Bloom and Van Reenen 2007; Bloom, Eifert, Mahajan, McKenzie, and Roberts 2013; Bloom, Mahajan, McKenzie, and Roberts 2018). Along with these existing studies, our analysis also confirms the returns to modern management practices by looking at the unique natural historical experiments of regime changes in corporate form in a developing economy. While these existing studies mainly focus on a single industry, our analysis provides an experience of managerial changes of plants for a wider range of industries in a developing economy during the rapid transitions.

Third, our results are also related to the literature on family firms in the early stage of economic development. While some existing studies have shown that the limited extent of firm growth of family firms in developing economies (Bloom, Mahajan, McKenzie, and Roberts 2010; Akcigit, Alp, and Peters 2018), our analysis also confirms that family firms are less likely to grow. Our comparison between modern corporate and individual plants shows that there are large returns to adopt a new modern organizational form: the

impacts of experiences of modern regime are about four times higher for corporate form plants than that of individual form plants. Thus, our results suggest that the plant become bigger as they age if they adopted modern corporate form when they faced changes in domestic institutions of organizational form (Laeven and Woodruff 2007).

The rest of the paper is organized as follows. Section 2 overviews the history of the regime change in late nineteenth century Japan, and describes its impact on plant growth, focusing on the cases of two specific plants, for which long-term time series data are available. Section 3 presents the data and descriptive analyses. Section 4 reports the results of econometric analyses. Section 5 concludes the paper.

2. Transition from a feudal regime to a modern regime

2.1 A Brief overview of the regime change

Japan experienced drastic and swift change in the political, social and economic regime, from the 1850s. Before that, a stable regime had continued for more than two hundred years (the Tokugawa Regime, hereafter) since the early seventeenth century, when Tokugawa Shogunate (*Bakufu*) was established in 1603. This political regime was composed of the central government, *Bakufu*, and around two hundred and fifty domains of feudal lords (*han*). For a feudal state, it was relatively centralized, in that *Bakufu* totally controlled the diplomatic policy. Also, *Bakufu* forced all the lords to stay in the capital city, Edo, for one year every two years, and *Bakufu* could change the domains of lords. At the same time, feudal lords held substantial autonomies. For example, they controlled the border of domains by installing checking points (*sekisho*), and they could issue regional paper currencies (*han satsu* or *han* notes) (Sasaki 1980, pp.39-42; Shinbo 1995, pp.4-5).

Concerning the social and economic aspects, the Tokugawa regime was a rigid class society. People were classified into the four classes, *samurai* (warrior), farmer, craftsman and merchant, by their origins. It is notable that each class corresponded to a certain occupation. In other words, people could not choose their occupations of their free wills. In addition, they did not have the freedom of movement or residence. While the agriculture was the largest industry, commerce and industries fairly developed as well. Merchants and craftsmen engaging in these industries were organized into regional trade associations, called *kabu nakama*, which was authorized by *Bakufu* or *han*. *Kabu nakama* strictly controlled new entries into each trade, and thereby enjoyed monopolistic rents. At the same time, they

provided the basis of markets by enforcing contracts and controlling the quality products and services (Miyamoto 1938; Okazaki 2005).

A basic condition for the Tokugawa Regime to be long maintained is that Japan was insulated from the outside world. Just after the foundation, *Bakufu* implemented the seclusion policy through a series of acts. By 1639, trade and other international relationships of Japan were limited to those with the Netherlands, China, Korea, and Ryukyu (Okinawa), and in addition they were strictly controlled by *Bakufu* (Tashiro 1988).

This condition was lost in the 1850s by the pressure from the Western countries. In 1853 Matthew C. Perry, a general of the U.S. Navy, came to Japan with his fleet, to request *Bakufu* to open the country. Under the threat of the fleet, *Bakufu* concluded the Treaty of Kanagawa in 1854 with the United States, which established a diplomatic relationship between Japan and the U.S.. Similar treaties were concluded with Britain, Russia, and the Netherlands in 1854, 1855, and 1856, respectively (Shinbo 1995, pp.18-19; Sugiyama 1989, pp.179-180; Fujita 2015, pp.130-134). Based on these diplomatic relationships, *Bakufu* then concluded trade treaties with the United States, Britain, Russia, the Netherlands, and France in 1858, which prescribed opening of five ports (Kanagawa, Nagasaki, Hakodate, Niigata, and Hyogo) and two markets (Edo and Osaka). The ports of Kanagawa, Nagasaki, and Hakodate were opened in 1859. Because of criticism and objections from powerful feudal lords, the opening of other ports was postponed, which obliged *Bakufu* a further concession. That is, in order to have foreign approval for this postponement, *Bakufu* accepted a low conventional tariff rate of 5%. In this sense, For Japan, opening the country meant not only the start of trade but also a transition to a de facto free trade regime (Shinbo 1995, p.20; Sugiyama 1989, p.180).

The opening of the country had a great impact on the Japanese economy, which had been closed for more than two hundred years. That is, relative prices changed sharply, which caused a substantial resource reallocation (Shinbo 1978; Bernhofen and Brown 2004). The impact of the opening the country was not limited to the economy. Several powerful feudal lords criticized *Bakufu* about the procedure of the decision on opening the country, which resulted in the civil war in 1868 between the anti-*Bakufu* loads and *Bakufu* supported by pro-*Bakufu* loads. Then, the former camp won the civil war to found a new government with the Emperor as the head of the state (Meiji Restoration). After

that building a modern state swiftly proceeded. In 1871, all the feudal domains were abolished, and prefectures were established as local administration organizations, which was an important epoch of the transition from a feudal decentralized state to a modern centralized state.

The transition to the modern state entailed a set of essential institutional changes, which are summarized in Table 1. It is notable that these reforms provided the fundamental institutional bases for the markets for production factors and commodities. The feudal class system was abolished by the Family Registration Act in 1871, and after that all the people could choose any occupations of their own wills (Fukushima 1975, p.224; Takahashi 1968, pp.70-72). This reform removed the barrier to allocation of labor force and human capital. The institutions on the land, another basic production factor, were reformed since just after the Meiji Restoration. In 1871 and 1872, farm land utilization and land sales were liberalized. Then, from 1873, the land tax reform was implemented. The Meiji government intended to establish its fiscal basis by constructing the modern tax system. Since the agriculture was the major industry of the Japanese economy in this period, the land tax should be the pillar of tax system. For reforming the land tax, the government first confirmed the land ownership of every piece of land in the country, and decided its price based on the revenue from it. Then, the land tax, 3% to the land price, was imposed to the land owner. The land tax reform took time, but it was finished in 1878 (Fukushima 1975, pp.220-244).

====Table 1====

With respect to the financial system, the National Bank Act was legislated in 1872. National banks were the private banks that had the privilege to issue bank notes. At first, just few national banks were founded, but since the amendment of the Act in 1876 made national banks improved the profitability of national banks, more than 150 national banks were founded by 1879, and they formed a nationwide financial network (Asakura 1988, pp.34-64, Okazaki, Sawada and Yokoyama 2005). Also, the Tokyo Stock Exchange and the Osaka Stock Exchange were established in 1878 (Hamao, Hoshi and Okazaki 2005). For these production factors to be utilized efficiently, the corporate system is a key. At first,

the Meiji Government strictly regulated foundation of corporations, but in 1878 it entrusted the regulation to prefecture governments, which, in turn, de facto liberalized foundations of corporations (Shinbo 1995, p.55; Takamura 1996, pp.49-50; Toshitani and Mizubayashi 1973, pp.47-48) . Finally, feudal regulations on commodity markets were removed as well. Just after the Meiji Restorations, checking points (*sekisho*), which *Bakufu* and *han* set to control borders of their domains, were removed (Shinbo 1995, pp.446-47), and from 1872 to 1873, feudal trade associations (*kabu nakama*) were dissolved (Miyamoto 1957, pp.8-9).

2.2 Tales of two plants

The regime change described in 2.1 indeed affected the growth pattern of plants. To show that we observe long-term time series data for two individual plants that cover the period before and after the regime change. It is known that in Japan, there are many companies with long histories dating back to the pre-modern period. For two of those companies, we obtain long-term data on production and employment of their plants.

The first case is a copper mining and refining plant at Besshi in Ehime Prefecture. Besshi Mine was a major pillar of Sumitomo *Zaibatsu*, the third largest business group in prewar Japan, whose origin dates back to the sixteenth century (Sakudo 1982). Sumitomo was given a license to mine copper ores at Besshi from *Bakufu* in 1691 (ibid). Sumitomo mined copper ore and smelted it to crude copper at Besshi, before sending this crude copper to Osaka to be refined (Sumitomo Metal Mining Co., 1991). Figure 1 displays the long-term time series of crude copper production at Besshi. It is remarkable that after a decline in the early eighteenth century, production was very stable at around 500 tons for about 150 years until the 1860s, and after that, it soared to exceed 4000 tons. In the context of this paper, until the 1860s, the Besshi Mine did not grow as it aged, whereas it grew sharply as it aged from the 1870s. Referring to the history of Besshi Mine, we can understand the reasons for this distinctive pattern of plant growth.

==== Figure 1====

The first reason is a technological constraint and the subsequent resolution of that constraint. In Tokugawa Period, Besshi Mine faced problems of transportation and drainage, as headways became longer and deeper, because both transportation and

drainage depended upon human power. They were fundamental problems common to all mines in this period (Sumitomo Metal Mining Co., 1991). The opening trade of Japan provided a chance to resolve these problems, and Sumitomo exploited the chance to do so. In 1869, directly following the Meiji Restoration, the manager of Besshi Mine, Saihei Hirose, traveled to Ikuno Mine, which was operated by the government. At Ikuno, Hirose learned Western mining technology from a French engineer employed by the government. After returning to Besshi, Hirose invited a mining engineer, Bruno L. Larroque, from France to come and work at Besshi. Based on the advice of Larroque, Sumitomo updated the Besshi Mine introducing Western technologies, including steam engines and machine drills (Ibid), which re-solved the problems that Besshi faced in the Tokugawa Period.

The second reason is a market constraint and its resolution. In the Tokugawa Period, the copper produced in Japan was mainly exported to China and The Netherlands, but it was strictly controlled by *Bakufu* (Sakudo 1982; Imai 2015). In 1871, the Meiji government liberalized domestic trade and exports of copper, and as a result, copper became a major export good in the 1870s (Takeda 1987). Sumitomo swiftly responded to this policy change, and established a branch in Kobe to sell copper to foreign trading houses there in 1871 (Sakudo 1982). The case of Besshi indicates that access to Western technologies and Western markets enabled the plant to grow, whereas it had not been able to grow as it aged prior to this under limited access to such technologies and markets.

The other case is from the soy sauce industry. Yamasa is a major soy sauce and food company in present Japan, and its origin dates back to early eighteenth century. The founder Gihei Hamaguchi came to Choshi in Chiba Prefecture and found a soy sauce plant in that period (Hayashi 1990). Yamasa established itself as a soy sauce producer by increasing its sales in the Edo (Tokyo) market in the late seventeenth and early nineteenth century. As the years progressed following the early nineteenth century, Yamasa's sales in Edo declined, due to the effects of control by the soy sauce merchant guild (*kabu nakama*) in Edo. Yamasa compensated for this decline in sales in Edo through sales in the local market, but nevertheless total sales stagnated from the early nineteenth century (Shinoda 1987). The movement of sales is reflected in that of employment (Figure 2). Although the number of employee at the Yamasa plant increased steadily from around 10 to around 20 until the 1810s, it stagnated after that. Then, in the 1870s, it started to grow again registering more than 40 employees in the 1880s. The company history of Yamasa writes:

there was an old saying that the upper limit of plant growth was 3500 koku (=631 kl), but under the new economic regime after the Meiji Restoration a new trend of capitalist mass production came, and our company got on the trend. Furthermore, our company shifted sales to the Tokyo market with the largest population. Although the proportion of sales to the Tokyo market and the local market were 50/50, respectively until 1871, they became 90% and 10%, respectively in 1887. This was indeed a drastic change (Yamasa Soy Sauce Co. ed. 1977, p.139). The case of Yamasa clearly indicates that restricted access to the Tokyo (Edo) market curbed the growth of the plant, and that the removal of this restriction enabled the plant to grow.

The cases of the two plants just described are highly motivating. That is, the sizes of these plants were stagnant for more than 100 years in Tokugawa Period, but started to grow fast just after Meiji Restoration. The transition from the stagnant phase to a growing phase was clear. Furthermore, historical narratives on these plants suggest the reasons for the change in the age-size profiles. That is, for Besshi, an introduction of the steam power resolved the problem of drainage that had been check the increase in production, and for Yamasa, improved access to a large market by the abolition of merchant guild, stimulated increase in soy source production.

==== Figure 2 ====

3. Data and descriptive analyses

The Ministry of Agriculture and Commerce conducted censuses on manufacturing plants with 10 or more workers from the 1890s, and the plant-level data were published under the title of *Kojo Tsuran (Handbook of Factories)* from 1902 (Matsuda, Sato and Kimura 1990). 1902 issue of *Kojo Tsuran* contains information for all the private manufacturing plants in Japan with 10 or more workers, in terms of plant name, industry, product, location, owner, year and month of foundation, number of workers, and number and horsepower of engines by power source¹. Herein, we use data from the 1902 issue of *Kojo Tsuran*.

Table 2 tabulates the plants in the data by industry and by period of foundation. An essential feature of our data set in the context of this paper is that the observations include

¹ *Kojo Tsuran* was continued to be published after that, but they do not include the information of the number of workers or the power sources.

a substantial number of plants founded before the regime change. According to Table 2 (the last row), out of the total 7,586 observations, 346 were founded before 1859, the year of opening the country, and 1,018 were founded before 1880, when most institutional reforms were completed. These plants were operated both before and after the regime change.

==== Table 2 ====

The key question here is how the lifecycle of plants was affected by the regime change that took place in Japan after the late 1850s. The lifecycle of plants is characterized by the relationship between the age of a plant (i.e. years of experience after the entry) and the size of the plant, that is the age-size profile. Figure 3 illustrates the age-size profiles using the data for 1902. The plant size is measured in terms of the number of workers, and the size of the youngest group (age 0-9) is normalized to 1. We calculate an age-size profile for the census data 1902 by computing average size by 10-year age bin. Then, we show cross-sectional age-size profile as a ratio of plant size increase relative to average plant size of the youngest group, age less than 10 years (footnote see Hsieh and Klenow 2014; Lagakos, Moll, Porzio, Qian, and Schoellman 2018a and 2018b). While the average plant size increases from age 0-9 to age 10-19, it declines after that. Converting the age categories into the categories of foundation years, we find that the foundation year category where the average plant size is the largest, is 1880-1889. This observation implies that plants became larger as they aged from the 1880s, whereas this upward sloping relationship between the plant age and plant size did not exist before the 1880s. Referring to the literature on the age-size profile in the present world, we can say that the situations before and after the 1880s are similar to the present developing countries and advanced countries, respectively (Hsieh and Klenow 2014). As we have seen in section 2.1 modern institutional bases for the market economy had been basically prepared by the end of the 1870s. It is suggested that these institutional reforms changed the environment of plants from that similar to the environment in present developing countries to that similar to the environment in present advanced countries.

==== Figure 3 ====

Our dataset allows us to depict the age-size profiles of plants by subgroup of plants classified by certain criteria. First, we focus on the distinction between export industries and non-export industries, because the opening of the trade was a very important institutional change that occurred in this period. Figure 4 shows the export of manufactured goods from Japan by commodity category. Evidently, textile was major export goods of Japan until the early twentieth century. Hence, we classify the textile industry as the exporting industry and the other industries as the non-exporting industry (Table 2). Figure 5 presents the age-size profiles of exporting and non-exporting industries. First, the profile of the exporting industry has a peak at age 10-19 like that of all the plants, while the profile of the non-exporting industry has a peak at age 20-29. Second, the slope from age 0-9 to age 10-19 is much steeper for the exporting industry. The steeper slope for the exporting industry suggests that the regime change had a larger impact on the exporting industry, and we can infer that the channel through which the regime change affected the plant lifecycle was the improved access to the international market.

==== Figures 4 and 5 ====

Next, we divide the plants by technology. The opening of the country drastically improved the access to modern technologies, and the impact of it would affect differently across industries, depending upon their technology intensity. Here, we measure the steam intensity of each industry by the ratio of the plant with steam power, and classify an industry as a steam intensive industry if the ratio was higher than the ratio of plants with steam power for all the plants (Table 2). Figure 6 shows the age-size profiles of plants by the steam power intensity. Both profiles have peaks at age 10-19, but the slope from age 0-9 to age 10-19 is much steeper for the steam power intensive industry, which is similar to the difference between export and non-export industries. It is suggested that the access to modern technologies is a channel through which the regime change affected the plant lifecycle.

==== Figure 6 ====

Finally, we divide the plant by organizational form. *Kojo Tsuran* provides the information on the names the plant owners, which enables us to see whether a plant was owned by a corporation or by an individual. Figure 7 compares the age-size profiles between plants owned by corporations and those owned by individuals. First, the profile of the former group has a peak at age 10-19, while the profile of the latter group has a peak at age 20-29. Second, the slope from age 0-9 to age 10-19 is much steeper for the plants owned by corporations. We can infer that availability of corporate organization is another channel through which the regime change affected the plant lifecycle.

==== Figure 7 ====

Simple graphical observations in this section suggest that years of operation experience of a plant has different effects on plant growth before and after the regime change, and that the difference depends upon the attributes of plants, such as export intensity, steam power intensity and organizational forms. In the following section, we examine these observations by regression analyses.

4. Regressions results

4.1 Empirical strategy and baseline results

Based on the observations in the previous section, we conduct regression analyses on the impact of the regime change on the age-size profiles of plants, exploiting the regime change in the late nineteenth century as a natural experiment. For that, we should identify the timing of the regime change. Here we assume that the regime change was primarily completed by the end of the 1870s, based on the description in Section 2. Figure 1 supports this judgement. The age-size profile kinks at age 10-19, which implies that from the early 1880s, the experience of operation came to have a positive impact on the plant growth. We check this assumption in Section 5.

The assumption above implies that before 1880, plants were exposed to a traditional environment, while after 1880, they were exposed to a modern environment. Based on this idea, we regress plant size (number of workers) on the years of operation under the traditional and modern environments. That is, we estimate the following linear equation

as the baseline model.

$$y_{ijp} = \beta_1(\text{Experience after entry})_{ijp} + \beta_x (\text{Other controls})_{ijp} + u_{ijp} \quad (1)$$

$$y_{ijp} = \beta_1 (\text{Experience before 1880})_{ijp} + \beta_2 (\text{Experience after 1880})_{ijp} + \beta_x (\text{Other controls})_{ijp} + u_{ijp} \quad (2)$$

where y_{ijp} is log of the number of workers at plant i belonging to industry j , located in prefecture p , in 1902. The explanatory variable "Years before 1880" is years from the plant foundation to 1880. "Years after 1880" is the years from 1880 to 1902. "Other controls" is a set of other explanatory variables including a plant-level steam power dummy, which equals to one if an industry was steam intensive in the sense defined in the previous section, an export industry dummy, which takes value one if an industry belonged to the textile industry, an enterprise dummy, which equals to one if the plant was adopting the corporate form, prefectures dummies, an urban country dummy, which equals to one if plant was in urban administrative county in each prefecture), the county-level population (*Population Census: Nihon Teikoku Jinkou Doutai Toukei*, 1903), and a year dummy. We estimate this equation by Ordinary Least Squares. Summary statistics is reported in Table 3.

====Table 3====

Table 4 shows the baseline estimation results. Column (1) reports the result of the estimation that does not distinguish the years before and after 1880. The coefficient on experience after entry, i.e., plant age, is positive and statistically significant at the 1% level. The magnitude of the coefficient 0.001 indicates that a plant grew 0.1 percentage point larger as it aged by 1 year. In this sense, the average annual growth rate was low.

Column (2) is the case where we distinguish the experience before and after 1880. The coefficient on years after 1880 is positive and statistically significant at 1% level. Also, the average annual growth rate was as high as 1.6%. Furthermore, it is notable that the coefficient on experience before 1880 is around 0. In other words, from 1880, plant growth was substantially

accelerated. Entry after 1880 dummy is positive and statistically significant too. That is, the regime change had a positive impact on the intercept of the age-size profile, as well as its slope.

==== Table 4 ====

4.2 Mechanisms

In the previous subsection, we revealed that experience of operation had different effects on plant growth between before and after the regime change. Then, the next question is through what channels the regime change affected the plant lifecycle. In section 3, by comparison of the shapes of age-size profiles between subgroups of plants, we inferred that access to the export market, access to modern technologies and availability of corporate organization were the possible channels. We can test this conjecture econometrically, by exploiting the variation in the values of these accesses and availability across plants.

First, the source of variation in the value of access to the export market is the extent of comparative advantage of the industry to which each plant was affiliated. If an industry has comparative advantage, opening of trade would have a direct positive impact to the plants in that industry, whereas an industry without comparative advantage would not, or would have a negative impact. We can see the extent of comparative advantage of each industry by looking at the actual export and import of its product after the opening of the trade. As we have already seen, textile was the major export goods from Japan in the late nineteenth and the early twentieth centuries (Figure 2). Hence, we can infer that the plants in the textile industry would have a larger positive impact from the trade opening. We capture this relationship by the export industry dummy, which takes value one, if a plant was in the textile industry, and zero, otherwise.

Columns (1) and (2) of Table 5 report the estimation results, dividing the observations into the exporting and the non-exporting industries. For both of the two industry groups, the age effect is significantly positive only for the experience after 1880, but the magnitude of the age effect after 1880 is substantially larger for the exporting industries. That is, the plants in the exporting industries enjoyed a larger positive impact from the regime change.

==== Table 5 ====

Second, the source of variation in the value of access to modern technologies is applicability of those technologies to each industry. We regard those industries that intensively used steam power in 1902, as the industries with high applicability of modern technologies. Here we use the definition of steam intensive industries in section 3. Columns (3) and (4) of Table 3 report the estimation results, dividing steam power intensive industries and non-steam power intensive industries. For both of the two industry groups, the age effect is significantly positive only for the experience after 1880, but the magnitude of the age effect after 1880 is much larger for the steam intensive industries. Indeed, the industries with higher applicability of steam power had a larger positive impact on plant growth from the regime change.

Finally, the source of variation in the value of availability of corporate organization is applicability of the corporate form to each plant. As in section 3, we classify plants into those owned by corporations and those owned by individuals. The estimation results are similar to the above two distinction. That is, for both of the two plant groups, the age effect is significantly positive only for the experience after 1880, but the magnitude of the age effect after 1880 is much larger for the plants owned by corporations.

Those results indicate that access to the export market, access to modern technologies and availability of the corporate organization were the channels through which the regime change affected the plant growth, and thereby changed the age-size profile of plants.

4.3. Robustness checks

This subsection checks robustness of the estimation results. The most important point to check is how to divide the period. In 4.2 we assume that the regime change was completed by the end of 1870s, based on historical information and observation of age-size profiles. Here we check whether this assumption is appropriate or not. To do that, we divide the whole period into five sub-periods, i.e., before 1839, 1840-1859, 1860-1879,

and after 1880, and estimate the age effects separately for these five sub-periods. The estimation results are reported in Table 6. Column (1) is for the whole samples. It is found that only the coefficient on experience after 1880 is a positive and significant, and that the coefficients on experience in the other four sub-periods are insignificant or significantly negative. Columns (2)-(7) report the same exercises dividing the samples by plant attribute as we did in subsection 4.2. The results are quite consistent. That is, all the coefficients on experience after 1880 are significantly positive, while the all the coefficients on the experience in the other periods are insignificant or significantly negative. These results indicate that the watershed between the traditional economic environment and the modern economic environment in Japan is located around 1880, and that the transition to the modern environment affected the plant lifecycle through the channels of access to the export market, access to modern technologies and availability of the corporate organization.

====Table 6====

Table 7 reports the results of other robustness checks. We checked whether the estimation results are driven by certain parts of samples, namely the samples of very large or very small plants (top 5, top 5%, bottom 1%, or bottom 5%), and very old plants (older than 300 years, 200 years or 100 years). It is confirmed that even in case we drop these samples, the results are qualitatively the same as those in Table 2 and Table 3.

====Table 7====

5. Concluding remarks

Difference in age-size profiles of manufacturing plants is one of the most remarkable distinctions between the advanced and developing economies (Hsieh and Klenow 2009, 2014). This paper empirically explores the mechanisms through which this difference emerges, using historical data from Japan. Japan experienced a drastic political social and economic regime change after the 1850s, that is, the opening of the country in 1859, Meiji Restoration in 1868, and subsequent institutional reforms, which were almost completed by the end of 1870s. We exploit this event as a natural experiment to investigate the

implications of a traditional environment before the regime change and a modern environment after that, on the shape of plant age-size profile.

The main findings are as follows. First, plants grew much faster as they aged after the regime change than before that. In other words, the age-size profile of plants is much steeper after the regime change. Second, the acceleration of growth after the regime change is larger for the plants in exporting industries, the industries intensively using steam power, and plants adopting the corporate form. These findings suggest that access to export market, access to modern technologies and availability of the modern corporate form were the channels through which the regime change affected the age-size profile of plants.

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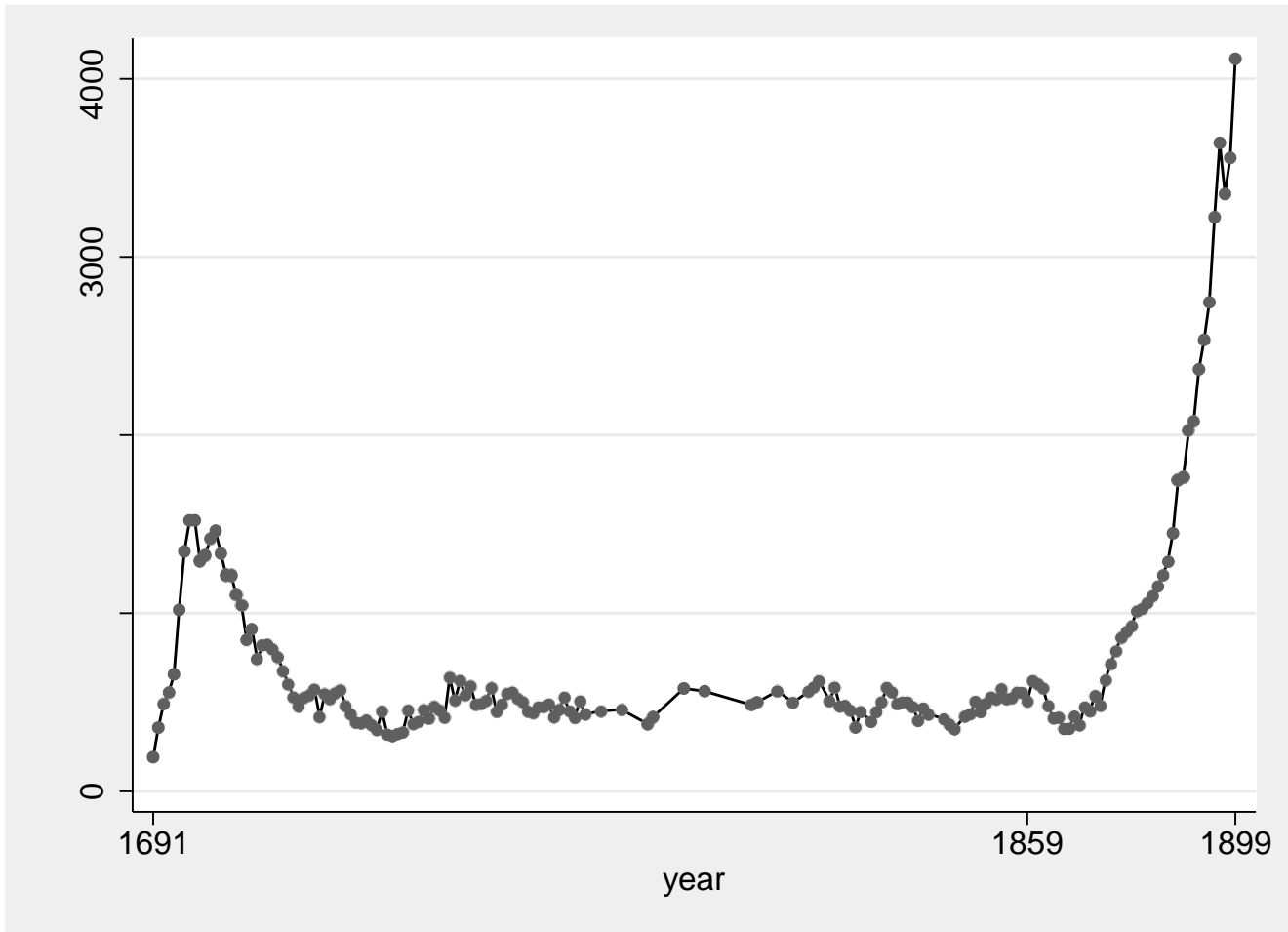
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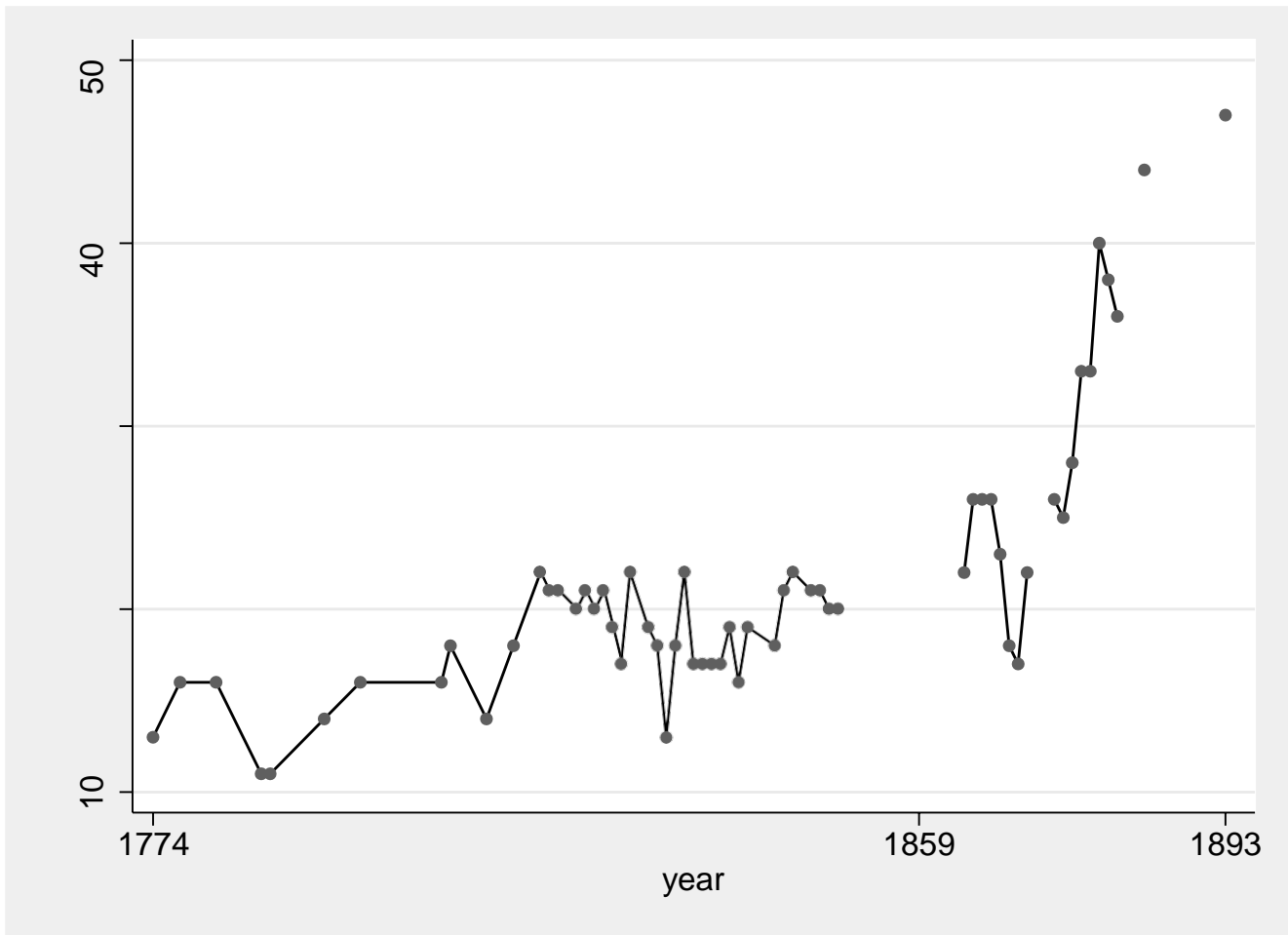
Figures and Tables

Figure 1: Production of copper at Sumitomo Besshi Mine (Unit: Tons), 1691-1899



Source: Sumitomo Metal Mining Co. ed. *Sumitomo Besshi Kozan-shi*, appendix volume, 1991.

Figure 2: Number of employees at Yamasa Soy Sauce (Unit: Persons), 1774-1893



Source: Suzuki (1990), pp.146-7. Those workers who were not employed in an entire year, are converted into the workers employed in an entire year by multiplying it by (days of employment/360).

Figure 3: Average and median plant size across age categories

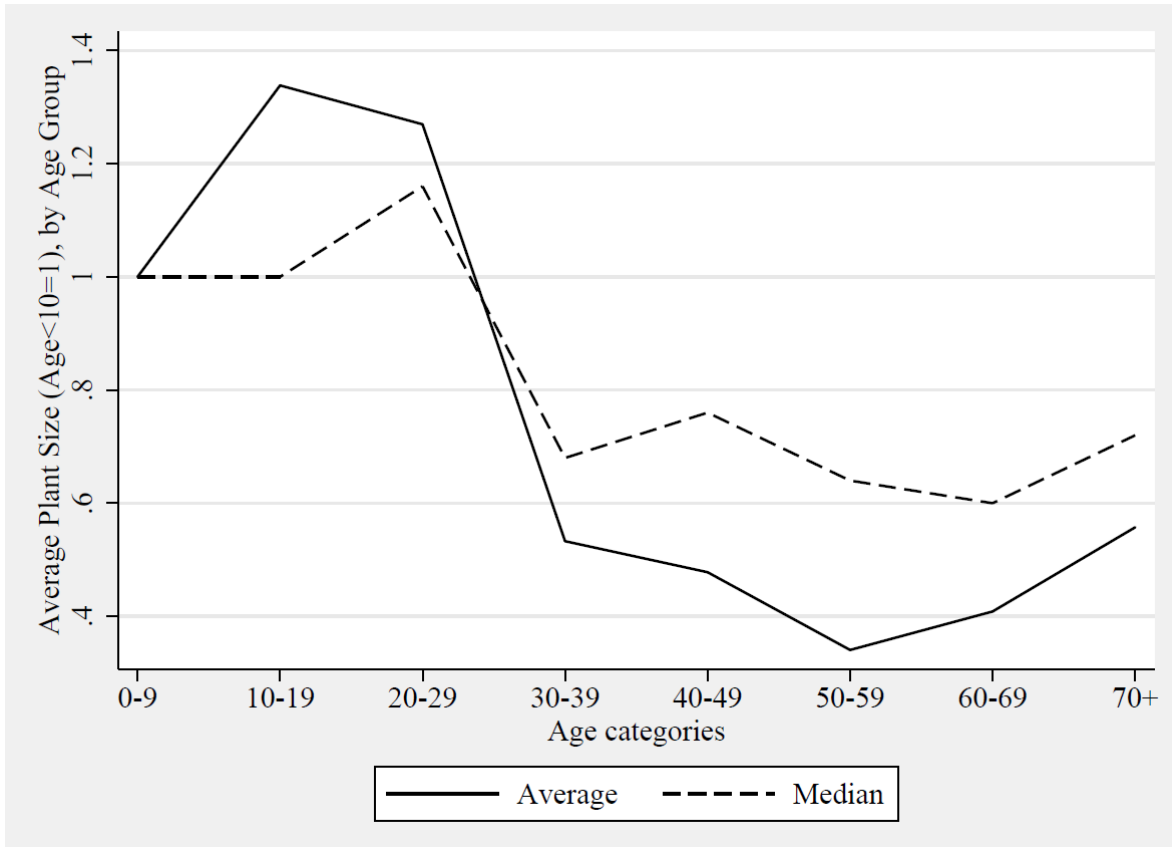
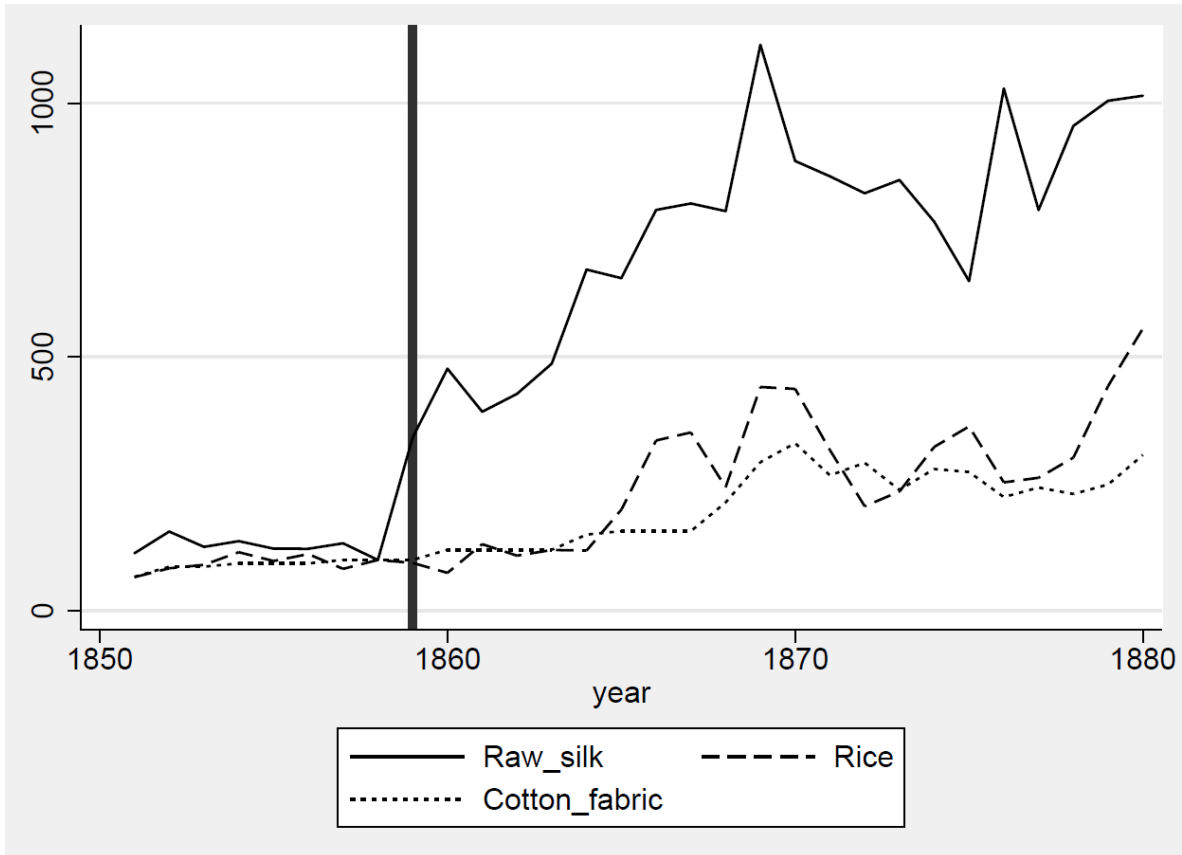


Figure 4: Relative prices (1858=100) of cotton fabric, raw silk, and rice in Japan following opening up to trade in 1859



Source: Source: *Kin'yu Kenkyukai* (1937), pp.13-15, 89-90 and 103-104.

Figure 5: Average and median plant size of exporting and non-exporting industries across age categories

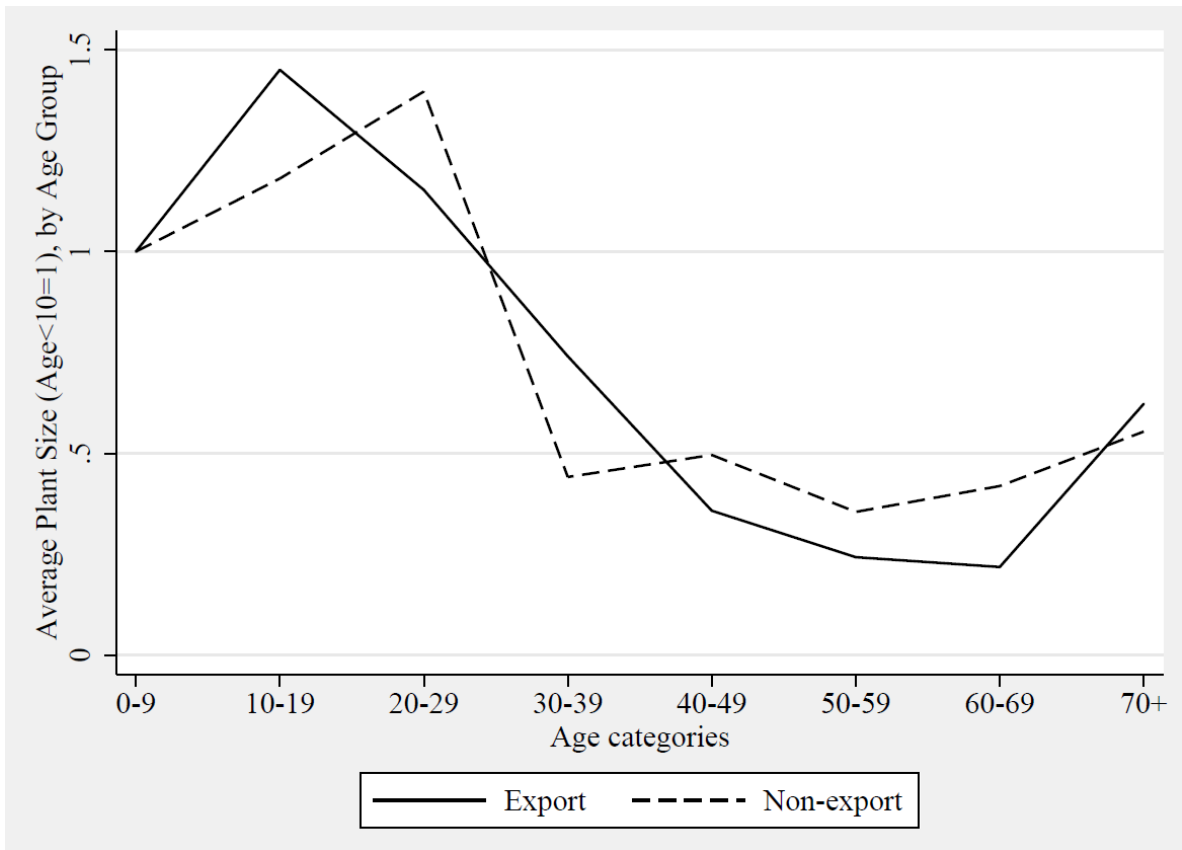


Figure 6: Average and median plant size of steam power intensive and non-intensive industries across age categories

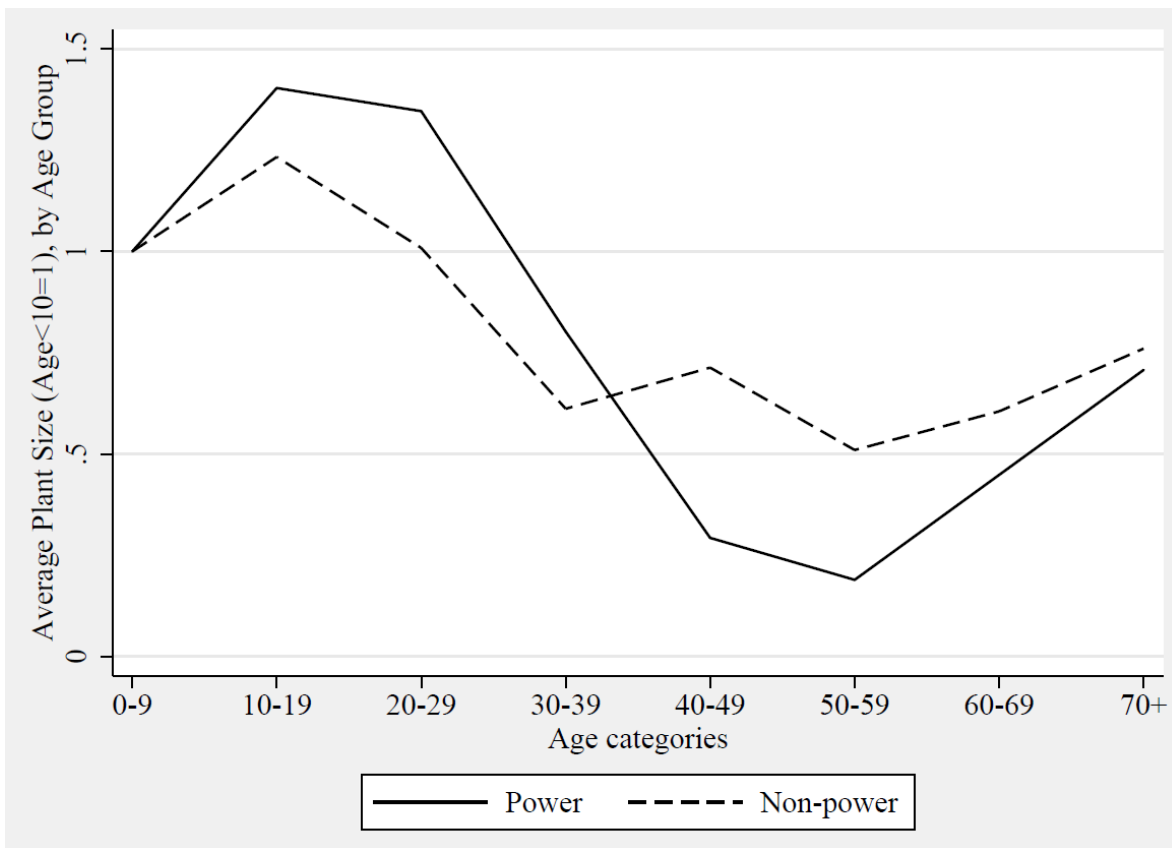


Figure 7: Average and median plant size of enterprise-owned plant and non-enterprise owned plants across age categories

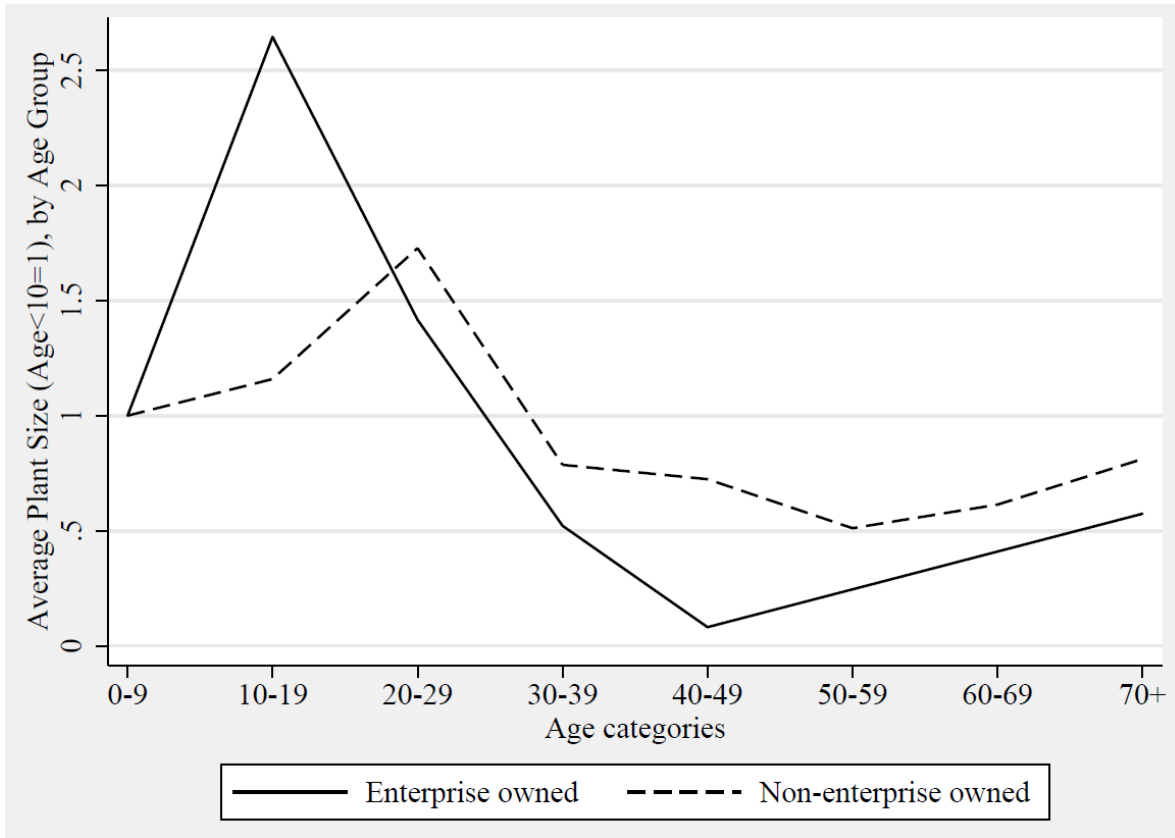


Table 1: Major changes in institutions

Classification	Year	Event
International trade	1859	Opening the international trade at three ports (Yokohama, Nagasaki and Hakodate)
	1866	Reduction of tariff rates 20% to 5%
Polity	1868	Meiji Resoration (Transition of the administration from <i>Shogun</i> to Emperor)
	1871	Substitution of prefectures for han
Class system	1871	Family Registration Act (Abolition of feudal class system)
	1871	Liberalization of choosing occupations
Land ownership and tax	1871	Liberalization of farm land utilization
	1872	Liberalization of land sales
	1873-1878	Establishment of modern land ownership and land tax system
Financial system	1872	National Bank Act
	1876	Amendment of the National Bank Act to Formation of nationwide network of national banks
	1878	Establishment of Tokyo Stock Exchange and Osaka Stock Exchange
Corporation	1878	Liberalization of founding corporations
Domestic commodity market	1869	Abolition of checking points (<i>sekisho</i>)
	1872-73	Dissolution of kabunakama

Table 2: Description of sample plants

Foundation year	-1839		1840-59		1860-79		1880+		Total		Exporting industries	Steam power intensive industries	Steam power intensity
	N	%	N	%	N	%	N	%	N	%			
Silk Reeling	2	0.9%	1	0.9%	200	29.6%	2,257	34.4%	2,460	32.4%	Yes	Yes	49.0%
Weaving	13	5.6%	10	9.1%	89	13.2%	1,473	22.4%	1,585	20.9%	Yes		3.6%
Ceramic	56	24.0%	23	20.9%	52	7.7%	285	4.3%	416	5.5%			8.9%
Tobacco	17	7.3%	21	19.1%	37	5.5%	279	4.2%	354	4.7%			13.0%
Brewing	75	32.2%	31	28.2%	79	11.7%	144	2.2%	329	4.3%			8.5%
Printing and Binding	0	0.0%	0	0.0%	20	3.0%	192	2.9%	212	2.8%			8.0%
Cotton Spinning	0	0.0%	0	0.0%	6	0.9%	199	3.0%	205	2.7%	Yes	Yes	53.7%
Firebomb	0	0.0%	0	0.0%	7	1.0%	198	3.0%	205	2.7%			15.6%
Mining	4	1.7%	0	0.0%	16	2.4%	170	2.6%	190	2.5%		Yes	45.8%
Wood and Bamboo	4	1.7%	1	0.9%	11	1.6%	161	2.5%	177	2.3%			25.4%
Tatami and Bakkan	0	0.0%	0	0.0%	0	0.0%	140	2.1%	140	1.8%			0.0%
Dyeing	3	1.3%	2	1.8%	14	2.1%	120	1.8%	139	1.8%			25.9%
Machinery	0	0.0%	0	0.0%	11	1.6%	122	1.9%	133	1.8%		Yes	60.2%
Paper Products	1	0.4%	1	0.9%	10	1.5%	106	1.6%	118	1.6%		Yes	33.1%
Instrument	5	2.1%	6	5.5%	21	3.1%	77	1.2%	109	1.4%			27.5%
Other Food Products	10	4.3%	2	1.8%	31	4.6%	63	1.0%	106	1.4%			0.0%
Metal Instrument	11	4.7%	3	2.7%	13	1.9%	67	1.0%	94	1.2%			24.5%
Flour	0	0.0%	0	0.0%	2	0.3%	78	1.2%	80	1.1%		Yes	87.5%
Metal Refining	9	3.9%	6	5.5%	7	1.0%	53	0.8%	75	1.0%			18.7%
Misc	2	0.9%	1	0.9%	9	1.3%	62	0.9%	74	1.0%			21.6%
Ship and Vehicle	8	3.4%	1	0.9%	11	1.6%	53	0.8%	73	1.0%		Yes	49.3%

Knitting	0	0.0%	0	0.0%	4	0.6%	53	0.8%	57	0.8%	Yes		22.8%
Pharmaceutical	2	0.9%	0	0.0%	3	0.4%	51	0.8%	56	0.7%		Yes	33.9%
Other Chemical Products	2	0.9%	1	0.9%	1	0.1%	19	0.3%	23	0.3%		Yes	34.8%
Oil and Wax	1	0.4%	0	0.0%	1	0.1%	17	0.3%	19	0.3%		Yes	89.5%
Stone, Bone, and Shell	1	0.4%	0	0.0%	2	0.3%	15	0.2%	18	0.2%		Yes	33.3%
Sweets	4	1.7%	0	0.0%	4	0.6%	10	0.2%	18	0.2%			27.8%
Feather	1	0.4%	0	0.0%	0	0.0%	15	0.2%	16	0.2%			25.0%
Canned and Bottled Products	0	0.0%	0	0.0%	1	0.1%	14	0.2%	15	0.2%		Yes	86.7%
Electricity	0	0.0%	0	0.0%	0	0.0%	14	0.2%	14	0.2%		Yes	64.3%
Tannery	0	0.0%	0	0.0%	3	0.4%	11	0.2%	14	0.2%		Yes	35.7%
Tea	0	0.0%	0	0.0%	6	0.9%	8	0.1%	14	0.2%		Yes	50.0%
Leather	0	0.0%	0	0.0%	3	0.4%	9	0.1%	12	0.2%		Yes	33.3%
Lacquer	1	0.4%	0	0.0%	0	0.0%	9	0.1%	10	0.1%			20.0%
Soda and Ice	0	0.0%	0	0.0%	0	0.0%	8	0.1%	8	0.1%		Yes	75.0%
Fertilizer	1	0.4%	0	0.0%	0	0.0%	6	0.1%	7	0.1%		Yes	57.1%
Gas	0	0.0%	0	0.0%	0	0.0%	4	0.1%	4	0.1%			0.0%
Stitchwork	0	0.0%	0	0.0%	0	0.0%	4	0.1%	4	0.1%	Yes		0.0%
Sugar	0	0.0%	0	0.0%	1	0.1%	2	0.0%	3	0.0%		Yes	66.7%
Total	233	100.0%	110	100.0%	675	100.0%	6,568	100.0%	7,586	100.0%			28.1%

Note: Steam power intensive industries=1 if Steam power intensity of for each industry>Mean of Steam power intensity (28.1%).

Table 3: Summary statistics

Variable	Mean	Std. Dev.	Min	Max
Plant size (Number of workers)	58.359	187.337	10	7224
Experiences	13.740	31.426	0	1016
Experience before 1880	4.504	28.646	0	994
Experience after 1880	9.236	7.211	0	22
Entry after opening (dummy)	0.876	0.329	0	1
Use steam power at the plant (dummy)	0.281	0.450	0	1
Use non-steam power at the plant (dummy)	0.181	0.385	0	1
Exporting industry (dummy)	0.568	0.495	0	1
Corporate enterprise (dummy)	0.161	0.368	0	1
Located urban area in the county (dummy)	0.234	0.423	0	1
County population (ln)	11.540	0.988	5.919	14.414

Table 4: Results of baseline regressions

	(1)	(2)	(3)
Experiences	0.001** (0.000)	0.000 (0.000)	
Experience before 1880			-0.000 (0.000)
Experience after 1880			0.016*** (0.002)
Entry after 1880 (dummy)		- 0.096*** (0.031)	0.101*** (0.037)
Use steam power at the plant (dummy)	0.679*** (0.024)	0.682*** (0.024)	0.684*** (0.023)
Use non-steam power at the plant (dummy)	0.448*** (0.027)	0.447*** (0.027)	0.436*** (0.027)
Exporting industry (dummy)	0.182*** (0.022)	0.189*** (0.023)	0.195*** (0.022)
Corporate enterprise (dummy)	0.691*** (0.033)	0.698*** (0.033)	0.726*** (0.033)
Located urban area in the county (dummy)	0.058** (0.027)	0.059** (0.027)	0.040 (0.027)
County population (ln)	0.066*** (0.013)	0.067*** (0.013)	0.066*** (0.013)
Regional controls (reference: Rest of Japan)	✓	✓	✓
Constant	2.130*** (0.149)	2.204*** (0.151)	1.897*** (0.154)
Observations	7,586	7,586	7,586
R-squared	0.267	0.267	0.276

Notes: Reference for the entry period dummies and region dummies are the period before 1839 and the rest of Japan, respectively. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Regressions for testing channels

Sample	(1) Exporting	(2) Non- Exporting	(3) Steam power intensive	(4) Non- steam power intensive	(5) Corporate enterprise	(6) Non- corporate enterprise
Experience before 1880	-0.005** (0.002)	0.000 (0.000)	0.000 (0.002)	0.000 (0.000)	-0.001 (0.008)	-0.001** (0.000)
Experience after 1880	0.018*** (0.002)	0.012*** (0.003)	0.020*** (0.003)	0.010*** (0.002)	0.048*** (0.007)	0.010*** (0.002)
Entry after 1880 (dummy)	-0.103* (0.059)	0.228*** (0.054)	-0.122* (0.072)	0.202*** (0.043)	0.429* (0.258)	0.048 (0.037)
Use steam power at the plant (dummy)	0.810*** (0.026)	0.486*** (0.045)	0.728*** (0.033)	0.559*** (0.053)	0.753*** (0.065)	0.649*** (0.024)
Use non-steam power at the plant (dummy)	0.445*** (0.030)	0.428*** (0.052)	0.513*** (0.040)	0.251*** (0.041)	0.623*** (0.094)	0.407*** (0.027)
Exporting industry (dummy)			0.152*** (0.056)	0.115*** (0.025)	0.637*** (0.068)	0.088*** (0.022)
Corporate enterprise (dummy)	0.930*** (0.046)	0.521*** (0.045)	0.882*** (0.050)	0.564*** (0.041)		
Located urban area in the county (dummy)	0.077** (0.038)	0.047 (0.040)	-0.162*** (0.061)	0.140*** (0.029)	0.044 (0.086)	0.037 (0.026)
County population (ln)	0.131*** (0.023)	0.027 (0.017)	0.084*** (0.027)	0.054*** (0.015)	-0.021 (0.041)	0.085*** (0.013)
Regional controls (reference: Rest of Japan)	✓	✓	✓	✓	✓	✓
Constant	1.462*** (0.271)	2.363*** (0.194)	1.885*** (0.321)	2.023*** (0.170)	2.717*** (0.518)	1.896*** (0.150)
Observations	4,311	3,275	3,462	4,124	1,223	6,363
R-squared	0.388	0.174	0.285	0.197	0.251	0.181

Notes: Reference for the entry period dummies and region dummies are the period before 1839 and the rest of Japan, respectively. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Detecting the period of the regime change

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sample	Whole	Exporting	Non-Exporting	Steam power intensive	Non-steam power intensive	Corporate enterprise	Non-corporate enterprise
Experience before 1839	-0.000 (0.000)	-0.000 (0.001)	0.000 (0.000)	0.004 (0.003)	-0.000 (0.000)	0.083 (0.106)	-0.000 (0.000)
Experience between 1840-1859	-0.010 (0.011)	-0.032* (0.019)	-0.010 (0.012)	-0.044 (0.054)	-0.010 (0.011)		-0.010 (0.011)
Experience between 1860-1879	-0.032*** (0.006)	-0.029*** (0.009)	-0.025*** (0.008)	-0.022 (0.014)	-0.018** (0.007)	-0.046 (0.046)	-0.034*** (0.006)
Experience after 1880	0.016*** (0.002)	0.019*** (0.002)	0.011*** (0.003)	0.021*** (0.003)	0.009*** (0.002)	0.049*** (0.007)	0.009*** (0.002)
Entry between 1840-1859	-0.202 (0.146)	-0.664** (0.271)	-0.169 (0.155)	-0.686 (0.640)	-0.160 (0.145)		-0.217 (0.143)
Entry between 1860-1879	-0.587** (0.242)	-0.783* (0.448)	-0.554** (0.257)	-0.824 (1.136)	-0.490** (0.242)	1.207 (2.630)	-0.586** (0.240)
Entry after 1880	-0.671*** (0.257)	-0.948** (0.465)	-0.500* (0.287)	-0.958 (1.147)	-0.418 (0.267)	1.499 (2.695)	-0.756*** (0.255)
Use steam power at the plant (dummy)	0.679*** (0.023)	0.806*** (0.026)	0.485*** (0.045)	0.726*** (0.033)	0.560*** (0.053)	0.751*** (0.065)	0.642*** (0.024)
Use non-steam power at the plant (dummy)	0.425*** (0.027)	0.438*** (0.030)	0.425*** (0.052)	0.512*** (0.040)	0.248*** (0.041)	0.619*** (0.094)	0.394*** (0.027)
Exporting industry (dummy)	0.184*** (0.023)			0.146*** (0.056)	0.115*** (0.025)	0.637*** (0.068)	0.073*** (0.022)
Corporate enterprise (dummy)	0.726*** (0.033)	0.928*** (0.046)	0.520*** (0.045)	0.880*** (0.050)	0.564*** (0.041)		
Located urban area in the county (dummy)	0.036 (0.027)	0.078** (0.038)	0.045 (0.040)	-0.159*** (0.061)	0.140*** (0.029)	0.043 (0.087)	0.031 (0.026)
County population (ln)	0.066*** (0.013)	0.132*** (0.023)	0.027 (0.017)	0.083*** (0.027)	0.054*** (0.015)	-0.022 (0.041)	0.084*** (0.013)
Regional controls (reference: Rest of Japan)	✓	✓	✓	✓	✓	✓	✓
Constant	2.689*** (0.295)	2.303*** (0.525)	3.099*** (0.338)	2.731** (1.168)	2.653*** (0.312)	1.653 (2.747)	2.724*** (0.290)
Observations	7,586	4,311	3,275	3,462	4,124	1,223	6,363
R-squared	0.279	0.390	0.175	0.286	0.197	0.252	0.186

Notes: Reference for the entry period dummies and region dummies are the period before 1839 and the rest of Japan, respectively. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Robustness checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sample	Whole	Exporting	Non-Exporting	Steam power intensive	Non-steam power intensive	Corporate enterprise	Non-corporate enterprise
Panel A: Drop top 1\% larger sample							
Experience before 1880	-0.000 (0.000)	-0.005** (0.002)	0.000 (0.000)	0.001 (0.002)	0.000 (0.000)	0.001 (0.007)	-0.000* (0.000)
Experience after 1880	0.012*** (0.002)	0.015*** (0.002)	0.007*** (0.003)	0.016*** (0.002)	0.007*** (0.002)	0.033*** (0.006)	0.009*** (0.002)
Entry after 1880 (dummy)	0.071** (0.034)	-0.136** (0.056)	0.193*** (0.048)	-0.156** (0.064)	0.171*** (0.040)	0.274 (0.206)	0.042 (0.035)
Panel B: Drop top 5\% larger sample							
Experience before 1880	-0.000 (0.000)	-0.005** (0.002)	0.000 (0.000)	0.000 (0.001)	-0.000 (0.000)	0.004 (0.007)	-0.000* (0.000)
Experience after 1880	0.010*** (0.001)	0.013*** (0.002)	0.004 (0.002)	0.013*** (0.002)	0.005*** (0.002)	0.023*** (0.005)	0.008*** (0.001)
Entry after 1880 (dummy)	0.059* (0.030)	-0.104** (0.051)	0.133*** (0.042)	-0.117** (0.055)	0.128*** (0.037)	0.119 (0.163)	0.045 (0.031)
Panel C: Drop bottom 1\% smaller sample							
Experience before 1880	-0.000* (0.000)	-0.005** (0.002)	0.000 (0.000)	0.001 (0.002)	-0.000 (0.000)	0.004 (0.006)	-0.001** (0.000)
Experience after 1880	0.015*** (0.002)	0.017*** (0.002)	0.011*** (0.003)	0.020*** (0.003)	0.008*** (0.002)	0.046*** (0.007)	0.009*** (0.002)
Entry after 1880 (dummy)	0.072* (0.038)	-0.127** (0.059)	0.201*** (0.055)	-0.129* (0.072)	0.166*** (0.044)	0.414 (0.261)	0.020 (0.038)
Panel D: Drop bottom 5\% smaller sample							
Experience before 1880	-0.000* (0.000)	-0.005** (0.002)	0.000 (0.000)	0.001 (0.002)	-0.000 (0.000)	0.004 (0.006)	-0.001** (0.000)
Experience after 1880	0.015*** (0.002)	0.017*** (0.002)	0.011*** (0.003)	0.020*** (0.003)	0.008*** (0.002)	0.046*** (0.007)	0.009*** (0.002)
Entry after 1880 (dummy)	0.072* (0.038)	-0.127** (0.059)	0.201*** (0.055)	-0.129* (0.072)	0.166*** (0.044)	0.414 (0.261)	0.020 (0.038)
Panel E: Drop age>300 sample							
Experience before 1880	-0.000 (0.001)	-0.009** (0.004)	0.001 (0.001)	0.000 (0.002)	0.000 (0.001)	-0.001 (0.008)	-0.001 (0.001)
Experience after 1880	0.016*** (0.002)	0.018*** (0.002)	0.012*** (0.003)	0.020*** (0.003)	0.010*** (0.002)	0.048*** (0.007)	0.010*** (0.002)
Entry after 1880 (dummy)	0.104*** (0.040)	-0.133** (0.064)	0.248*** (0.058)	-0.122* (0.072)	0.213*** (0.046)	0.429* (0.258)	0.047 (0.040)
Panel F: Drop age>200 sample							

Experience before 1880	-0.001*	-0.009**	0.000	-0.004*	0.001	-0.001	-0.002**
	(0.001)	(0.004)	(0.001)	(0.002)	(0.001)	(0.008)	(0.001)
Experience after 1880	0.016***	0.018***	0.012***	0.020***	0.010***	0.048***	0.010***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.007)	(0.002)
Entry after 1880 (dummy)	0.083**	-0.133**	0.238***	-0.156**	0.224***	0.429*	0.023
	(0.042)	(0.064)	(0.060)	(0.073)	(0.048)	(0.258)	(0.042)
Panel G: Drop age>100 sample							
Experience before 1880	-0.003**	-0.010*	0.001	-0.011**	0.002	-0.001	-0.004***
	(0.001)	(0.005)	(0.001)	(0.005)	(0.001)	(0.008)	(0.001)
Experience after 1880	0.016***	0.018***	0.012***	0.020***	0.010***	0.048***	0.010***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.007)	(0.002)
Entry after 1880 (dummy)	0.060	-0.142**	0.240***	-0.197**	0.241***	0.429*	-0.006
	(0.045)	(0.069)	(0.065)	(0.079)	(0.051)	(0.258)	(0.045)

Notes: Reference for the entry period dummies and region dummies are the period before 1839 and the rest of Japan, respectively. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.