Expansion and Transformation of the Export-Oriented Silk Weaving District: The Case of Fukui in Japan from 1890 to 1919

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Abstract

The development of the Fukui silk weaving district was curious because it became the largest industrial district of *habutae*, or plain silk, fabric production in Japan within a decade after it began operations in the late 1880s. Initially, the production of *habutae* rapidly spread geographically from the capital city to surrounding areas in the same prefecture. Fukui introduced power looms beginning in the mid-1900s, which was the earliest among Japan's silk weaving districts. Production was first dominated by small family firms, but later by factories employing 10 or more workers. Interestingly, Fukui's emphasis on weaving *habutae* gradually shifted, and a range of more sophisticated products emerged during the later stages of the silk industry's development in the district. This study attempts to explore the causes of the rapid expansion and transformation of the Fukui silk weaving district and the effects on the size, location, structure, and labour productivity of weaving firms.

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1. Introduction

The issue of the Great Divergence between the West and the East has received increasing attention among economic historians, which has led to a proliferation of studies on Asian economic history with a view to establishing a fuller picture of global economic history (Van der Eng 2004; Broadberry and Van der Eng 2010; Broadberry and Hindle 2011). In spite of this growing body of research, however, the actual catch-up process of the East after the Great Divergence has not been fully explored because of a lack of micro-level data necessary to investigate how specific industries or regions within Eastern countries learned from the West and adapted accordingly.

It is well known that the textile industry has played an important role in the process of early industrialization in developed countries as well as in contemporary developing countries. This industry is unique, as it consists of diverse industrial sectors—from the production of raw materials to distribution—some of which use traditional or indigenous technologies, while others use modern technologies. While the spinning industry in 19th century Japan typified a capital-intensive modern industry characterized by large-scale production and imported mechanized technologies (see, for example, Otsuka et al. 1988), the weaving industry involved a mixture of traditional and modern technologies and production organizations. According to the literature review conducted by Hashino and Saito (2004), Japanese economic historians had generally believed until recently that the rise of modern sectors contributed to economic growth more than the modernization of traditional sectors.

Nakamura (1983), however, argues that traditional sectors employed a larger

share of workers and contributed more significantly to GDP growth in Japan from the late 19th through early 20th centuries. His argument strongly suggests that the modernization of traditional industries depended on the successful introduction of new technologies from the West. In fact, not only local and central governments, but also local people themselves, developed various institutions and organizations to introduce and absorb such technologies (Hashino 2012). Based on a large number of case studies and following Nakamura's argument, Tanimoto (2006) suggests a new perspective on the significant role of small-scale and indigenous industries in Japan's industrialization: 'another path to the industrialization', so to speak. Tanimoto's argument emphasizes the continuity of industrial development that accompanied the transformation of traditional industries. After all, the latter had a long history of operation before Japanese ports were opened in the middle of the 19th century. If his argument is correct, the success of the East in catching up with the West hinged on the existence of traditional sectors.

The aim of this study is to explore the development of the Fukui weaving district by analysing production data from Fukui city and seven surrounding counties. Fukui became the top exporter of *habutae*, or plain silk, fabric in late 19th century Japan—shortly after the introduction of weaving technologies from more advanced districts such as Kyoto and Kiryu. The striking feature of the development of the Fukui district was its rapid growth and the geographic expansion of production from the capital city to surrounding rural areas. In this respect, Fukui's development recalls that of the silk fabric industry in Lyon, France, in which production spread from urban to rural areas in the 18th century (Matsubara 2003). It is worth emphasizing that this industry was newly

‘transplanted’ to Fukui in the modern era, suggesting that an established, traditional weaving industry was not necessarily a pre-requisite for a modernized equivalent.

The case of Fukui’s development also offers a good example of a traditional industry which was successful in export-led growth. Saito (2012) argues that Meiji growth was largely export-led with traditional manufacturing which was rural setting with some interactions with the emerging modern sector (Saito 2012, pp. 11-12, 18). Almost all *habutae* was exported to the United States and European countries such as France and the United Kingdom. Fukui’s development can be regarded as a typical case of labour-intensive industrialization consistent with the endowment of cheap labour per Sugihara (2007). However, labour-saving technologies, such as power looms, were rapidly introduced in response to the rise in wage rate in the mid-1900s. In this study, we argue that importing Western technologies—in accordance with dynamically changing comparative advantage—was the key to the successful modernization of traditional industry in Japan.

The rest of the paper is organized as follows. The next section provides an overview of the growth of *habutae* export and the accompanying development of the Fukui weaving district by observing indicators of changes in production, the number of firms, firm size in terms of the number of workers per ferm, and labour productivity. Section III examines the conditions which facilitated the geographical expansion of *habutae* production from Fukui city to surrounding rural areas. In Section IV, three hypotheses regarding the geographical expansion of production, the introduction of power looms, and a shift from *habutae* to other products are tested. We conclude by

summarizing the main findings of the paper and drawing implications for future research in the last section.

2. A Brief History of Rapid Industrial Development

2-1. The rise of *habutae* production in Fukui prefecture

Because of the lack of a major manufacturing sector within Fukui prefecture, the prefectural government made various attempts to promote new industries, particularly for the sake of ex-samurais who found themselves without employment. For example, the government first tried to stimulate the production of *hosho-tsumugi*, traditional plain silk fabrics for the domestic market, according to the newest production techniques. To this end, the prefectural government sent a few people to Kyoto to be trained in advanced methods of weaving and dyeing. *Hosho-tsumugi* had long been produced mainly in Fukui city; however, it was not so promising a growth industry because demand was limited. Local people wanted to start producing fabrics which had large market and export potential. A small group of ex-samurais established the weaving workshop *'Shokko-gaisha',* which was equipped with ten hand looms with flying shuttles, to produce silk handkerchiefs and umbrella material for export. This was the first weaving workshop in Fukui prefecture (Fukuiken Silk Fabric Association 1921, pp. 182-189), but its success was by no means guaranteed. The workshop faced a number of problems regarding management and struggled to stay open. New industries with market opportunities were continually sought by trial-and-error.

It was *habutae* production which started in Fukui city in 1887 that seemed to

afford the most promise. Local people learned the basic production methods from Naohiro Koriki, an engineer in the Kiryu silk weaving district located 500 km away, who was invited by the Fukui prefectural government to conduct a three-week training session in the capital, Fukui city (Harada 2006, pp. 25-26).[1] An estimated 100 people participated. Kiryu had been the first exporter of *habutae*, beginning around 1877, and several prefectures including Fukui had directly introduced Kiryu's *habutae* production methods. The Kiryu district, however, contracted *habuae* production and concentrated on the production of more sophisticated products, such as *kimono*, rather than just simple *habutae* (Hashino and Otsuka 2013).

After the introduction of the flying shuttle from Kyoto and following the three-week training program, production of *habutae* grew rapidly in Fukui city. It is said that in 1892, shortly after foreign merchants from Yokohama opened local branch offices, more than fifty new hand looms entered into operation every day in Fukui city (Mikami and Debuchi 1900, p. 7). Although there is no specific evidence to this effect, it might well be that many foreign merchants identified Fukui as promising new centre of *habutae* production in Japan. The production of *habutae* quickly spread from Fukui city to surrounding rural areas. Export of *habutae* produced in Fukui prefecture increased sharply and surpassed Kiryu's *habutae* export a mere several years after production had first commenced

[1] Unfortunately, the content of the training and participant demographics are not well reported. It is known that prefectural officials and workshop owners decided to pay 0.15 yen per person (per hand loom) to Koriki for his training services, and that he received 15 yen in total. This suggests that 100 people received training (Fukuiken Silk Fabric Association 1921, pp. 188-89). It is interesting to note that the development of the garment industry in Bangladesh also started with a training program (Mottaleb and Sonobe 2011).

Figure 1 shows the map of the Fukui weaving district, with its centre in Fukui city. *Habutae* production geographically expanded first to nearby counties: Imadate county started production in 1887, Yoshida county in 1888, Sakai county in 1889, and Ohno and Nanjo counties in 1890 (Fukuiken Yushutsu Orimono Kensajo 1911, pp. 5-9).[2] As will be shown later, the history of the export-led growth of the Fukui weaving district accompanied the geographic—and thus net—expansion of production.[3]

2-2. The rapid growth of *habutae* export

Figure 2 shows the growth in real value of Japanese *habutae* exports, *habutae* production in Fukui prefecture, and *habutae* as a share of total exports. The real value of *habutae* exports rose sharply in the 1890s. After stagnant growth during the first decade of the 20th century, export again took off in the 1910s. The share of *habutae* as a fraction of total Japanese exports increased to more than 10 percent in 1904, which indicates the importance of this commodity at the early stage of Japan's modern economic development. At the same time, *habutae* production in Fukui prefecture occupied a significant place in the Japanese export, especially in the 1890s and 1910s.[4]

As intermediate goods, *habutae* fabrics had to be very light, even, and uniform (Hashino 2010, p. 488). Most of the *habutae* was shipped in its grey state and then printed or dyed in European countries to be used for ladies' dresses, blouses, linings,

[2] Starting years of production in Asuwa and Nyu counties are unknown, but production probably began later than in more northern counties.
[3] As the weaving industry did not become popular in the southern part of Fukui prefecture, consisting of Mikata, Oi, Tsuruga, and Onyu counties, we focus only on Fukui city and seven northern counties.
[4] Almost all of the *habutae* produced in Fukui was exported.

trimmings, and various ornamental purposes (Crowe 1909, p. 33). Japanese *habutae* that sent to France to be dyed or printed was supplied not only to the French domestic market, but also beyond. Japanese *habutae* became popular throughout Western countries, where demand had increased for silk fabrics made more cheaply thanks to modern production techniques. This was the so-called great 'democratization of silk' (Matsubara 2003, p. 54). Cheap silk fabrics, in solid colours and piece-dyed prints, became much more fashionable than expensive figured or pre-dyed fabrics. They had to be light and thin so as to save material costs (Tamura 2009, p. 191). The production of such fabrics is highly labour-intensive, and Fukui was suitable for producing them because cheap labour was available for weaving *habutae* on hand looms outfitted with flying shuttles. In addition, thin raw silk for producing light fabric was available from Yokohama. The raw silk was too thin to be used for power loom production in those days.

According to survey data from the Ministry of Agriculture and Commerce (1911, pp. 8-9), in 1895, more than 60 percent of Japanese *habutae* was exported to the United States, 20 percent to France, and 6 percent to the United Kingdom.[5] *Habutae* export to the United States, however, decreased sharply beginning in the late 1890s due to tariffs protecting their nascent silk weaving industry. In the United States, the introduction of power looms and the import of cheap and uniform Japanese raw silk, rather than *habutae*, enabled the domestic silk weaving industry to grow rapidly. Thus, the European market became more important for Japanese *habutae* in the early 20th century. In 1910, around 30 percent of Japanese *habutae* was exported to France, 20 percent to the United

[5] Ministry of Agriculture and Commerce (1911), pp. 8-9. The figures were reported on a value basis.

Kingdom, and only 13 percent to the United States.

Yet, the above figures do not necessarily mean that Japanese *habutae* was always competitive in the European market. In 1896, a Japanese inspector pointed out that no product could compete with Japanese *habutae* except Chinese pongee in the major silk markets such as Patterson, Manchester, Geneva, Zurich, and Lyon. However, when he visited the European market again in 1900, the inspector found a number of worthy competitors: pongee, mixed goods with silk and cotton produced in Lyon, American light silk, Chinese pongee, and English satin with silk and cotton (Tamura 2009, p. 192).

In fact, *habutae* export as well as its production in Fukui prefecture drastically declined in the 1920s (see Figure 2). It appears that the silk weaving industry in European countries gradually developed technologies which enabled the use of power looms to produce silk fabrics, as well as mixed fabrics with silk and cotton, which were cheap enough to compete with Japanese *habutae*. It is also important to consider the significant turn to rayon, which was much cheaper than silk; rayon fabric production soon outpaced that of *habutae*.

2-3. Production growth in Fukui prefecture

How did production grow in Fukui prefecture, leading it to become the top exporter of *habutae* in Japan soon after the industry first developed? Table 1 shows fabric production, the number of firms, workers, and looms in 1902, 1910, and 1918 by location. Several important findings can be made. First, Fukui city was by far the most important centre of

production, accounting for 50 percent of the district's production in 1902. Its production share, however, decreased significantly over time. Second, production totals in Yoshida and Imadate counties were the largest next to Fukui city in 1902. Taking advantage of their geographic proximity to Fukui city (Figure 1), these counties seem to have begun *habutae* production relatively early on. Thus, we call these counties 'early followers' or EF1 and EF2. Third, Sakai and Ohno counties caught up with and surpassed EF1 and EF2 in production totals later, thanks to a higher adoption rate of power looms. It appears that these counties can be called 'late followers' or LF1 and LF2. Fourth, in general, the percentage of *habutae* out of total silk fabric production was high in 1902 and 1910, but became much smaller in 1918, indicating that production shifted towards non-*habutae* fabrics. Fifth, Nanjo, Asuwa, and Nyu counties are characteristically different from Fukui city and other counties in that they evidence low production levels, low shares of *habutae* production, specifically, a large number of firms and workers, and low adoption rates of power looms. We call these counties "remaining areas" or R1, R2, and R3.

It is the purpose of this study to explore why such unique patterns of development emerged in the Fukui silk weaving district by using the available county-level data from 1890 to 1919. We cover this period because reliable data are available from 1890 and because the slowdown of *habutae* production began around 1920.[6]

[6] The large-scale production of rayon fabrics became common in the 1920s (Hashino 2007, pp. 31-32), an analysis of which requires a separate approach focusing on how new products' production techniques were mastered.

3. Descriptive Analyses

3-1. An overview of development

In order to identify the major components of growth in industrial production, we decompose the value of production (Q) into the number of firms (N), firm size in terms of the number of workers per firm (L/N), and labour productivity (Q/L) according to the following:

$$Q = N \times (L/N) \times (Q/L).$$

Taking the logarithm, the above equation can be rewritten as:

$$Ln\,(Q) = Ln\,(N) + Ln\,(L/N) + Ln\,(Q/L).$$

Using this relationship, changes in logarithms of the indices of Q, N, L/N, and Q/L are shown in Figure 3.[7] It should be noted that indices in this figure are set to be unity in 1890 and pertain to the production of not only *habutae*, but also other fabrics including silk, cotton, and linen.

It is interesting to observe that the development patterns of this industrial district are markedly different in at least three periods. It was primarily an increase in the number of firms that brought about a rapid growth in production from 1890 to 1908. All of a sudden, however, the number of firms began declining after 1908. On the other hand, labour productivity did not increase appreciably, or even declined, until 1908, though it would increase steadily from 1908 up to 1915. The average firm size increased from 1903 to 1907 but decreased or stagnated thereafter. Based on these observations, we may

[7] 'Firms' include (1) workshops employing more than 10 workers, (2) workshops employing less than 9 workers, (3) weaving manufactures-cum-contractors, and (4) out-weavers.

be able to divide the entire study period into three phases: (1) Phase I (1890-1908), in which the increasing number of firms was a major source of growth; (2) Phase II (1909-14), in which the number of firms declined but the labour productivity increased; and (3) Phase III (1915-19), in which average firm size and labour productivity remained largely unchanged, but total production increased due to the increase in the number of firms. Why such characteristically different phases of development emerged is a major question to be addressed in the rest of this paper.

3-2. Regional expansion of production

Figure 4 shows changing shares of silk fabric production in the Fukui silk weaving district by region. It is clear that the production centre shifted from Fukui city to other areas, particularly to nearby counties of early followers in Phase I. Considering that it was an increase in the number of firms, neither higher employment rates per firm nor labour productivity growth, that was the main source of production growth in Phase I, and that the decentralization of the production base took place, it seems reasonable to hypothesize that there were not strong Marshallian agglomeration economies. In fact, in the case of strong agglomeration economies, production expansion takes place in locations where the total size of production was large from the beginning.[8] Similar arguments can be made for the number of weaving firms. Although we do not have concrete evidence, the most important reason for the industry's geographical expansion

[8] Usually, industrial districts or clusters are geographically concentrated in small areas. Thus, the case of the Fukui silk weaving district is exceptional. See Sonobe and Otsuka (2006) and Hashino and Kurosawa (2013) for a discussion of the expansion of industrial clusters and Marshallian agglomeration economies in contemporary East Asia and modern Japan, respectively.

was the lower wage rate outside Fukui city, which may correspond to the predictions of product cycle theory (Vernon 1966).

It also seems sensible to conjecture that scale economies at the workshop or factory level were weak. If they are strong, the firm size tends to increase in areas where the firm size was large from the beginning. According to Figure 3, however, the firm size expansion was not pronounced except for several years during the middle of the first decade of the 20th century. If scale economies were strong in the case of the Fukui district, the initial capital requirement would have been large, which, in turn, may have discouraged the entry of new firms into the silk weaving business.

It is also interesting to observe from Figure 4 that production shares of the late followers, located to the far north and east, respectively, gradually increased in the second and third phases. Why this happened is another interesting question. It may also be noteworthy that the remaining areas increased their production shares in the late 1910s. As was pointed out earlier, these areas were characterized by the persistent use of hand looms.

The production generally increases either by an increase in the total number of firms or by firm's increased scale of operations. Patterns of changes in the number of firms, shown in Figure 5, and the average firm size, shown in Figure 6, are markedly different among the four regions. According to Figure 5, the number of firms in Phase I (1902-08) increased except in Fukui city, which is consistent with the geographical expansion of *habutae* production. Yet, the number of firms declined—not only in Fukui city, but also among the early and late followers in Phase II. An exception was in the

remaining areas, in which the number of firms reached 3,000 in the early 1910s. Also intriguing is the increasing number of firms primarily in these remaining areas in Phase III.

Overall, there appears to be a negative correlation between the number of firms and firm size. In Phase I, the firm size was the largest in Fukui city, averaging 10 to 20 workers per firm, whereas it was very small outside Fukui city, ranging from 3 to 6 workers per firm. In some areas, such as EFs and the remaining areas, there were out-weavers, who were members of farming households and accepted the putting-out contract with the merchants. [9] Subsequently, firm size remained at roughly 10 workers per firm in Fukui city, whereas it increased from 4 to 14 workers in the LF region from the early 1900s to the late 1910s. There might have been weak, but growing, advantages of larger-scale operations associated with the use of power looms. In contrast, the firm size somewhat decreased in the remaining areas of the district and shrunk to an average as low as 2 workers in the 1910s. Such differences in the number of firms and their firm size across regions are intimately related with the overall structural transformation of this silk weaving district to be discussed below.

3-3. Structural transformation of industrial districts

Figure 7 compares different rates of power loom adoption by region with changes in the real wage rate in Fukui city. It is clear that the use of hand looms completely dominated

[9] Out-weavers were commonly observed in Kiryu, which was a more advanced industrial district, and they produced a small number of diverse and complicated *kimono* primarily for domestic markets (Hashino and Otsuka 2013; Hashino and Kurosawa 2013).

in Phase I. Responding to the increasing wage rate after 1907, the adoption of power looms almost seems to have increased sharply, first in Fukui city, followed by the late followers and subsequently by the early followers, but not by the remaining areas even in 1919. The differences in the adoption rate of power looms in Phases II and III are largely consistent with changes over time and differences across regions in terms of the number of firms, shown in Figure 5, and the average firm size, observed in Figure 6; the number of firms tended to be large in areas where the hand looms were used, while the firm size tended to be larger in areas where the adoption rate of power loom was higher. In fact, the number of firms decreased in Fukui city, and the early and late followers' regions, whereas firm size generally increased. In contrast, the number of firms increased, but the average firm size decreased, in the remaining areas, where the introduction of power looms was delayed. In Phase II, a structural transformation took place along with the introduction of power looms—first in Fukui city and followed by the early and late followers—which destroyed a large number of small firms and increased labour productivity. In contrast, no such major change took place in the remaining areas of the district.

Such differences and changes are also consistent with the regional differences in the labour productivity growth shown in Figure 8. It is clear that labour productivity increased sharply first in Fukui city, second among the late followers, and third among the early followers, whereas it did not increase much in the remaining areas of the district. These observations clearly indicate that the introduction of power looms triggered the structural transformation of the Fukui silk weaving district.

While the major silk product in the Fukui silk weaving district had been *habutae* from 1892 to the mid-1910s (see Figure 9), production shifted towards non-*habutae* products beginning in the mid-1910s. It is important to observe that in the remaining areas of the district where the use of hand looms was common, the production of *habutae* decreased abruptly, but its regional share of silk production increased (see Figure 4); this suggests that high-value silk products were increasingly produced by hand loom in this region.

Such a change in the composition of silk products was primarily in response to the relative decrease in *habutae* prices (see Figure 10).[10] Several important observations can be made from this figure. First, there were no clear differences in *habutae* prices across regions and realo *habutae* prices were largely constant until 1910. Second, regional differences in *habutae* prices appeared after 1910, at which point prices were highest in Fukui city, second highest in the late followers' region, third highest in the early followers' region, and lowest in the remaining areas. Given the difference in the adoption rates of power looms, these observations suggest that power looms became better suited for the production of high-quality *habutae* products in the 1910s.[11] Fourth, and most importantly, *habutae* prices abruptly began decreasing after the mid-1910s. It seems clear that this general drop in *habutae* prices was another driver for the structural

[10] It must be pointed out that different units were used for the *habutae* price; *tan* (1889-93 and 1901-10), *hiki* (1894-1900), and *hon* (1911-19). Since one *hiki* is equivalent to two *tan*, we constructed a consistent price series using this conversion rate from 1889 to 1910. However, so far, we have failed to match price data before 1910 and after 1911.

[11] Our hypothesis is that unlike earlier period, the improvement of technology made it possible to produce high-quality *habutae* by power looms.

transformation of the Fukui industrial district in the early 20th century.[12]

4. Hypotheses and Empirical Methodology

4-1. Hypotheses

We have found that the whole development process of the Fukui silk weaving district can be divided into three phases: (1) one of geographical expansion (1894-1908); (2) one of structural transformation (1909-14); and (3) one of product diversification (1915-19). For each phase, we would like to postulate the following hypotheses based on the descriptive analyses carried out in the last section:

Hypothesis 1: The growth in the production of silk products accompanied the geographic expansion of the industry in Phase I because agglomeration economies were weak, scale economies at the workshop level were weak, and the imitation of existing technology was easy.

Hypothesis 2: The introduction of power looms in Phase II, which would have been induced by increasing wage rates, brought about a structural transformation in which the number of small firms decreased and the production and labour productivity increased in areas where power looms were actively introduced.

Hypothesis 3: The diversification of products away from such a simple product as *habutae* to more sophisticated products took place in Phase III—when the relative price of *habutae* declined—which favoured production by hand loom.

[12] A major reason why *habutae* prices began declining so sharply could have been the rapid growth in the consumption of rayon fabrics.

4-2. Empirical methodology

In order to test the validity of the above hypotheses, we estimate the following function by growth phase using OLS:

$$Z_{it} = \alpha_0 + \Sigma\ \alpha_i D_i + \Sigma\ \beta_i D_j T + \Sigma\ \gamma_t Y_t + \varepsilon\ ,$$

where Z_{it} refers to the logarithm of the value of production, the number of firms, the number of workers per firm (which is called 'firm size' for short), labour productivity, the adoption rate of power looms, *habutae* price, or the proportional share of *habutae* production in *i*-th county in year *t*; D_i is a county dummy in which Fukui city is the basis of comparison; T is the time trend beginning with zero in each phase (i.e. 1902, 1909, and 1915); Y_t is a year dummy; α_s, β_s, and γ_s are regression parameters; and ε is an error term. Note that α_i shows the difference in Z_{it} between the *i*-th county and Fukui city in the initial year of each phase. Growth in Fukui city is captured by γ_t, whereas β_i shows the average growth in the *i*-th county relative to Fukui city during a specific phase. Thus, if β_i is not significantly different from zero, the hypothesis that Z grows at the same rate in Fukui city and *i*-th county cannot be rejected.

If agglomeration economies were strong in the geographical expansion phase, the larger the production (i.e. α_i), the larger would be growth rate (i.e. β_i). Thus, Hypothesis 1 can be tested by examining whether larger α_i values are associated with larger β_i values in the regression function of the value of production. The same tendency may be observed in the regression analysis for the number of firms. On the other hand, if

economies of scale were strong, the larger the average firm size, the larger the employment growth of the firm size, implying a positive association between α_i and β_i in the regression estimates of the firm size function. Finally, the ease of imitation can be confirmed by the non-significance of α_i in the labour productivity and *habutae* price functions, given the fact that Fukui city was always the leading centre of *habutae* production. We expect that *habutae* prices should be similar within the Fukui weaving district to the extent that product qualities were similar, even though the differences in transport cost would also affect local *habutae* prices.

Hypothesis 2 on the structural transformation can be tested by examining whether a positive association exists between the adoption rate of power looms and labour productivity, and whether a negative relationship exists between power loom adoption and the number of weaving firms. Testing Hypothesis 3 is a more subtle exercise, because the share of *habutae* production decreased everywhere. Assuming that hand looms were suitable for high-value non-*habutae* products, we may test whether the production increased faster in the remaining of the areas (where the use of hand looms was more common) in Phase III.

4-3. Regression results

Now let us examine the results of regression analyses by phase. Table 2 deals with the last part of Phase I, for which detailed county-level data are available, that is, 1902-08. A glance establishes that all the coefficients of regional dummies are negative, large in absolute value, and highly significant for the value of production regression, indicating

that Fukui city was by far the leader in *habutae* production as of 1902. It is remarkable to observe that, while the coefficients of LF2 and R2 are negative and large, their interaction terms with the time trend variable are positive and significant, implying that production growth was faster in those areas where the amount of production was smaller in 1902. Similar observations can be made from the analysis of the number of firms: the coefficients of LF1, R1, and R2 are negative and large, but their interaction terms with time trends are positive and significant. These results strongly suggest the absence of strong agglomeration economies in Phase I.

Firm size was generally greater in Fukui city than in surrounding counties, judging from the generally negative and significant coefficients of county dummies in the firm size regression. There is, however, no indication that firm size increased in areas where firm size was relatively large from the beginning. This supports the hypothesis regarding the absence of scale economies. This is also consistent with the fact that the average number of workers per firm was consistently very small throughout the Fukui silk weaving district.

In contrast to the significant difference in the value of production, the number of weaving firms, firm size, and labour productivity are shown to generally not have been significantly different between Fukui city and the counties. This finding suggests that production technologies were relatively easily imitated. According to Table 3,[13] which shows the estimation results of the *habutae* price function, prices were not significantly

[13] Since the units of *habutae* prices are different before 1910 and after 1911, we estimated the *habutae* price functions separately for 1902-10 and 1911-18.

different across locations, indicating that the quality of *habutae* was quite uniform in the early years due to the easy imitation. All these findings lend support for Hypothesis 1.

Column 1 of Table 4 shows that the magnitude of the coefficients of county dummies in the regression of the value of production in Phase II are similar to those in Phase I shown in Table 2, signifying the continued dominance of Fukui city in the production of silk fabrics in 1909. It is, however, remarkable to observe that while the coefficients of LF1 and LF2 are negative and comparatively large, the coefficients of their interaction terms with the time trend are positive and significant, which again points to the absence of agglomeration economies. This rapid growth of production in LF1 and LF2 can be attributed to the rapid adoption of power looms in these counties.

Unlike the Phase I results, only the LF2 dummy and EF2 have significant coefficients in the number of firms' regression for Phase II: the former is negative and the latter positively signed. This suggests that the number of firms in Fukui city was not much larger than in most counties around 1909. The coefficients of the year dummies are all negative and significant and their magnitudes become larger over time, whereas interaction terms between time trend and early and late follower dummies are non-significant. These results imply that the number of firms in these counties declined as fast as in Fukui city in Phase II. In contrast, the number of firms increased significantly in R2 and R3 in this phase, judging from the significant coefficients of interaction terms between county dummies and time trend variable.

These results are consistent with the estimation result of the power loom adoption ratio function in Phase II, reported in the first column in Table 5, which shows

the following: (1) a general increase in the adoption of power looms as indicated by the positive coefficients of year dummies; and (2) low adoption rates in R1, R2, and R3, which are indicated by the negative coefficients of these three county dummies and the negative coefficients of their interaction terms with the time trend. Since the firm size was small and the number of firms tended to increase in R1, R2, and R3 according to Table 4, we may say that the number of small firms using hand looms proliferated in these counties.

The coefficients of EF1, EF2, LF1, and LF2 dummies are negative and three of them are significant in the firm size regression, suggesting that there were fewer workers per firm in these surrounding counties than in Fukui city in the early stage of power loom diffusion. Unlike the results presented in Table 2, the coefficients of the county dummies are all negative and significant in the labour productivity function regression, indicating the large and significant impact of early power loom adoption in Fukui city on the regional gap in labour productivity. It is, however, important to observe that the interaction terms of the LF1 and LF2 dummies with the time trend are positive and significant, whereas those of the R2 and R3 dummies with the time trend are negative and significant. The former findings can be explained by the fact that the adoption rate of power looms in LF1 was not significantly lower than in Fukui city and that the rate in LF 2 was significantly higher (see Table 5). The latter findings can be explained by the low adoption rate of power looms, particularly in R2 and R3.

These results support Hypothesis 2 that the structural transformation took place due to the adoption of power looms, which reduced the number of small firms and

increased labour productivity significantly. This finding is consistent with Minami's argument that the transition from hand looms to power looms raised productivity (Minami 1977, p. 952). Such a transformation, however, did not take place in R1, R2, and R3. It seems to us that these counties specialized in silk fabrics, which were more sophisticated than *habutae*, by using hand looms rather than power looms.

According to Table 6 concerning Phase III, the production gap between Fukui city and the early and late followers became somewhat smaller in 1915, whereas the gap between Fukui city and the remaining areas widened. The firm size of R1 to R3 is found to be significantly lower, whereas the number of firms in R2 and R3 was not significantly smaller than in Fukui city at the time. According to the second column in Table 5, there was no significant difference in the adoption rate of power looms between Fukui city and early followers, adoption rates were significantly higher among the late followers than in Fukui city, and adoption was significantly lower in the remaining areas than in Fukui city. Note that the coefficient of the interaction term between R2 and the time trend is positive and significant in the regressions of both the value of production and labour productivity in Phase III. Thus, R2 increased its production by increasing labour productivity, despite the use of hand looms.

It is interesting to observe from Table 3 that the coefficient of the R1 dummy (corresponding to a county where hand looms were mainly used) is negative and significant for the 1910s, whereas the coefficient of LF1 is positive and significant. These findings indicate that power looms were capable of producing higher quality *habutae*, or at least not inferior quality *habutae*, compared with hand looms in this period. This tells

us something significant about *habutae* production in the Fukui silk weaving district, because the production of *habutae* by cheap unskilled labour using hand looms would have no longer been district's comparative advantage.

The somewhat puzzling surge in labour productivity in R2 cannot be understood unless differences in product composition are taken into account. According to Table 7, which analyses the determinants of the production share of *habutae* out of the total fabric production, the interaction terms between R2 and the time trend are negative and significant in both Phases I and II. As a result, the coefficient of R2, as well as that of R3, becomes negative and significant in Phase III, suggesting that R2 had particularly specialized in the production of non-*habutae* products by this time. It is also noteworthy that three year dummy coefficients are negative and significant and most coefficients of the interaction terms are non-significant, indicating that a shift away from *habutae* to non-*habutae* fabrics took place widely in the Fukui silk weaving district.

It is important to emphasize that a sharp reduction in *habutae* production was not synonymous with an overall reduction in the silk fabric production in the Fukui weaving district. On the contrary, the real value of total fabric production increased in the late 1910s (see Figures 2 and 3). It may well be that producers in the Fukui district had acquired the skill of silk weaving while producing *habutae*, so that they could shift production away from such a simple product as *habutae* to a variety of more sophisticated silk products, as well as rayon, in the late 1910s and thereafter.

5. Conclusion

This study attempted to explore the development of the Fukui silk weaving district, which became the top exporter of *habutae* in Japan shortly after it had introduced production technology from more advanced Japanese weaving districts in the late 1890s. Major factors underlying the successful development of this district were found to be distinctly different in three phases: (1) initially the geographical expansion of the industry took place with an increasing number of firms and a reliance on hand loom technology; (2) subsequently a structural transformation occurred, marked by a declining number of firms, but increased labour productivity through the introduction of power looms; and (3) finally a product diversification away from *habutae* took place with accompanying increases in labour productivity.

Before *habutae* was introduced, even though people in Fukui city had attempted to establish a weaving industry, it was not successful and, hence, skilled workers were quite scarce. Thus, the finding that *habutae* production rapidly expanded from Fukui city to rural area without reducing labour productivity and product quality strongly indicates that its production was easy and, hence, unskilled-labour intensive. Since unskilled labour was abundantly available, the Fukui silk weaving district must have had a comparative advantage in producing *habutae*.[14] Indeed, the Kyoto and Kiryu silk weaving districts, which had long traditions of producing complicated silk products, such as *kimono*, by using skilled workers, did not undertake *habutae* production on a large scale. Also, power looms were most rapidly introduced to Fukui among the three silk

[14] Since there were other areas in which there was not a strong weaving tradition, the question of why Fukui particularly developed a silk weaving industry is difficult to answer. It must be pointed out that other districts undertook *habutae* production without much success.

weaving districts (Hashino 2007), presumably because machineries could be easily substituted for simple tasks carried out by unskilled labour in the *habutae* production process. Thus, following its comparative advantage seems to be the key to the successful development of this weaving district.

When wage rates increased, the comparative advantage of *habutae* production using hand looms and unskilled labour must have weakened. It is also true that the quality of domestically produced power looms improved and their prices declined significantly (Minami and Makino 1983, p. 3; Suzuki 1996, Chapter 9). As a result, power looms were rapidly introduced in the Fukui weaving district beginning in the early 1900s. Such shift in technology—from hand looms to power looms—is consistent with the argument of both Broadberry and Guputa (2006; 2009) and Allen (2012), which indicates the significance of factor prices in explaining the large divergence in technology choice and productivity growth between Europe and Asia.

The dominant use of power looms, and higher or comparable prices of *habutae* produced by power looms, implies that this silk weaving industry was no longer unskilled-labour intensive by the 1910s; it became more capital-intensive. This suggests that Fukui lost its comparative advantage in producing *habutae*, so far as the basis for its comparative advantage lay in the availability of cheap unskilled labour. The sharp decrease in *habutae* prices in the mid-1910s may be a manifestation of such a fundamental change in the comparative advantage environment.

Moreover, given that the number of looms in Lyon increased from 10,362 in 1880 to 42,500 in 1914 (Matsubara 2003, p. 116), Japanese *habutae* production became

obliged to compete with its French counterpart by using power looms. Also important must have been the substitution of rayon for silk, which must have had devastating impacts on *habutae* production in the Fukui silk weaving district. The adoption of rayon as raw material in Japanese weaving districts was more successful than the Western nations (Singleton 1997, p. 88-89). On the other hand, the skill of the workers in the Fukui weaving district must have improved over the years spent producing *habutae*. As a result, producers in Fukui shifted production quickly away from *habutae* to other more sophisticated silk products or rayon products; they thereby succeeded in increasing labour productivity in the late 1910s. Though our study focused on the production growth of *habutae* and the development of the Fukui weaving district, further analysis will be needed to investigate the structural changes and competition effects in weaving production on the world market from the perspective of a dynamic shift in raw materials from the 1910s to 1920s.[15]

In short, the key to the success in the development of the Fukui silk weaving district seems to be the choice of products and production methods consistent with the industry's dynamically changing comparative advantage.

[15] See Yamazaki (1975) for the detailed study on the development of Japanese rayon industry and its impact on weaving districts in Japan.

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Table 1. *An Overview of Production and Employment in the Fukui Weaving District by Location*

City/County	Total fabric production in 1000 yen (% of *habutae*)	Number of firms	Number of workers	Number of looms (% of power looms)
1902				
Fukui	7,680 (78.4)	1,004	10,596	10,596 (0.0)
Yoshida (EF1)	2,717 (97.5)	399	3,609	3,409 (0.0)
Imadate (EF2)	1,780 (91.0)	848	2,126	1,925 (0.0)
Sakai (LF1)	1,114 (87.6)	208	2,107	1,971 (0.0)
Ohno (LF2)	341 (80.9)	169	1,034	913 (0.0)
Nanjo (R1)	443 (72.6)	178	1,280	529 (0.0)
Asuwa (R2)	520 (97.7)	428	1,618	1,270 (0.0)
Nyu (R3)	578 (49.4)	1,025	1,036	1,036 (0.0)
1910				
Fukui	11,376 (90.0)	720	2,514	6,836 (27.3)
Yoshida (EF1)	3,369 (90.2)	695	3,276	3,254 (13.7)
Imadate (EF2)	2,424 (91.0)	1,125	2,280	3,412 (13.3)
Sakai (LF1)	2,480 (77.4)	796	3,049	3,352 (19.8)
Ohno (LF2)	1,453 (74.3)	180	1,679	1,876 (42.0)
Nanjo (R1)	949 (81.6)	612	1,606	1,593 (6.5)
Asuwa (R2)	1,550 (66.7)	1,035	2,823	2,901 (2.4)
Nyu (R3)	662 (77.1)	1,359	2,080	2,066 (1.5)
1918				
Fukui	16,498 (69.9)	522	3,293	6,129 (84.5)
Yoshida (EF1)	3,597 (35.1)	380	2,822	3,145 (81.6)
Imadate (EF2)	7,681 (95.4)	982	4,281	4,281 (77.4)
Sakai (LF1)	10,350 (41.3)	263	3,834	4,516 (88.2)
Ohno (LF2)	6,054 (79.7)	187	2,552	2,830 (97.5)
Nanjo (R1)	2,325 (82.9)	291	680	600 (60.3)
Asuwa (R2)	2,637 (33.5)	2,925	4,457	4,928 (19.3)
Nyu (R3)	858 (72.1)	685	1,410	1,339 (20.9)

Source: Fukui Prefecture (1902, 1910, and 1918).

Notes: For deflator, we used price index for textile products in Ohkawa et al. (1967), pp. 192-3.

Table 2. *Determinants of the production structures in the Fukui silk-weaving district during phase I (1902-08)*

	Ln (value of production)	Ln (number of firms)	Ln (firm size)	Ln (labour productivity)
Early follower 1 (EF1)	-1.03 (-6.10)**	-1.12 (-3.05)**	-.00 (-.00)	.08 (.36)
Early follower 2 (EF2)	-1.39 (-8.20)**	-0.19 (-.51)	-1.43 (-4.50)**	.23 (.98)
Late follower 1 (LF1)	-1.78 (-1.048)**	-1.53 (-4.19)**	-.21 (-.65)	-.04 (-.17)
Late follower 2 (LF2)	-2.68 (-15.79)**	-1.13 (-3.08)**	-1.36 (-4.28)**	-.35 (-1.50)
Rest 1 (R1)	-2.56 (-15.09)**	-.96 (-2.63)**	-.37 (-1.15)	-.66 (-2.83)**
Rest 2 (R2)	-2.60 (-15.35)**	-1.53 (-4.18)**	-1.02 (-3.19)**	-.46 (-1.97)
Rest 3 (R3)	-2.82 (-16.64)**	-.21 (-.58)	-2.52 (-7.92)**	-0.9 (-.38)
EF1 x Time trend	-.01 (-.27)	.13 (1.27)	-.09 (-1.02)	-.05 (-.79)
EF2 x Time trend	.04 (.77)	.10 (1.06)	.05 (.57)	-.12 (-1.87)
LF1 x Time trend	.07 (1.59)	.36 (3.55)**	-.18 (-2.02)	-.11 (-1.65)
LF2 x Time trend	.18 (3.81)**	.02 (.24)	.13 (1.45)	.03 (.42)
R1 x Time trend	.04 (.94)	.23 (2.26)*	-.14 (-1.63)	-.04 (-.62)
R2 x Time trend	.16 (3.44)**	.23 (2.30)*	-.01 (-.16)	-.06 (-.88)
R3 x Time trend	.01 (.27)	.03 (.27)	.18 (2.07)*	-.20 (-3.04)**
1903 dummy	.14 (1.51)	-.16 (-.82)	.10 (.54)	..21 (1.63)
1904 dummy	.55 (5.10)**	-.16 (-.70)	.29 (1.42)	.43 (2.86)**
1905 dummy	.12 (.95)	-.05 (-.19)	-.13 (-.54)	.31 (1.72)
1906 dummy	.26 (1.72)	-.08 (-.24)	-.10 (-.35)	.44 (2.10)*
1907 dummy	-.71 (-.40)	-.64 (-1.65)	.12 (.37)	.44 (1.78)
1908 dummy	.14 (.68)	-.12 (-.27)	-.22 (-.58)	.49 (1.70)
Intercept	15.75 (122.8)**	6.87 (24.8)**	2.48 (10.3)**	6.41 (36.1)**
R^2	.975	.741	.856	.738
No. of observations	56	56	56	56

Notes: t-statistics are in parentheses. Coefficients marked * and ** are significant at the 5% and 1% level.

Table 3. *Determinants of real habutae price in the Fukui silk-weaving district*

	1902-10	1911-19
Early follower 1 (EF1)	-.29 (-.08)	.12 (.82)
Early follower 2 (EF2)	3.20 (.88)	-.16 (-1.09)
Late follower 1 (LF1)	.93 (.26)	.39 (2.63)**
Late follower 2 (LF2)	2.35 (.65)	-.08 (-.59)
Rest 1 (R1)	1.14 (.31)	-.42 (-2.82)**
Rest 2 (R2)	-1.10 (-.30)	-.04 (-.32)
Rest 3 (R3)	6.30 (1.71)	-.06 (-.43)
EF1 x Time trend	-.05 (-.07)	-.01 (-.55)
EF2 x Time trend	-.54 (-.73)	-.02 (-.85)
LF1 x Time trend	-.25 (-.34)	-.03 (-1.16)
LF2 x Time trend	-.46 (-.62)	-.05 (-1.84)
R1 x Time trend	-.10 (-14)	-.05 (-1.80)
R2 x Time trend	-.06 (-.77)	-.04 (-1.47)
R3 x Time trend	-.74 (-.96)	-.06 (-1.99)
2^{nd} year dummy	1.28 (.59)	.08 (.97)
3^{rd} year dummy	-.10 (-.05)	.09 (1.00)
4^{th} year dummy	4.03 (1.56)	.41 (3.89)**
5^{th} year dummy	.82 (.28)	.57 (4.80)**
6^{th} year dummy	.06 (.02)	.56 (4.20)**
7^{th} year dummy	1.06 (.29)	.34 (2.25)*
8^{th} year dummy	1.86 (.46)	.52 (3.11)**
9^{th} year dummy	1.23 (.26)	.42 (2.29)*
Intercept	5.17 (2.83)*	3.06 (26.32)**
R^2	.23	.82
No. of observations	72	72

Notes: t-statistics are in parentheses. Coefficients marked * and ** are significant at the 5% and 1% level.

Table 4. *Determinants of the production structures in the Fukui silk-weaving district during phase II (1909-14)*

	Ln (value of production)	Ln (number of firms)	Ln (firm size)	Ln (labour productivity)
Early follower 1 (EF1)	-1.16 (-8.9)**	-.17 (-.89)	-.59 (-3.15)**	-.40 (-3.09)**
Early follower 2 (EF2)	-1.35 (-10.31)**	.53 (2.70)*	-1.20 (-6.41)**	-.68 (-5.24)**
Late follower 1 (LF1)	-1.51 (-11.54)**	.04 (.18)	-.83 (-4.44)**	-.72 (-5.52)**
Late follower 2 (LF2)	-2.00 (-15.30)**	-1.05 (-5.40)**	-.18 (-.95)	-.77 (-5.94)**
Rest 1 (R1)	-2.40 (-18.31)**	-.19 (-.98)	-1.00 (-5.36)**	-1.20 (-9.28)**
Rest 2 (R2)	-1.76 (-13.47)**	-.07 (-.35)	-.84 (-4.50)**	-.85 (-6.58)**
Rest 3 (R3)	-2.63 (-20.08)**	.37 (1.90)	-1.49 (-8.00)**	-1.51 (-11.62)**
EF1 x Time trend	-.01 (-.31)	.03 (.53)	.03 (.42)	-.07 (-1.72)
EF2 x Time trend	.03 (.74)	.04 (.69)	-.02 (-.29)	.01 (.12)
LF1 x Time trend	.18 (4.20)**	-.03 (-.43)	.11 (1.79)	.10 (2.31)*
LF2 x Time trend	.15 (3.36)**	-.04 (-.64)	.09 (1.48)	.10 (2.23)*
R1 x Time trend	.10 (2.25)*	.04 (.67)	.00 (.08)	.05 (1.15)
R2 x Time trend	-.06 (-1.45)	.23 (3.59)**	-.09 (-1.52)	-.20 (-4.68)**
R3 x Time trend	-.12 (-2.87)**	.13 (2.01)*	-.10 (-1.62)	-.15 (-3.59)**
1910 dummy	-.06 (-.87)	-.22 (-2.12)*	-.02 (-.20)	.18 (2.60)*
1911 dummy	-.09 (-1.01)	-.35 (-2.72)*	.06 (.45)	.21 (2.43)*
1912 dummy	-.11 (-.99)	-.59 (-3.67)**	.09 (.58)	.39 (3.69)**
1913 dummy	0.5 (.40)	-.61 (-3.12)**	-.03 (-.17)	.69 (5.35)**
1914 dummy	-.06 (-.35)	-.88 (-3.78)**	.04 (.16)	.79 (5.11)**
Intercept	16.17 (165.5)**	6.84 (46.9)**	2.10 (15.1)**	7.23 (74.7)**
R^2	.986	.946	.948	.977
No. of observations	48	48	48	48

Notes: t-statistics are in parentheses. Coefficients marked * and ** are significant at the 5% and 1% level.

Table 5. *Determinants of the adoption rate of power looms in the Fukui silk-weaving district*

	Phase II (1909-14)	Phase III (1915-19)
Early follower 1 (EF1)	-.10 (-2.84)**	-.02 (-.46)
Early follower 2 (EF2)	-.09 (-2.65)*	-.09 (-1.73)
Late follower 1 (LF1)	-.06 (-1.66)	.10 (2.03)*
Late follower 2 (LF2)	.09 (2.67)*	.17 (3.34)**
Rest 1 (R1)	-.08 (-2.42)*	-.18 (-3.53)**
Rest 2 (R2)	-.11 (-3.29)**	-.55 (-11.00)**
Rest 3 (R3)	-.15 (-3.81)**	-.56 (-11.23)**
EF1 x Time trend	-.03 (-2.57)*	.01 (.45)
EF2 x Time trend	-.01 (-.84)	.03 (1.26)
LF1 x Time trend	-.01 (-1.10)	-.00 (-.23)
LF2 x Time trend	-.00 (-.10)	.00 (.12)
R1 x Time trend	-.10 (-9.00)**	.00 (.10)
R2 x Time trend	-.09 (-8.34)**	-.01 (-.64)
R3 x Time trend	-.09 (-7.51)**	-.02 (-1.16)
2^{nd} year dummy	.16 (8.86)**	-.01 (-.39)
3^{rd} year dummy	.27 (12.30)**	.03 (.89)
4^{th} year dummy	.39 (14.11)**	.08 (1.67)
5^{th} year dummy	.49 (14.58)**	.09 (1.59)
6^{th} year dummy	.64 (16.00)**	n.a.
Intercept	.10 (3.93)**	.73 (19.66)**
R^2	n.a.	.986
Log likelihood	93.93	n.a.
No. of observations	48	40

Notes: t-statistics are in parentheses. Coefficients marked * and ** are significant at the 5% and 1% level. Year dummies cover 1910-14 in the first column and 1916-19 in the second column. “n.a.” means not applicable.

Table 6. *Determinants of the production structures in the Fukui silk-weaving district during phase III (1915-19)*

	Ln (value of production)	Ln (number of firms)	Ln (firm size)	Ln (labour productivity)
Early follower 1 (EF1)	-.71 (-6.49)**	-.34 (-2.19)*	.02 (.16)	-.38 (-2.91)**.
Early follower 2 (EF2)	-.44 (-4.01)**	.16 (1.03)	-.35 (-2.90)**	-.25 (-1.87)
Late follower 1 (LF1)	-.38 (-3.45)**	-.40 (-2.55)*	.16 (1.34)	-.14 (-1.06)
Late follower 2 (LF2)	-.63 (-5.81)**	-.69 (-4.41)**	.28 (2.32)*	-.23 (-1.71)
Rest 1 (R1)	-.93 (-8.53)**	-.43 (-2.74)*	-.36 (-2.97)**	-.14 (-1.09)
Rest 2 (R2)	-1.19 (-10.95)**	.33 (2.14)*	-.56 (-4.65)**	-.96 (-7.30)**
Rest 3 (R3)	-1.51 (-14.07)**	.10 (.63)	-.64 (-5.31)**	-.99 (-7.50)**
EF1 x Time trend	.03 (.73)	.07 (1.03)	-.03 (-.60)	-.00 (-.06)
EF2 x Time trend	.03 (.69)	-.00 (-.06)	.03 (.59)	.01 (.10)
LF1 x Time trend	.05 (1.23)	.03 (.42)	.03 (.54)	.00 (.03)
LF2 x Time trend	.08 (1.76)	.05 (.77)	.00 (.04)	.03 (.51)
R1 x Time trend	.02 (.54)	.02 (.35)	-.02 (-.47)	.02 (.46)
R2 x Time trend	.20 (4.42)**	.06 (1.00)	-.02 (-.39)	.15 (2.82)**
R3 x Time trend	.05 (1.18)	.03 (.47)	.00 (.08)	.02 (.35)
1916 dummy	-.09 (-1.62)	.01 (.16)	-.00 (-.01)	-.11 (-1.52)
1917 dummy	-.15 (-1.95)	.01 (.13)	.01 (.15)	-.18 (-1.89)
1918 dummy	-.01 (-.06)	.05 (.36)	.01 (.10)	-.07 (-.56)
1919 dummy	.02 (.17)	.11 (.58)	-.00 (-.03)	-.08 (-.51)
Intercept	7.20 (89.9)**	2.73 (23.8)**	.87 (9.85)**	3.60 (37.0)**
R^2	.973	.914	.945	.929
No. of observations	40	40	40	40

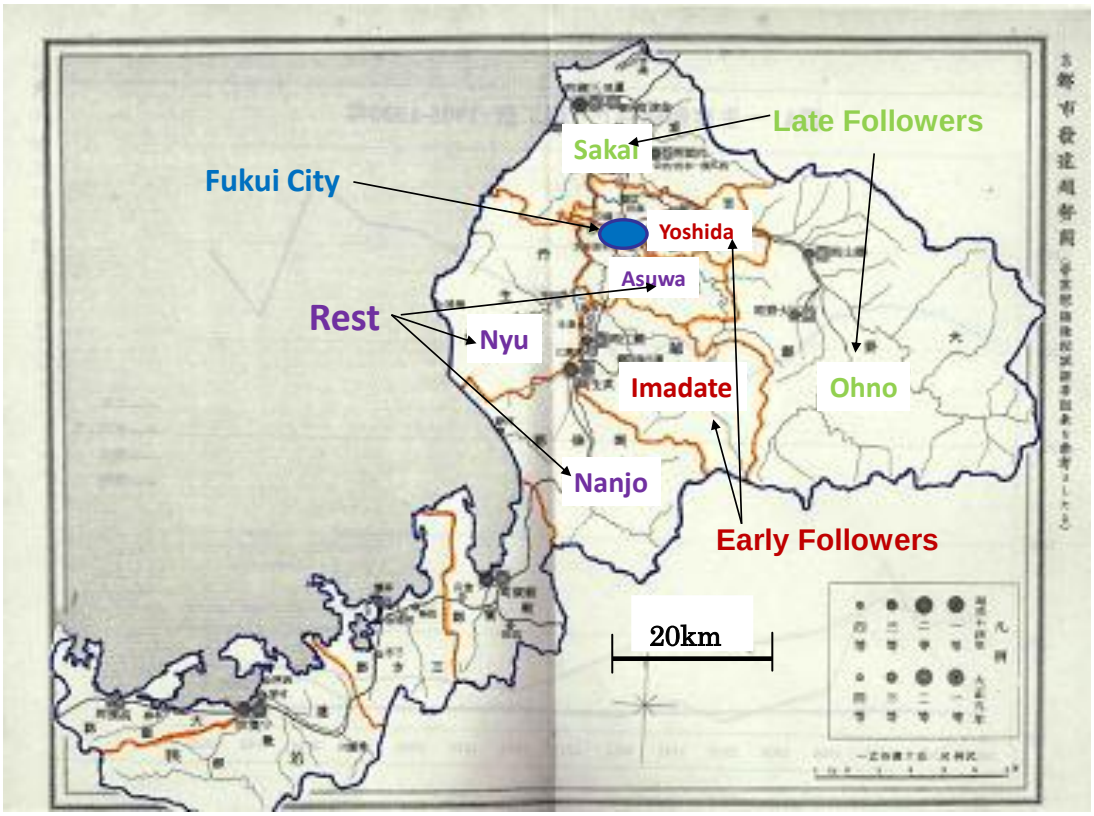
Notes: t-statistics are in parentheses. Coefficients marked * and ** are significant at the 5% and 1% level.

Table 7. *Determinants of the production share of habutae in the Fukui silk-weaving district*

	Phase I (1902-08)	Phase II (1909-14)	Phase III (1915-19)
Early follower 1 (EF1)	.17 (1.99)	-17 (-1.26)	-.06 (-.75)
Early follower 2 (EF2)	.09 (1.05)	.04 (.29)	-.01 (-.08)
Late follower 1 (LF1)	.04 (.53)	-.10 (-.74)	-.01 (-.13)
Late follower 2 (LF2)	.04 (.44)	-.15 (-1.17)	.06 (.69)
Rest 1 (R1)	-.03 (-.39)	-.01 (-.09)	-.02 (-.23)
Rest 2 (R2)	.12 (1.41)	-.11 (-.86)	-.38 (-4.80)**
Rest 3 (R3)	-.24 (-2.80)**	-.13 (-.97)	-.34 (-4.25)**
EF1 x Time trend	-.02 (-1.05)	-.02 (-.41)	-.04 (-1.25)
EF2 x Time trend	.02 (.70)	.00 (.08)	.08 (2.60)*
LF1 x Time trend	-.00 (-.01)	.02 (.46)	-.06 (-1.89)
LF2 x Time trend	.00 (.07)	.04 (.83)	.01 (.29)
R1 x Time trend	.04 (1.84)	-.08 (-1.92)*	.05 (1.42)
R2 x Time trend	-.05 (-2.21)*	-.00 (-.02)	-.00 (-.08)
R3 x Time trend	.04 (1.62)	-.04 (-.95)	.09 (2.86)**
2^{nd} year dummy	.06 (1.20)	.00 (.07)	-.05 (-1.22)
3^{rd} year dummy	.10 (1.92)	-.09 (-.99)	-.16 (-2.81)**
4^{th} year dummy	.02 (.32)	-.03 (-.24)	-.21 (-2.77)*
5^{th} year dummy	-.04 (-.54)	-.01 (-.04)	-.38 (-4.10)**
6^{th} year dummy	-.04 (-.50)	-.06 (-.35)	n.a.
7^{th} year dummy	.01 (.13)	n.a.	n.a.
Intercept	.80 (12.29)**	.90 (9.11)**	.89 (15.13)**
R^2	.708	.681	.942
No. of observations	56	48	40

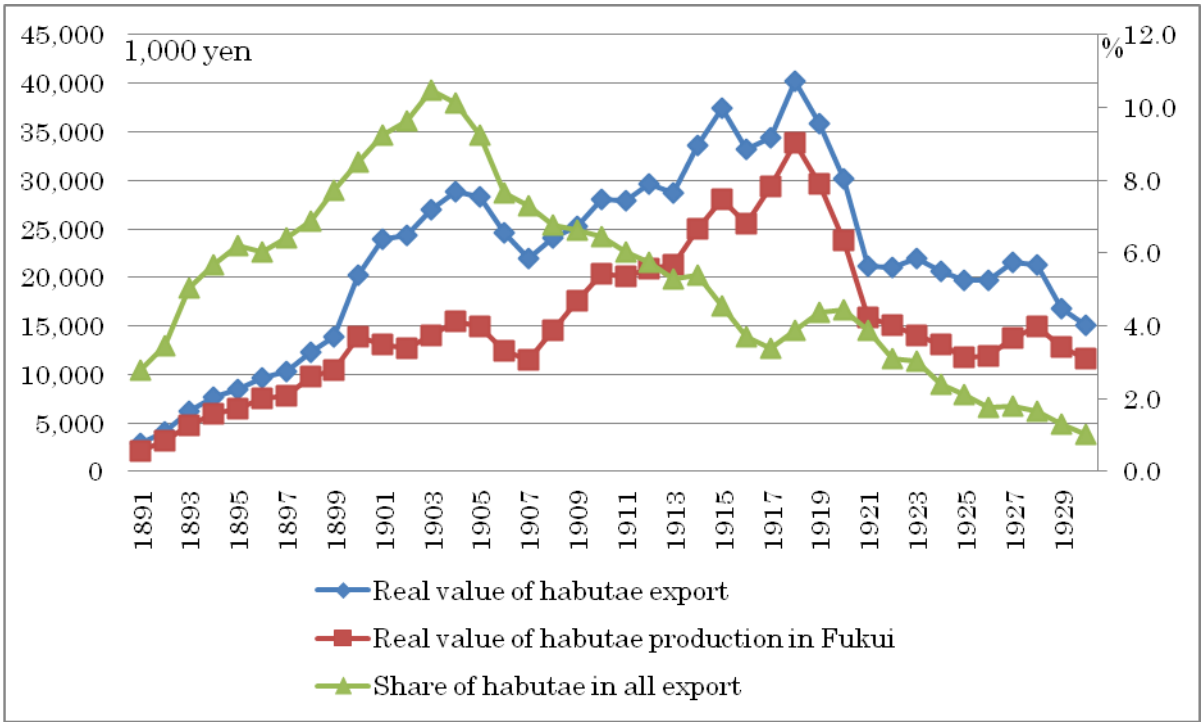
Notes: t-statistics are in parentheses. Coefficients marked * and ** are significant at the 5% and 1% level. Year dummies cover 1903-08 in the first column, 1910-14 in the second column, and 1916-19 in the third column. “n.a.” means not applicable.

Figure 1. *The map of Fukui weaving district in 1920*



Source: Fukui Prefecture (1922).

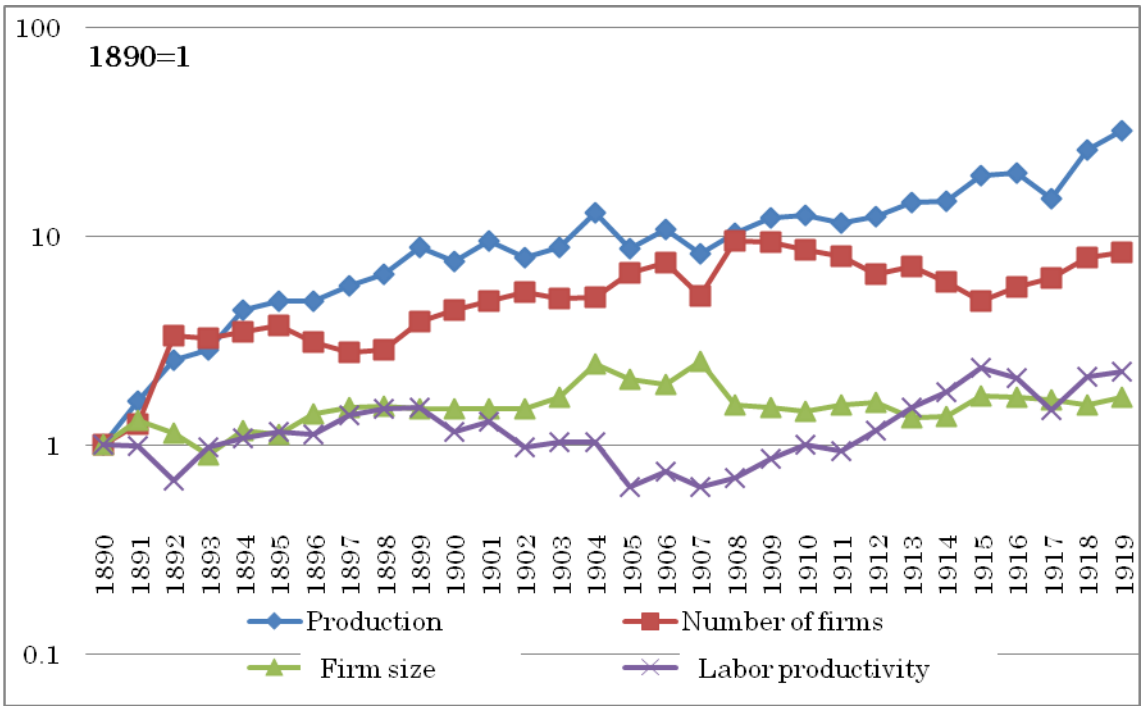
Figure 2. *Growth of real value of habutae export, habutae production in Fukui, and share of habutae in all export, three-year averages*



Source: Toyo Keizai Shinposha (1935), p. 2, pp. 73-74, for total value of all export goods and value of *habutae* export; Ministry of Agriculture and Commerce (from 1891 to 1923) and Ministry of Commerce and Industry (from 1923 to 1930) for value of *habutae* production in Fukui (Fukui prefecture).

Notes: For deflator, we used price index of export products in Ohkawa et al. (1967), p. 212.

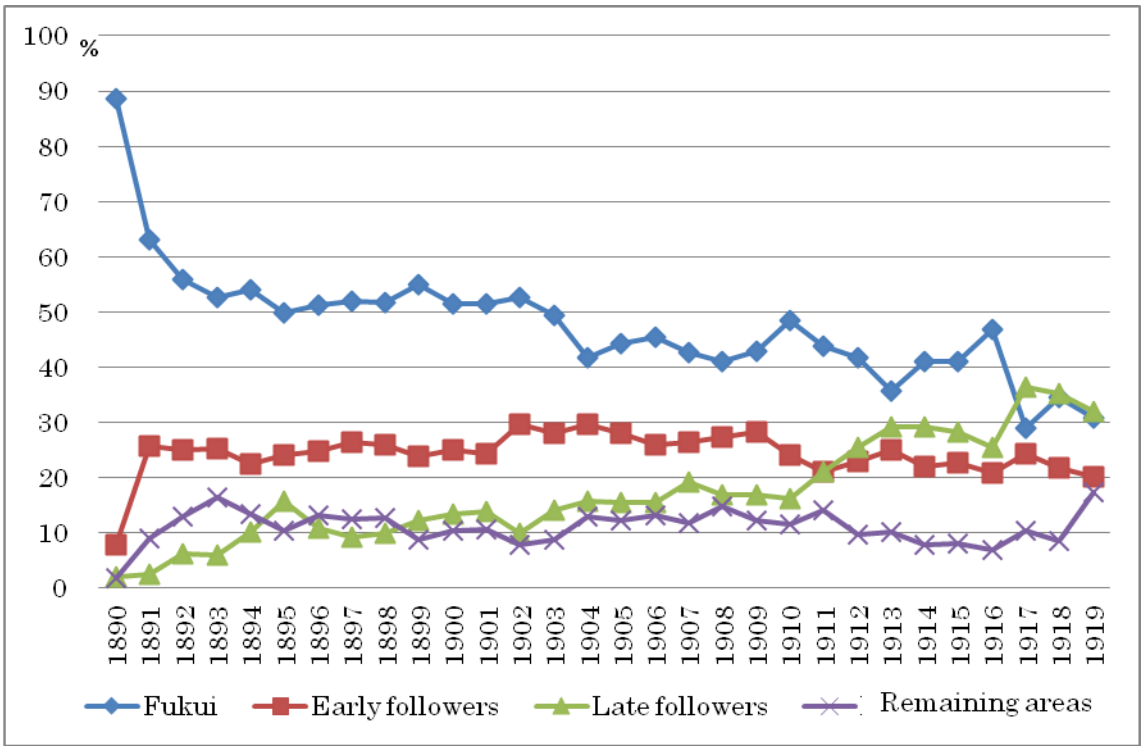
Figure 3. *Changes in production, the number of firms, average firm size, and labor productivity, 1890-1919*



Source: Fukui Prefecture (1889-1900) for data from 1890-1900; Fukui Prefecture (1901) for data in 1901; Fukui Prefecture (1902-1919) for data from 1902 to 1919.

Notes: For deflator, we used price index for textile products in Ohkawa et al. (1967), pp. 192-3.

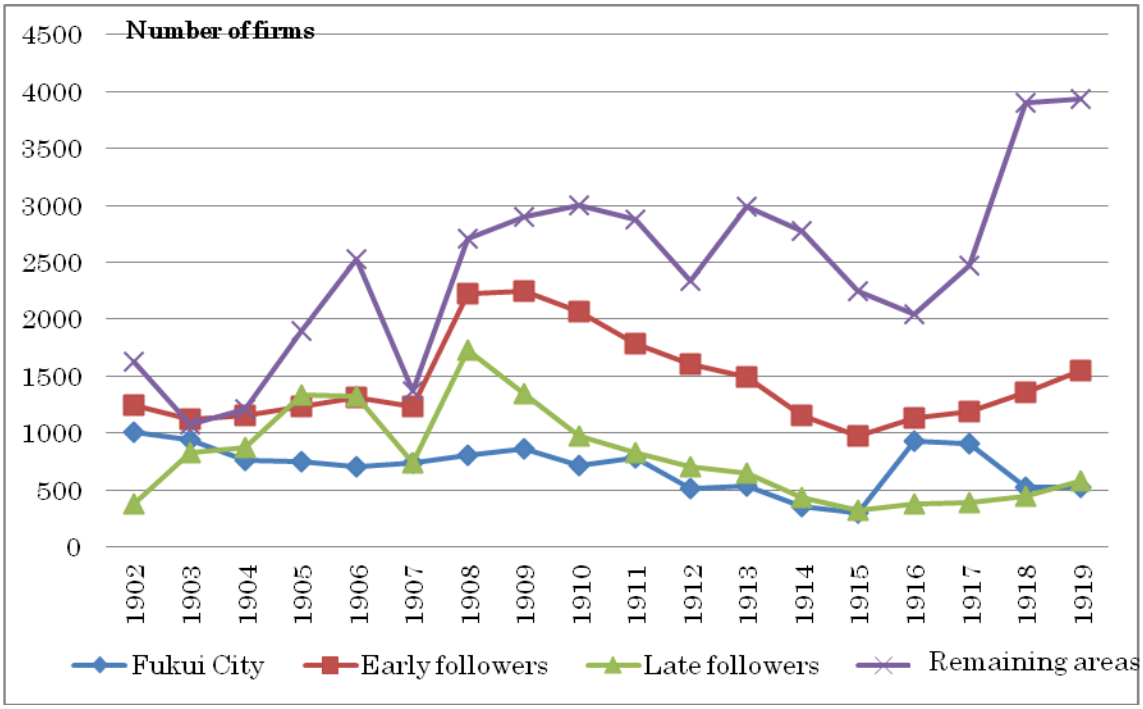
Figure 4. *Changes in regional shares of silk fabric production, 1890-1919*



Source: Same as Figure 3.

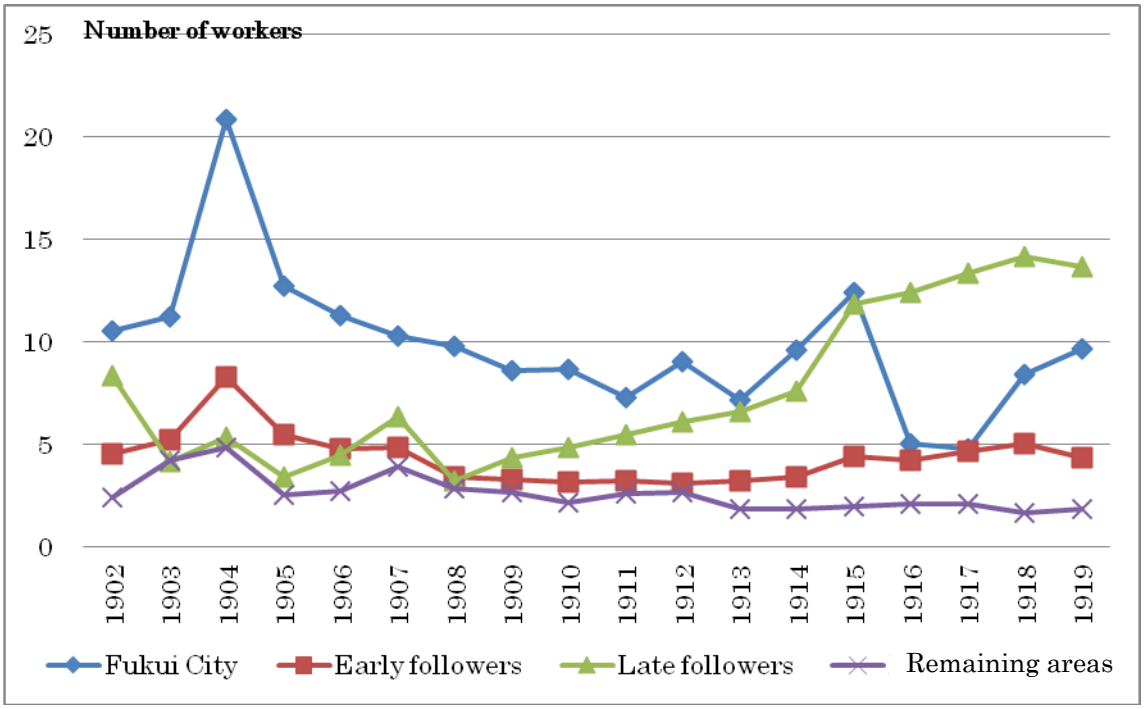
Notes: We categorized capital city and seven counties into following four groups. Fukui; Fukui city, Early followers; EF1 (Yoshida) and EF2 (Imadate), Late followers; LF1 (Sakai) and LF2 (Ohno), and Remaining areas; R1 (Nanjo), R2 (Asuwa), and R3 (Nyu). We use the same classification in following figures.

Figure 5. *Changes in the number of weaving firms by region, 1902-1919*



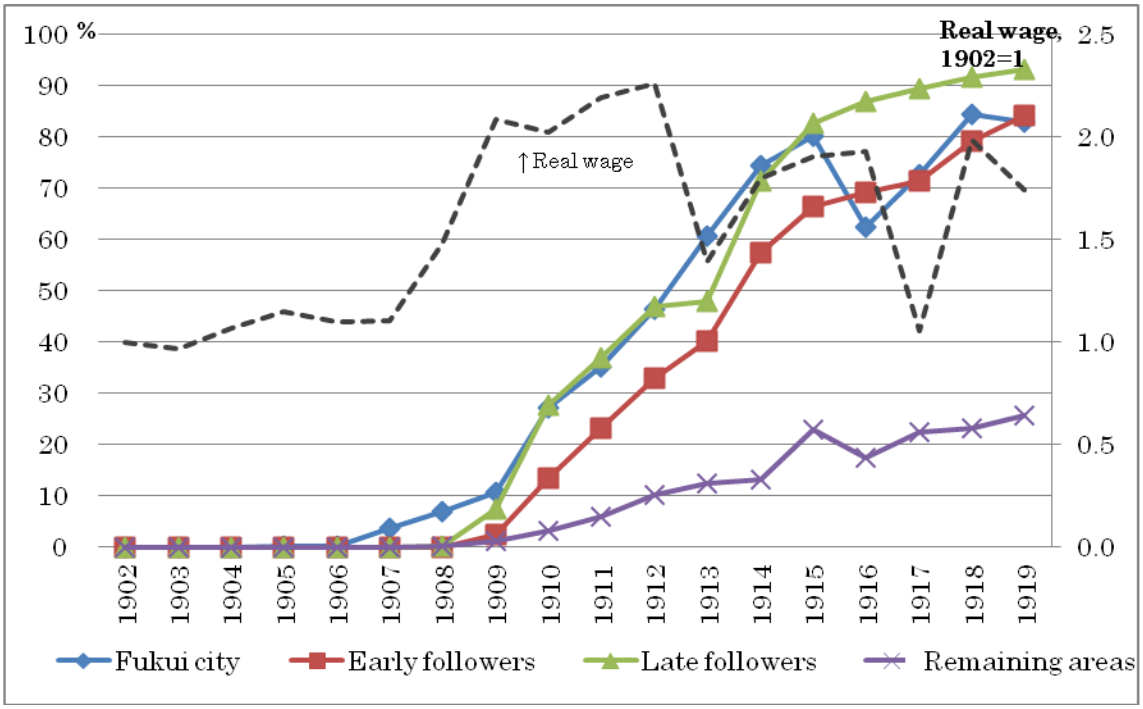
Source: Fukui Prefecture (1902-19).

Figure 6. *Changes in size of weaving firms by region*



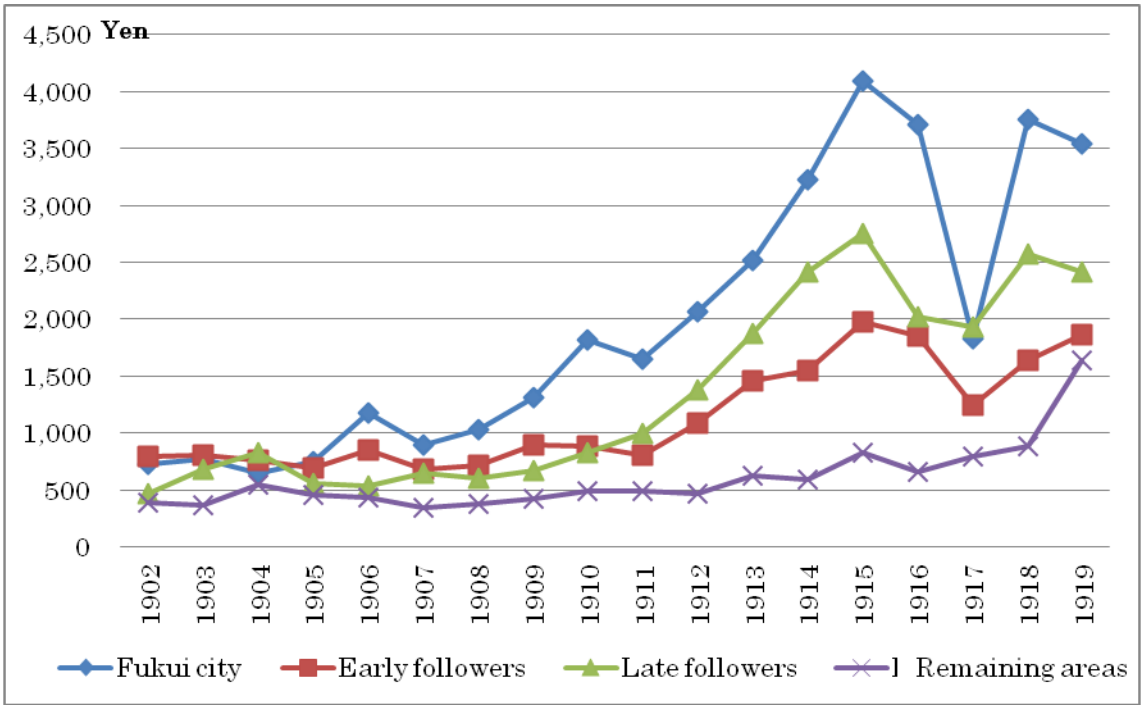
Source: The same as Figure 5.

Figure 7. *Changes in real wage rate and adoption rate of power looms by region*



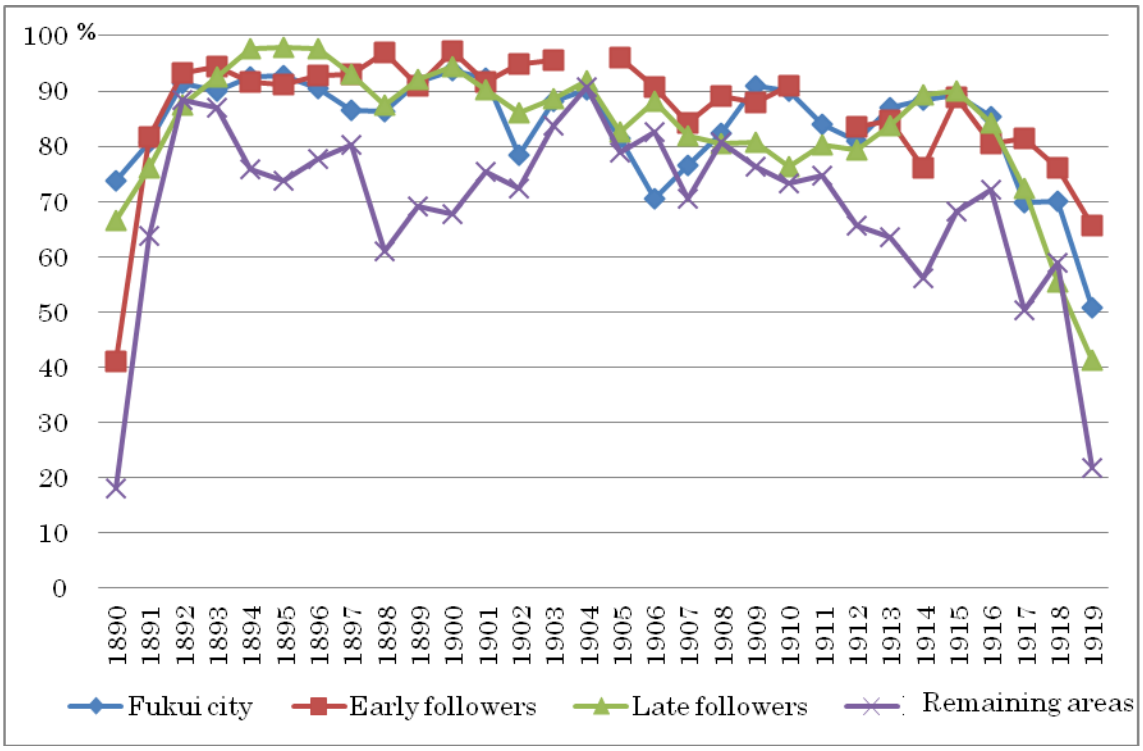
Source: The same as Figure 5.

Figure 8. *Changes in labour productivity by region*



Source: The same as Figure 5.

Figure 9. *Percentage of habutae production in fabric production by region*

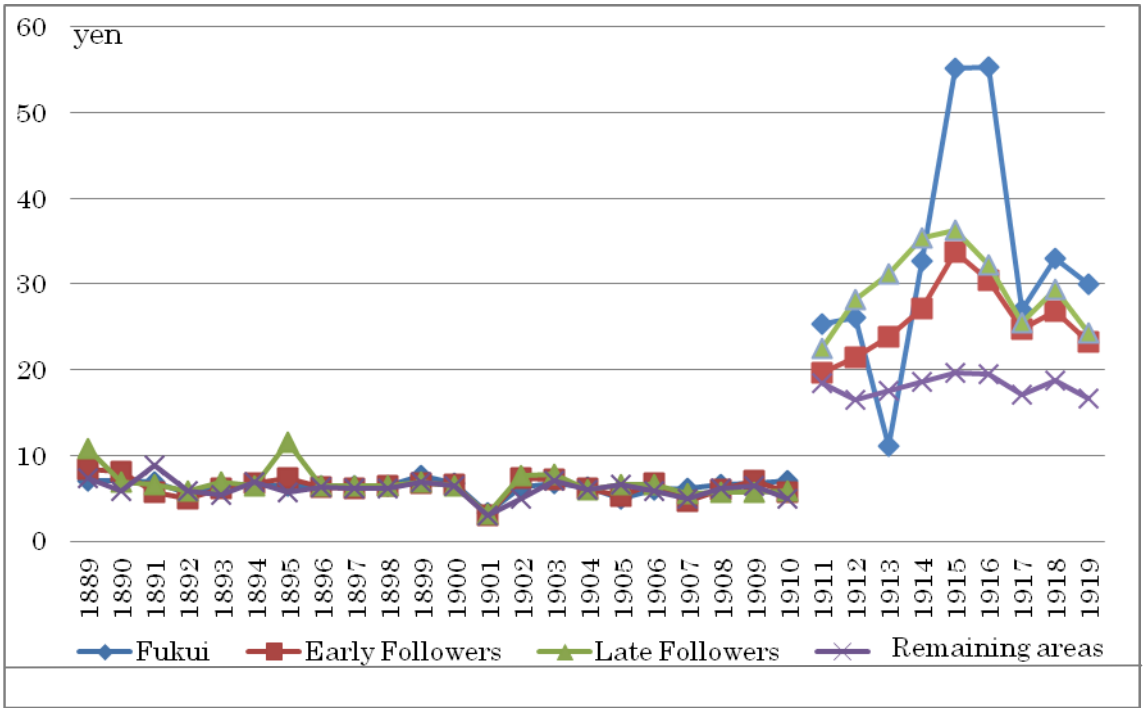


Source: The same as Figure 5.

Notes: The figures are on a value basis.

Figure 10. *Changes in real habutae price by region*

(per tan, 1889-1910; per hon, 1911-1919)



Source: The same as Figure 3.

Notes: In the original data surveyed by Fukui Prefecture, different units were used for the *habutae* price, see footnote 10. For deflator, we used price index for textile products in Ohkawa et al. (1967), pp. 192-3.