Agglomeration with the Declining Marshallian Agglomeration Economies: An inquiry into the postwar development of the Nada sake brewing district in Japan

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Agglomeration with the Declining Marshallian Agglomeration Economies:

An inquiry into the postwar development of the Nada sake brewing district in Japan

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Abstract

This study explores the changing roles of agglomeration economies in cluster development based on the historical experience of sake brewing districts in postwar Japan. Nada, the most advanced brewing district, had grown through the horizontal division of labor and development of skilled labor market when production was labor-intensive in the 1950s. The adoption of capital-intensive mechanized brewing, induced by wage growth in the 1960s and 1970s, replaced skilled labor. In recent periods, Nada's breweries attempted quality improvement and establishing a regional brand by collectively internalizing the external benefits of information spillovers, which are beyond the scope of the Marshallian arguments.

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1 Introduction

The vital role of the industrial district or cluster in industrial development is increasingly recognized with the accumulation of empirical studies. Alfred Marshall (1920) is the first economist who identified the three advantages of industrial district called Marshallian agglomeration economies: These are (1) information spillover or imitation, (2) vertical division of labor and specialization among enterprises, and (3) the development of skilled labor market. The pioneering studies by Piore and Sabel (1984), Sabel and Zeitlin (1999) and Zeitlin (2007) demonstrated that fine and flexible division of labor among small enterprises significantly contributed to cluster-based industrial development in European countries. In developing countries, Sonobe and Otsuka (2006b, 2011, 2014) and Hashino and Otsuka (2016) found that many spontaneously established clusters were formed by the entry of imitators who often used to work for founding firms and imitated production technology, management and marketing methods from them in Asia as well as in Africa.

The shortcoming on Marshall's argument of agglomeration economies is the absence of the discussion about innovation, without which it is unclear why information spillovers are important. Sonobe and Otsuka (2006b, 2011, 2014) found that the improving product quality by innovation is an engine of growth in many

industrial clusters. Other studies also provide insights into the process leading to innovation by arguing that local collective action which internalizes the externality within the industrial district promotes the innovation or the improvement of production systems (Schmitz 1995; Nadvi 2007; Hashino 2012; Hashino and Kurosawa 2013) .

The history of economic development in Japan is replete with the successful development of industrial districts. In the case of weaving industries, merchant-manufacturers, engaged in weaving and marketing, offer subcontracts with small-scale out-weavers, called putting-out system, which was an important institutional factor in cluster development (Abe and Saito 1988; Hashino and Kurosawa 2013). With respect to the sake brewing industry, interfirm sake transactions,[1] in which small breweries sell sake to large ones, contributed to the development of sake brewing districts since the prewar period (Yunoki 1941; Yunoki 1965). The pottery industry, one of the traditional industries in Japan, also developed by horizontal division of labor within clusters. Large pottery firms or merchants outsource their production and processing to small firms, which is similar to OEM, thereby realizing the division of labor between production and sales within the district (Miyachi 2008;

[1] Note that although inter-firm transaction in the brewing industry has also been observed in the whiskey industry (High and Coppin 1988), the discussion of its causes is absent.

Yamada and Ito 2008, 2013). These examples indicate that the horizontal division of labor among enterprises played an important role in the historical development of industrial districts in Japan, which is different from the vertical division of labor envisaged by Marshall (1920).

Another feature of the development of industrial districts in Japan is that mechanization led to changes in the composition of skilled and unskilled workers (Sakurai 1981; Miyachi 2008), to which Marshall did not pay any attention. While the impact of mechanization on productivity growth has been well analyzed, the discussion about how it affected the skilled labor market has been largely absent. In addition, the discussion of the long-term development process of industrial clusters with special attention to the changing role of agglomeration economies is scant.

In this study, we would like to address the following questions: (1) What are the conditions underlying the horizontal division of labor? (2) How did mechanization change the importance of the skilled labor market? and (3) Under what circumstances was local collective action toward the innovation induced? To answer these questions, we explore the long-term development process of the sake brewing districts in Japan, with particular attention to the Nada brewery district.

The rest of this article is organized as follows. The next section provides a

historical overview of the cluster formation in Nada and the development of the postwar sake brewing industry by comparing contrasting performance of three major brewing districts. Section 3 describes changes in production, number of firms, firm size, and labor productivity, as well as production of special rice variety for sake brewing, called *Yamada-Nisihiki*, to identify the three distinct phases of development in Nada from 1953 to 2017. In the following two sections, the driving forces for the three phases are discussed, i.e., interfirm sake transactions in the early postwar period, mechanization of the brewing process during high wage growth periods, and local collective action in the face of increasing demand for high-quality sake in recent period. We conclude this study by summarizing the main findings and their contributions to the literature in Section 6.

2 Historical Development of the Japanese Sake Industry

2.1 The rise of sake production in Nada

The Nada sake brewing district, located 15 kilometers along the coast of the Hyogo prefecture (Figure 1), has been the largest cluster producing branded sake since the early nineteenth century.[2] According to the Nada Sake Research Association (1960),

[2] Note that the sake brewing industry was one of the most important traditional industries for historical development in Japan. Survey data from the Ministry of Home Affairs (1874) showed

the production share of Nada's sake in Japan exceeded 10 per cent in 1902, which was higher than Fushimi in the Kyoto prefecture and Ikeda in the Osaka prefecture, where major sake clusters were located in this period.

<Figure 1>

Historically, the formation and growth of the Nada district were driven by its geographical advantages. In addition to the maritime advantages, which reduced transportation costs, the cold climate and the availability of clean spring water suitable for brewing sake conferred the advantage of producing high-quality sake in Nada (Yunoki 1941; Yunoki 1965).[3] Consistent with the arguments advanced by Marshall (1920), the development of the labor market with specialized skills was another source of cluster development. Since the Hyogo prefecture is covered by snow in winter, many farmers engaged in sake brewing as a side business during the slack months in the prewar period.[4] Gradually, they became skilled sake brewers

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that, in 1874, sake accounted for 16 per cent of total Japanese industrial production, indicating its importance as a manufactured products in the early stage of modern Japanese economic development. It was also important for public finances: the liquor tax has been an important source of government revenue, and it surpassed the land tax to become Japan's largest source of tax revenue in 1900 (Ministry of Finance 1969).

[3] The importance of geographical advantages in sake industry is similar to the wine industry, which emphasizes the ideal natural environment for growing wine grape, called *terroir* (Sato and Kohsaka 2017).

[4] As in modern developing countries, such utilization of underemployed rural labor during the slack months was important for economic development in pre-industrial Japan. Similar cases are observed in Japanese sericulture and weaving (Nghiep and Hayami 1979; Hashino and Otsuka 2016).

called *toji*, who were seasonal migrants to Nada and technically responsible for sake production there (Sakurai 1981).

In contrast to the vertical division of labor envisaged by Marshall, horizontal division of labor, that is, a subcontracting relationship between large firms, which are sake brewers and sellers in nation-wide markets, and small firms, which sell sake to large local firms, promoted the prewar growth in the Nada district.[5] Subcontracting in the sake brewing industry was buying and selling operation between firms producing raw sake before bottling, which was called *oke-torihiki* or transaction by the tub. Since separating the fermentation processes in the sake brewing industry is difficult, the division of labor is limited to transactions after brewing (Kawaguchi and Fujimoto 2010). Because the sake brewing industry was labor-intensive without mechanization in the prewar period, production was characterized by scale diseconomies. Thus, large brewers in Nada with established brand names could not expand the volume of their sake sales without subcontracting with the small brewers (Shinbo 1962; Tanimoto 1996). Such interfirm

[5] Marshall (1920) pointed out that the vertical division of labor among different industries develops when industries that supply intermediate and capital goods are established in the cluster. On the other hand, the inter-firm transaction envisaged in this paper represents the horizontal division of labor between large and small sake breweries, which is clearly different from the Marshallian arguments.

transactions were advantageous for large brewers to secure volume and small brewers to secure customers (Oshima 2009).

2.2 Overview of the sake brewing industry in the postwar period

Figure 2 depicts the number of sake factories in Japan and the total quantity of sake production from 1953 to 2017. Production grew rapidly throughout the 1950s and 1960s, whereas the number of factories slightly declined, implying an expansion in firm size. In the early period after the Second World War (1939–45), sake was Japan's most popular alcohol product. The demand for sake increased significantly since consumption expenditures increased along with rapid income growth (Miyamoto 2010). Demand was high for brand-named sake produced in Nada, Hyogo and Fushimi, Kyoto. The increase in firm size in this period was mainly due to the growth of firm size in these two districts.

Figure 2 also shows that sake production entered a stagnant and slightly decreasing period from the 1970s to the late-1990s. In this period, reasonable-quality sake for the mass market, which was mainly produced in Nada and Fushimi, became increasingly popular (Hakutsuru Syuzo Co. 1977). Large firms succeeded in mass production through mechanization; hence, structural transformation in favor of

large firms seemed to have occurred in the brewing industry.

Since the late-1990s, however, production as well as the number of firms sharply declined. When the sake industry entered a slump, demand for other alcohol products such as wine and whiskey imported from Western countries increased. Therefore, consumption stimulation and marketing campaign became important for sake (Miyamoto 2010). According to Ito (2000), the unique feature of this period is that while the demand for mass-market sake mainly produced in Nada and Fushimi significantly declined, the demand for high-quality sake produced in small brewing districts increased.

<Figure 2>

Why did large brewing districts shrink, whereas small districts prospered? Since the availability of district-level data is limited, we will examine prefecture-level data.[6] Table 1 exhibits the historical changes in production share, production per factory (i.e., firm size), and the real price per kiloliter of sake in the top three prefectures,[7] Hyogo, Kyoto, and Niigata, as of 2017. Several important observations

[6] In Hyogo prefecture, there are several other sake brewing districts. Throughout the postwar period, however, sake produced in Nada accounted for approximately 60% to 80% of total sake production in this prefecture (Nada-shu Kenkyu Kai 1969, 1988). Similarly, Fushimi, the largest sake brewing district in Kyoto prefecture, accounted for more than 80% of total production in this prefecture. On the other hand, firms in Niigata Prefecture are dispersed in their location within the prefecture.

[7] The real price per kl is obtained by dividing the real value of shipments by the quantity. The

can be made. First, Hyogo prefecture, where Nada district accounted for lion's share, dramatically increased its production share to more than 30 per cent in the 1980s and maintained a high share thereafter. We hypothesize that this is due to the pursuit of scale economies by mechanization of their production facilities by the major firms in Nada.

Second, it can be pointed out that while the production per factory expanded in Hyogo and Kyoto prefectures during the 1980s, the Niigata prefecture has consistently been characterized by small-scale producers. These differences in production scale are related to the extent of mechanization. According to Morimoto and Yagura (1998), the large firms with established brand names in Hyogo and Kyoto pursued the mechanization of their production processes. In contrast, mechanization was not pursued in other districts due to the absence of large firms with well-known brand names. Thus, small-scale brewers in these districts have produced sake by traditional, labor-intensive methods (Hiroi 1990; Ito 2000).

Third, while the real prices per kiloliter in the Hyogo and Kyoto prefectures were much higher than in the Niigata prefecture in the 1960s, the price difference decreased in the 1980s. Furthermore, the sake price in Niigata surpassed the other

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nominal price per kl and the nominal value of shipments are deflated by the consumer price index (Statistics Bureau of Japan 2017).

prefectures after the 2000s, whereas prices in Hyogo and Kyoto stagnated in the subsequent period. This emerging difference in price among the three prefectures indicates a changing difference in the quality of sake. According to Shinoda (1981), brewing high-quality sake requires traditional, skill-intensive brewing method, which can be hardly mechanized. As in many other traditional industries, small-scale firms using labor-intensive, traditional technologies have a comparative advantage in producing high-quality sake. It can be assumed that firms in Niigata succeeded in producing the highest-quality and expensive sake, whereas firms in Hyogo chose cost reduction rather than an increase in quality.

<Table 1>

The price differences in Table 1 are also attributed to the differences in the raw-material rice. The rice used for high-quality sake is called sake rice, which is different from ordinary rice for consumption.[8] Among the varieties of sake rice, *Yamada-Nishiki*,[9] developed in the Hyogo prefecture in 1936, is the most popular

[8] Sake rice is characterized by its large grain size. In order to brew high-quality sake, grains of raw-material rice must be shaved significantly, and thus ordinary rice is easily cracked due to its smaller grain size compared to sake rice (Hyogo Sakamai Kenkyu Group 2010).

[9] Historically, sake brewers in Nada conducted contract farming with *Yamada-Nishiki* farmers (Hyogo Sakamai Kenkyu Group 2010), especially classified as marketing contract which concerned only with the conditions of product delivery (Otsuka et al. 2016). Likewise, in the wine industry, contract farming is practiced to ensure the quality of the wine grapes, and most cases seem to be limited to marketing contracts in which autonomy of production is largely left to farmers (Goodhue et al. 2003; Fraser 2005).

variety, which was used for the most expensive, high-quality sake produced in Hyogo in the early postwar period, when its prices were comparatively high (Table 1). In the mid-1960s, however, demand for mass-produced sake using cheap rice began to increase, which decreased the demand for *Yamada-Nishiki* (Hyogo Sakamai Kenkyu Group 2010). The demand for sake rice has once again increased from small-scale brewing districts, especially from Niigata prefecture, which pursued to produce expensive, high-quality sake in the 2000s. In recent period, brewers in Hyogo resumed to use *Yamada-Nishiki* to improve the quality of sake (Hyogo Sakamai Shinkokai 2020).[10] This historical experience suggests that the use of *Yamada-Nishiki* has been animportant factor affecting the rise and fall of sake brewing in the Nada district.

3 Three Phases of Growth Process in Nada

To identify the major factors affecting the change in the growth processes in Nada, we divided the postwar growth of Nada into three phases based on the changing trends in sake production, the number of brewery firms and rice production. Figure 3 examines the long-term sake production in Nada and other areas in the Hyogo

[10] Recently, *Yamada-Nishiki* has been increasingly produced in other prefectures, but 60 per cent of this rice variety in Japan is still produced in Hyogo (Hyogo Sakamai Kenkyu Group 2010).

prefecture (excluding Nada), the number of brewery firms in Nada, and the production of *Yamada-Nishiki* in Hyogo prefecture. From Figure 3, several distinct trends can be identified. First, the production of sake continued to grow from 1953 to around 1970. It stagnated from around 1970 to the mid-1980s and sharply declined after the late-1980s. Second, the number of firms grew slightly until around 1970, but it started to decline after the early-1970s. Third, production of *Yamada-Nishiki* increased until the mid-1960s, when the demand for mass-produced sake using cheap sake rice began increasing. Hence, its production declined until the mid-1980s. Yet it has been growing since then, except for a temporary decline in the early-2000s. Finally, the sake production trends for Nada and the rest of Hyogo are similar throughout all periods.

<Figure 3>

Based on these observations, the development path of this industrial district can be divided into three periods. From 1953 to around 1970, the increase in the number of firms and *Yamada-Nishiki* was responsible for production growth. We call this phase I. Phase Ⅱ started in 1970 with a sudden stagnation in the number of firms and production until the mid-1980s. Since the production of *Yamada-Nishiki* remained low, it can be assumed that the production system has shifted to a capital-

intensive mass-production of sake using cheap sake rice. After the mid-1980s (phase III), sake production and the number of firms declined, but *Yamada-Nishiki* production gradually increased, particularly from around 2010. It can be assumed that Nada was forced to reduce its production due to declining demand for mass-market sake, but they partially restored its competitiveness by shifting to high-quality sake using *Yamada-Nishiki* after 2010.

To identify the major components of production growth in Hyogo, we decompose the real value of production (Q)[11] into the number of firms (N), firm size in terms of the number of workers per firm (L/N), and labor productivity (Q/L) using the following formula:

$$Q = N \times (L/N) \times (Q/L) \tag{1}$$

Taking the logarithm of (1), we can transform it into the following equation:

$$Ln(Q) = Ln(N) + Ln(L/N) + Ln(Q/L) \tag{2}$$

Using this relationship, changes in the indices of Q, N, L/N, and Q/L for the production of sake after 1971, for which the data are available, are shown in Figure 4. These indices were set to be 100 in 1971. Observed trends reveal several characteristics that support our hypothesis. First, labor productivity in terms of the

[11] Since the data for value of production is limited, value of shipment is used as a proxy variable.

real value of production per worker grew rapidly until the middle of phase Ⅱ, and then it began declining and stagnating in phase Ⅲ. This suggests that although Nada gradually lost its comparative advantages after increasing labor productivity due to the capital-labor substitution in phase Ⅱ, such production system was maintained even in phase Ⅲ, judgeing from largely unchanged labor productivity. Second, the decline in real value of production in phase Ⅲ was stopped around 2010, suggesting that innovative changes might have occurred in the district.

<Figure 4>

4 Dynamic Growth of Nada Sake Brewing District

4.1 Phase I : Demand expansion and interfirm sake transaction

Phase Ⅰ is characterized by the high growth of sake production and the number of firms (Figure 3). The question is what kind of firms and production methods contributed to such production growth.

Table 2 shows the average characteristics of sake brewing firms in Hyogo prefecture in selected years from 1959 to 1995. We define large firms as those that had produced more than 10,000 kiloliters per year by the 1990s and small and

medium-sized firms as others.[12] All large firms are located in the Nada district. Table 2 indicates that the all firms entered into sake brewing business in Hyogo prefecture by the 1970s were small and medium-sized, and their average production was much smaller than that of large firms. In terms of the production method, the adoption of capital-intensive technology known as four-seasons brewing, which helped realize scale economies and perform strict quality control throughout the year, was particularly important in the sake brewing industry (Segashira 1964; Kondo 1967). Table 2 exhibits the adoption rate of this technology by the large firms for which data are available. The adoption rate was low in the early-1960s, suggesting that their production was still labor-intensive and subject to scale diseconomies in phase Ⅰ.

<Table 2>

It is important to note that the expansion of the interfirm sake transactions through subcontracting relationships promoted the development of Nada in phase Ⅰ. Figure 5 illustrates the difference between the shares of shipments and production in each prefecture, which indicates the net amount of sake transaction across prefectures through subcontracting. From the late-1960s to the early-1970s,

[12] According to National Tax Agency (2018), despite only 0.8% of firms annually produced more than 10,000 kl of sake in 2017, their production accounted for 48.7% of total production in Japan. This suggests that the existence of huge production gaps between large and small firms in the sake brewing industry.

the market share of shipments in Hyogo exceeded that of production. In contrast, the opposite trend was observed in other prefectures except for Kyoto and Niigata, suggesting that large firms in Hyogo offered subcontracts to small-scale brewers in other prefectures.

Unfortunately, we cannot observe the subcontracted amount of sake within Nada, but it is highly likely that similar transactions were made between large and small firms within this district. In fact, demands were highly concentrated on sake produced by a small number of large firms with well-recognized brands in Nada, although they cannot expand their own production due to scale diseconomies caused by the lack of mechanization of production facilities.[13] Under this condition, large firms in Nada expanded their subcontracts to small firms in other prefectures, since the amount of subcontracted sake from small firms within the district was insufficient (Kato and Ishikawa 2006; Ozeki Corporation 2014).[14] As a result, subcontracted small firms were not engaged in sales and marketing activities to develop their sales channels, while large firms strengthened their corporate brands

[13] This was partly because rice trade was strictly controlled by the government under the Food Control Law until 1968, so that large firms could not get enough rice for brewing.
[14] Similarly, Ito (2000) pointed out that large firms with established brand names increased subcontracting amount from their districts and neighboring prefectures when demands were rising, while they decreased subcontracts and increased their own production when demands were declining.

by investing a substantial portion of their profits to advertising (Tomita 1974; Ninomiya 2016), which leads to the division of labor between production and sales within the district.[15] It seems clear that under the situation in which production was labor-intensive and demands for brand-named sake were high, the horizontal division of labor between sales by large firms and production by small firms developed.[16]

<Figure 5>

4.2 Phase Ⅱ: Rapid growth of labor productivity

Figure 4 shows that the value of production per worker in Hyogo prefecture rapidly increased in phase Ⅱ. It is clear that mechanization in sake brewing played an important role in boosting production as well as labor productivity. As is shown in Table 2, the adoption rate of four-season brewing technology by large firms located in Nada dramatically increased to 100 per cent in phase Ⅱ. The average size of the large firms measured by production also doubled, while the average number of

[15] In other words, large firms have a comparative advantage in sales and marketing, whereas small firms have a comparative advantage in production.

[16] Note that information spillover and imitation, one of the Marshallian agglomeration economies, were active in Nada in phase Ⅰ. Workers in small firms absorbed brewing knowledge and technology from skilled labor in large firms through regular meetings in Nada Sake Research Association, organized by brewers in Nada in 1917 (Nada-shu Kenkyu Kai 1968).

workers in large firms has declined (Table 2). This suggests that the brewing industry in Nada has changed from being labor intensive to capital intensive in phase Ⅱ.

Such process innovation was associated with the increase in wage rate caused by miraculous economic growth in Japan.[17] Table 3 exhibits the changes in the number of skilled workers called *toji* and their real wage rate. From 1950 to 1965, not only did the number of skilled workers increase —from 249 to 302— but also their daily wage rate rapidly increased from 4,704 to 8,176.[18] In contrast, their number rapidly declined, and the growth of wage rate had slowed after the 1970s. These observations indicate that firms in Nada had enjoyed the Marshallian agglomeration economies arising from the developed skilled labor market when production method was skilled labor-intensive in phase Ⅰ. In contrast, the importance of skilled workers diminished as they were replaced by machines after phase Ⅱ, which Marshall (1920) did not envisage. In fact, as skills and experience of the skilled workers were embodied in machines, they were replaced with unskilled workers who can handle machines (Sakurai 1981; Morimoto and Yagura 1998; Ozeki

[17] According to Sakurai (1980), the development and diffusion of labor-saving technologies is strongly expected due to the significant increase in wage rates after the 1960s.
[18] According to the data from Ministry of Labor (1961), their wage rates were about twice the average wage rates of Japanese manufacturing workers in 1960.

Corporation 2014).

<Table 3>

It must be emphasized that increase in labor productivity and diminishing importance of skilled labor by mechanization were achieved at the sacrifice of the quality of sake. Figure 6 shows the changes in real price per kiloliter of sake in the top three prefectures (Hyogo, Kyoto, and Niigata). Although the average price in Hyogo prefecture was highest in the 1960s, the gap between average price in Hyogo and other prefectures had decreased throughout the phase Ⅱ, and Hyogo's price was finally surpassed by Niigata in the middle of the 1980s.[19] This indicates that the mechanization reduced the quality of sake. Indeed, many large firms in Nada which realized the mechanization of the brewing process began to use the cheap sake rice as a raw-material for brewing instead of *Yamada-Nisihiki* after the 1970s (Ozeki Corporation 2014). Figure 6 also shows that the gap between average price in Hyogo and other prefectures has increased until around 2010. In all likelihood, Nada maintained the large-scale mechanized production system for mass-market sake

[19] The number of firms that introduced four-seasons brewing increased from 6 to 10 in Hyogo prefecture in the period of 1983–1990, while it increased only from 1 to 2 in Niigata prefecture (Ito 2000). This trend supports the conjecture that Nada pursued cheap, mass-produced sake by capital-intensive production method, whereas Niigata specialized in expensive, high-quality sake by labor-intensive production method.

established in the phase Ⅱ until the middle of the phase Ⅲ.[20]

<Figure 6>

In addition, a large number of small firms bankrupted in phase II. As is shown in Table 2, the number of small firms has decreased and average production of small and medium-sized firms has increased since the 1970s, suggesting that the exit and absorption were accelerated.[21] Such shakeouts took place presumably due to the inefficient scale of production of small firms. Capital intensive technologies, such as four-seasons brewing, were rarely adopted by small firms because it requires large investment (Onishi 1968), which suggests that the technological spillover within the district was limited.[22] In addition, since subcontracts offered by large firms have declined after the 1970s (Figure 5), when capital-labor substitution

[20] Similar to Hyogo prefecture, Kyoto prefecture also tended to produce low-priced sake. For instance, *Gekkeikan Co.*, a large company located in Fushimi in Kyoto, introduced four-season brewing in 1961, earlier than any other company in Nada, and realized capital-labor substitution (Gekkeikan Kabushiki Gaisha Shashi Hensan Iinkai 1999). Furthermore, *Takara Shuzo Co.*, the largest company in Fushimi, built a new large factory capable of four-season brewing in the late-1980s and has continued to produce mass-market sake (Kawaguchi and Fujimoto 2010). It seems that Fushimi district followed the similar growth path to Nada.

[21] In the case of beer-brewing industry in New South Wales described by Stubbs (1996, 1999), improvements in technologies such as power machinery and better refrigeration enabled larger breweries to achieve greater scale economies. Since these were too expensive for small breweries to install in their plants, most small brewery exited. Stubbs also pointed out that this is because of the increase in the minimum optimal scale, based on the discussion by Scherer (1974). In addition, a similar case is also observed in the brewing industry in New Zealand (Jones and Paul 1991).

[22] Note that the role of information spillover and imitation within Nada also diminished in phase Ⅱ. According to the Nada-shu Kenkyu Kai (1968), large firms in Nada refrained from joint research and technological exchanges as competition among the firms intensified.

rapidly advanced in Nada, small firms attempted to survive within the district by expanding their firm size through merger of firms (Editorial Department of Journal of the Brewing Society of Japan 1972).[23] These findings are consistent with the theory of efficient scale of firms formulated by Romer (1990a, 1990b), who argues that results of R&D, such as large mechanization of production processes, will increase the minimum efficient size of the plant, which forces inefficient-scale firms to exit from the market.

5 Expansion of High-quality Sake and Catching up of Nada in PhaseⅢ

5.1 Rapid decline of Nada and growth of small brewing districts

Figure 3 shows a sharp decline in sake production in Nada, whereas *Yamada-Nishiki* production was gradually increasing in phaseⅢ. This means that mass-market sake produced in Nada in phaseⅢ was unsuitable for the boom of the high-quality sake using *Yamada-Nishiki*. While total production of sake in Japan declined significantly after the 1990s, consumer preferences for high-quality sake mainly produced in

[23] For example, *Kiku Shuzo Co.*, a subsidiary of a large firm in Table 2, was established through the merger of four companies in Hyogo and Kyoto prefecture in 1971. Another firm, *Hyakumangoku Shuzo Co.*, established in Nada in 1973 through the merger of two firms in Hyogo, is also absorbed as a subsidiary by one of the large firms in Table 2 (Journal of the Brewing Society of Japan Editorial Department 1972). Such merged firms mainly specialized in selling subcontracted sake, since their own-brand sales declined significantly after the 1970s.

small firms increased, and they occupied major market share (Niigataken Shuzo Kumiai 2003; Noma 2006).[24] At the same time, the demand for *Yamada-Nishiki* produced in Hyogo prefecture from small brewing districts in other prefectures,[25] which concentrated in producing high-quality sake, has increased (Hyogoken Sakamai Shinkokai 2020).[26]

Large brewers in Nada district, however, continued to pursue a strategy of producing mass-market sake by capital-intensive brewing methods, which resulted in the crisis of this district. If we turn to the data on large firms in Table 2, it is clear that they still expanded their production in the 1990s, but the sales per worker have sharply declined —from 103.3 in 1977 to 67.1 in 1995— suggesting rapid decline in the demand for their mass-produced sake. In fact, since large firms wished to secure large volume to sustain their business under the decreasing demand for their sake, they increasingly attempted to reduce costs by adopting cheap paper bottles (Nada-

[24] According to the data from National Tax Agency (1961-2018), the market share of high-quality sake rapidly increased from 10 to over 30 per cent from the 1990s to the 2010s.

[25] Note that the quality of *Yamada-Nishiki* produced in Hyogo prefecture is the highest in Japan. According to the data from Ministry of Agriculture, Forestry and Fisheries (2017), the average production share of *Yamada-Nishiki* graded over "high" by government was only 7 per cent in other prefectures, while that of Hyogo was 71 per cent in 2017.

[26] The shift of raw-material rice from *Yamada-Nishiki* to cheap rice by large brewers in Nada was also a cause of crisis for farmers producing *Yamada-Nishiki*. Therefore, Japan Agricultural Co-operatives organized by farmers in Hyogo prefecture organized sales promotion activities to small brewers in other prefectures, resulting in the rapid expansion of sales channels of *Yamada-Nishiki* after the 1990s (Hyogoken Sakamai Shinkokai 2020).

syu Kenkyu Kai 1987)[27]. As a result, Nada lagged behind in the development of high-quality sake. According to the results of the annual nation-wide sake quality competition from the 1950s to the 2010s, whereas firms in Niigata and other small brewing districts had been awarded gold medals, firms in Nada only began to win a few awards in the 1980s. Thus, there were concerns that its brand image may have been tarnished by the sale of such cheap paper-bottled sake (Mitsui and Mizutani 2000). In other words, Nada was recognized as a district for cheap sake.

In response to such distress, however, some small firms in Nada achieved high growth by changing their strategies for producing superior sake. For example, *Kobe Shu-shin-kan Co.*, located in the Nada district, successfully exported its products and established brand as a high-quality sake internationally (Yasufuku 2020). In the early phase Ⅲ, there was a division between small firms following the strategy of producing high-quality products and large firms following the unchanged strategy in Nada.

[27] Such pursuit of producing mass-market sake also attributed to the changes in sales channel. After the 1980s, the main sellers of sake were shifted from commercial liquor retailers to convenience stores and supermarkets, where cheap paper-bottled sake for mass consumption was sold (Morimoto and Yagura 1998).

5.2 Quality upgrading through local collective action

Contrary to Hyogo and Kyoto, Niigata became one of the growing prefectures, that successfully adapted to the high-quality sake boom and increased its market share in phase Ⅲ.[28] Traditionally, brewing in Niigata was characterized by labor-intensive production methods by small-scale breweries. Interfirm sake transaction was uncommon due to the absence of large breweries with famous corporate brands in the district. In response to the growing demand for high-quality sake, they attempted to produce high-quality sake for which small brewers have comparative advantages.

As Sonobe and Otsuka (2014) pointed out, the private benefit of the entrepreneur who succeeds in innovation (in terms of quality improvement) is lower than social benefit because of the imitation in the industrial district. Therefore, the private incentives for innovation may be depressed. In other words, market failure occurs since the market for innovative knowledge does not function. To overcome market failures, Niigata Sake Brewers' Association (NSBA) organized the local collective action, which attempted to internalize external benefits of information

[28] Other small-brewing districts, such as Shiga, Kochi, and Yamagata prefectures, have also succeed in shifting their production to high-quality sake since the 1980s (Seki 2013, 2015; Ono 2018)

spillovers within the district. For example, NSBA held regular meetings for technical exchanges among the brewers as well as training of managers and employees.[29] In addition, they engaged in the diffusion of new sake rice varieties used for high-quality sake, and jointly owned rice milling machines which is useful for the production of high-quality sake (Niigataken Shuzo Kumiai 2003). Niigata Sake School (*Niigata Seishu Gakko*), which was also founded by NSBA in 1984, have played the central role in training skilled workers to produce high-quality sake (Shima 1991). As a result, several firms in Niigata succeeded in producing high-quality corporate brands such as *Koshino-Kanbai* and *Kubota*, whose prices were far higher than the average sake price in Japan (Asahi Shuzo Corporation 2003; Shima 2007).[30]

Nada began catching up with other districts to produce high-quality sake around 2010. In order to improve the quality of sake, brewers in Nada first returned to using their original sake rice, *Yamada-Nishiki*. Production of *Yamada-Nishiki* in

[29] The training included marketing, market research, and customer management (Niigataken Shuzo Kumiai 2003). In developing economies, the growth of the garment industry in Bangladesh and Tanzania has also been facilitated by training programs (Mottaleb and Sonobe 2011; Sonobe and Otsuka 2014).

[30] Historically, collective action through local associations has also been undertaken in the Fushimi district, Kyoto. In the pre-war period, sake brewed by Fushimi brewers was called out-of-place because of its low quality. Fushimi Sake Brewers' Association organized by brewers in Fushimi, however, succeeded in developing the regional brand and expanding its market share by monitoring the brewers to ensure that they never produce inferior products (Fushimi Shuzo Kumiai 2001). In addition, this association has held the meeting for technology exchanges in recent years (Tasaki 2009; Kawaguchi and Fujimoto 2010).

Hyogo prefecture has increased significantly since 2010 (Figure 3). It accounted for approximately 50 per cent of all sake rice used for brewing in Hyogo prefecture in the 1990s, but it has risen to around 70 per cent in the 2010s (Hyogoken Sakamai Shinkokai 2020). The brewers clearly recognized *Yamada-Nishiki* as an indispensable material for the production of high-quality sake.

In addition, similar to Niigata prefecture, the large brewers in Nada also took local collective action.[31] In contrast to Niigata, which attempted to develop each corporate brand, large brewers in Nada attempted to construct the regional brand through collective quality control.[32] The research group, which was newly organized by six large firms in Nada, was responsible for promoting this brand. They collectively attempted to recover the regional reputation through quality improvement by strictly monitoring the quality and eliminating poor-quality

[31] According to Mitsui and Mizutani (2000), there had been a strong competitive relationship between large firms in Nada since they have achieved mechanization in the 1970s. Therefore, unlike in Niigata prefecture, where the market share of each firm was small and the competitive relationship between firms was weak, the incentive for collective action was probably low in Nada.

[32] The distinctive feature of this project is that it achieved cooperation by emphasizing the establishment of a unified regional brand, while maintaining difference in the products of each firm. According to interviews with executives of large firms in Nada and Nada brewers' association, "Brewers in Nada are large and it is difficult to brew completely unified products. Therefore, cooperation is possible only by selling each firm's sake under a unified regional brand. Even within the Nada district, we wish that consumers enjoy the unique taste of sake of each brewery" (Interview conducted on October 21, 2021).

products (Akashi 2017).[33] This research group also collectively monitored the raw-material rice because the desired high-quality sake with regional brand requires using rice produced only in Hyogo prefecture (Nada-shu Kenkyu Kai 2011).[34] On the other hand, small and medium-sized firms did not participate in this brand formation and attempted to enhance their own corporate brands without much success. Thus, firms in Nada were divided into two groups: large firms with collective regional brand and small firms with their own corporate brands. Through these efforts, Nada seems to be partly successful in quality upgrading. The declining trend in the real value of sake production halted (Figure 4), and its real price in Hyogo prefecture began to increase again in the 2010s (Figure 6).

The collective efforts to improve quality and construct regional brand in phase Ⅲ are also confirmed by the introduction of Geographical Indication (GI) system in Nada in 2018.[35] In order to claim Nada-brewed sake, GI system legally requires the certification by the Nada-gogo Brewers' Association (NBA) organized by sake

[33] All but one of these firms are large firms in Table 2 (Nada-Shu Kenkyu Kai 2011).

[34] The average price per kiloliter of this branded sake, calculated from each brewer's retail price, was 1.5 yen in 2011 (Nada Sake Research Association Sake Quality Review Committee 2011). This price is much higher than the national average price in 2011 (that is, 0.7 yen), which suggests that Nada partly succeeded in quality improvement in phase Ⅲ.

[35] The introduction of the GI in sake was modeled after the wine industry, which succeeded in eliminating imitated poor-quality products in Europe and Latin America (Crozet et al. 2012; Defrancesco et al. 2012; Agostino and Trivieri 2014).

brewers (National Tax Agency 2018). NBA developed strict rules for production of quality of certified sake, such as the use of clean spring water in Nada and high-quality sake rice, which successfully prevents the distribution of imitated sake.

Quality improvement through establishing regional brand by the local collective action was clearly beyond the scope of Marshallian agglomeration economies. The fact that such innovation halted the declining production of the district is consistent with the argument of Sonobe, Otsuka and Hashino (2016), who suggest the importance of local collective action for innovations by internalizing the externality within the cluster.

6 Conclusions

This study explored the changing roles of agglomeration economies in the industrial cluster by addressing three questions underlying the long-term development of the Nada sake brewing district. These are (1) economic forces underlying the horizontal division of labor, (2) the impact of mechanization on the importance of skilled labor market, and (3) conditions triggering local collective action toward the innovation induced. In the postwar period, Nada experienced three distinct changes in its development process, which provide unique evidence to answer our questions. In

the first phase (from the 1950s to the 1960s), under the condition in which production was labor-intensive with scale diseconomies, and demands were highly concentrated on branded, reasonable-quality sake, the horizontal division of labor between sales by large firms and production by small firms accelerated the growth of this district. In the second phase (from the 1970s to the mid-1980s), while large firms achieved the increase in labor productivity through the mechanization of the brewing process, skilled laborers were replaced by machines, suggesting the declining importance of the skilled labor market. In addition, technological spillovers from large to small firms within the district were limited, which accelerated shakeouts of small firms with inefficient production scale. In the last phase (from the late-1980s to the 2010s), Nada faced a rapid decline in demand for their reasonable-quality sake, due to the increasing demand for higher-quality sake mainly produced in small brewing districts. This crisis, however, induced the quality improvement in Nada through the establishment of regional brand by collectively internalizing the external benefits of information spillovers, which is beyond the scope of the Marshallian arguments.

One of the most important contributions of this study is that the increase in wage rate and demand for high-quality products associated with economic

development can have decisive impacts on the development and stagnation of sake brewing districts. This study, however, indicates the possibility that stagnated traditional clusters can recover growth by collectively internalizing the external benefits of information spillovers. The relationship between the impacts of such exogenous changes and the development of industrial districts has not been considered in previous studies on cluster development (e.g., Sonobe and Otsuka 2006a). In this sense, the results of this study, obtained through historical observations using long-term data, add a new perspective to the literature on the development of industrial clusters.

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Table 1. Comparison of sake brewing firm characteristics of top three prefectures in selected years from 1961 to 2017

	Production share (%)	Average production per factory (kl)	Real price per kl (yen)[a]
1961			
Hyogo	16.3	501.6	1.60
Kyoto	7.3	483.3	1.44
Niigata	3.3	211.0	1.05
Average in other prefectures	-	201.3	1.05
1981			
Hyogo	33.1	3,667.7	0.69
Kyoto	10.9	2,390.2	0.67
Niigata	2.8	509.9	0.65
Average in other prefectures	-	455.9	0.58
2001			
Hyogo	32.8	2,880.1	0.57
Kyoto	13.8	2,290.7	0.63
Niigata	5.9	647.2	0.91
Average in other prefectures	-	298.8	0.70
2017			
Hyogo	32.7	2,353.9	0.56
Kyoto	15.1	1,792.1	0.63
Niigata	7.9	512.0	0.97
Average in other prefectures	-	182.4	0.86

Notes: a Real prices were calculated by deflating from the Consumer Price Index (Statistics Bureau of Japan 2017).

Sources: Kogyo Tokei Chosa-kekka Hokoku (1961-2017).

Table 2. Number of large and small/medium sake brewing firms in Hyogo and their average characteristics in selected years from 1959 to 1995

	1959	1963	1967	1977	1984	1995
Large firms[a]						
Average No. of firms[b]	7	7	7	7	8	8
Average year of establishment[c]	1920	1920	1920	1920	1927	1927
Average production (kl)[d]	-	8,362	11,804	18,271	21,969	22,668
Four-seasons brewing ratio (%)	0	14	71	100	100	100
Average No. of workers	-	-	-	499	458	445
Average sales revenue (million yen)	-	-	-	51,612	39,826	29,849
Average sales revenue per worker (million yen)	-	-	-	103.3	87	67.1
Small and medium firms[a]						
Average No. of firms[e]	110	125	146	121	90	83
Average year of establishment[c]	1921	1924	1925	1925	1926	1929
Average production (kl)[d]	-	578	719	1,041	1,150	1,046

Notes : a Firms that experienced production of 10,000 kiloliters or more were defined as large firms, and those that did not were defined as small and medium-sized firms. The data includes firms which factories are located in Hyogo but headquarters are located outside of the prefecture.

b All large firms are located in Nada district.

c Since most of the traditional firms are old and it is difficult to define the exact year of establishment, it is taken as the year of foundation.

d Production refers only to sake produced by themselves, which does not include the subcontracted amount. Therefore, it can be underestimated for large firms, while it is overestimated for small and medium-sized firms.

e Exclude those small and medium-sized firms whose year of establishment or production is unknown.

Sources: Zenkoku Jyozoka Meikan (1959-1995), Hyogoken Kojyo Meikan (1961-1995) and *Zenkoku Syokuhin-gaisha Meikan (1981-1999)*.

Table 3. Changes in the number of skilled workers and their real wage rate

	Number of skilled workers	Real wage rate per day (yen)[a]
1955	249	4,704
1960	287	5,951
1965	302	8,176
1970	265	13,453
1975	218	17,564
1980	164	17,086
1985	125	18,333
1990	117	20,087

Notes: a The real wage rate of skilled workers called *toji* is not fixed, but it should be set to 1.5 times that of their assistants according to the contract (Nada-gogo Syuzo Kumiai Chingin Kyoteisho 1970). Hence, we estimated wage rate of the *toji* based on that of their assistants. Real wage rate is calculated by deflating from the Consumer Price Index (Statistics Bureau of Japan 2017).

Sources: Nada-gogo Syuzo Kumiai Chingin Kyoteisho (1955-1990) and *Tanba Toji Meibo (1955-1990)*.

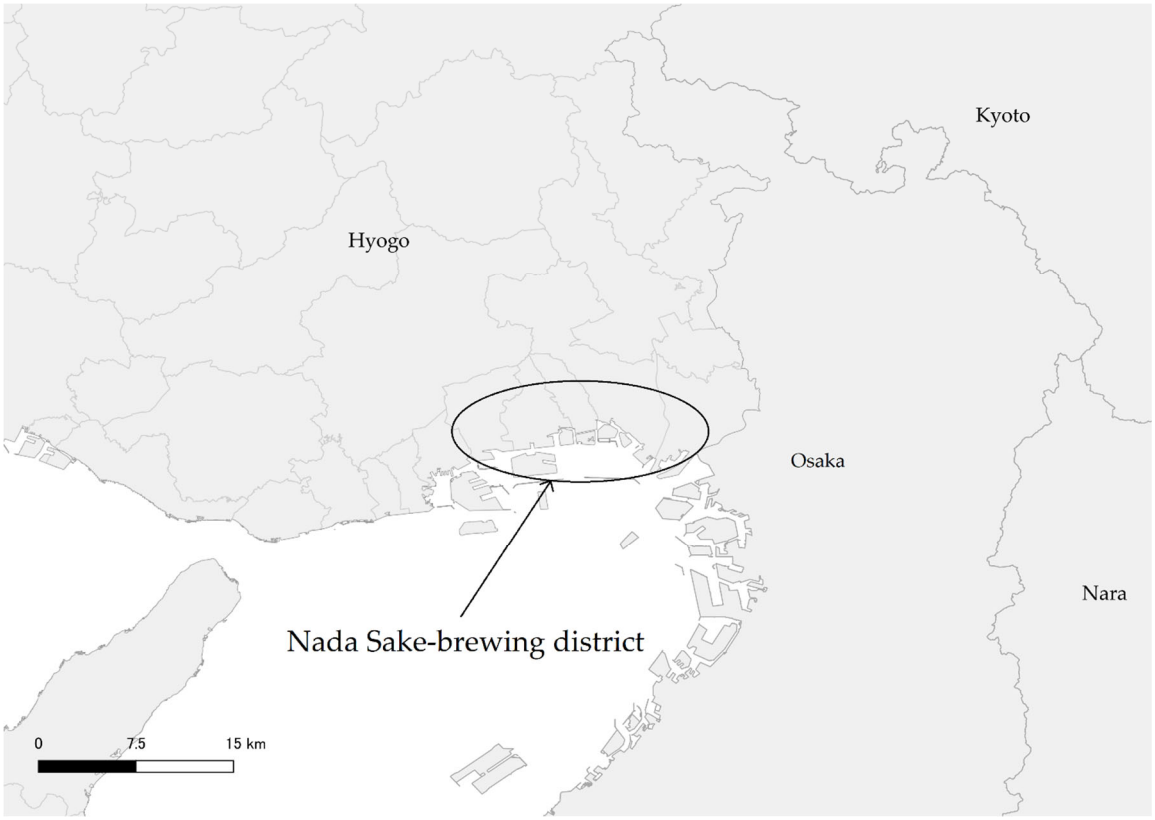

Figure 1. Map of Hyogo prefecture and Nada sake brewing districts

Notes and sources: This map is drawn based on the data from National Land Numerical Data, Ministry of Land, Infrastructure, Transport and Tourism. (https://nlftp.mlit.go.jp/index.html)

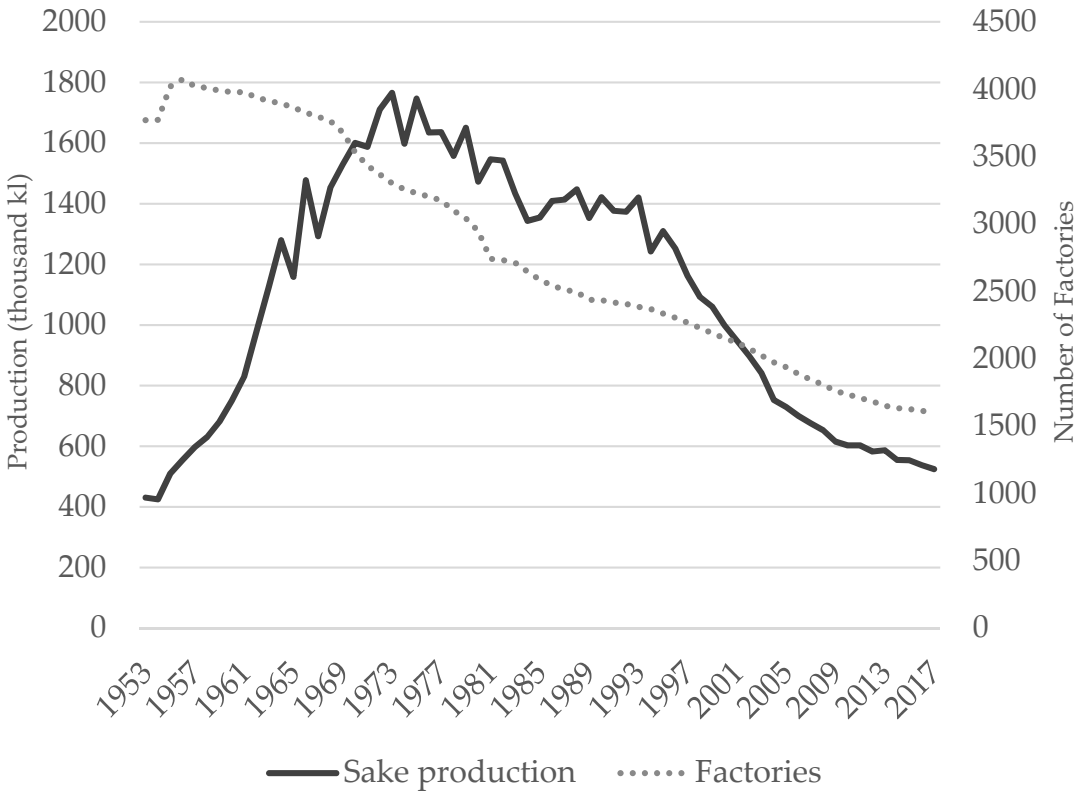

Figure 2. The number of sake factories and the quantity of sake production in Japan, 1953–2017

Notes: Production is measured by the shipment which refers to the quantity of sake that is finally bottled and shipped, including purchased sake.

Sources: *Kokuzeicho Tokeinenpo (1953-2017)*.

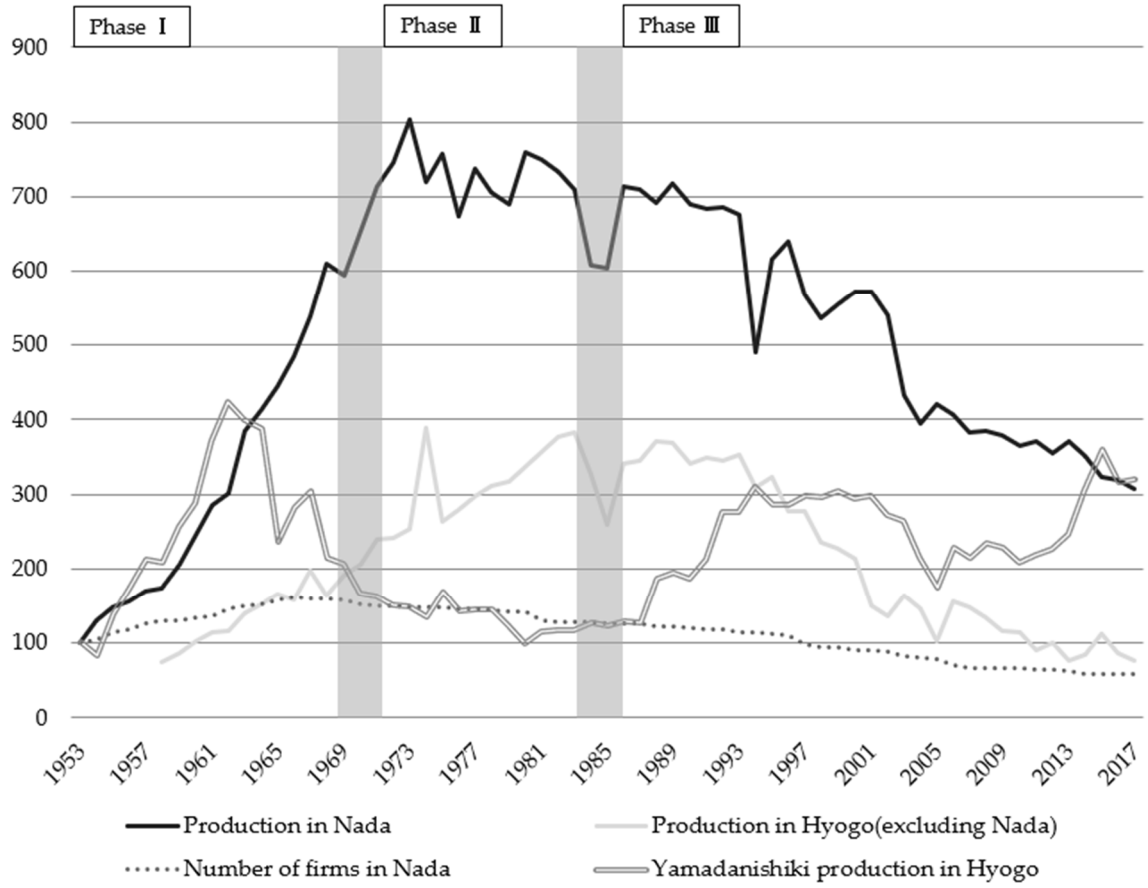

Figure 3. Indices of number of firms, production, and *Yamada-Nishiki* in Nada sake brewing district, 1953–2017 (1953 = 100)

Notes: All indices were set to 100 in 1953.

Sources: Nada-shu (1969), Zoku Nada-shu (1988), Kogyo Tokei Chosa-kekka Hokoku (1953-2017) and data provided by *Nada-gogo Sake Brewers' Association (1953-2017).*

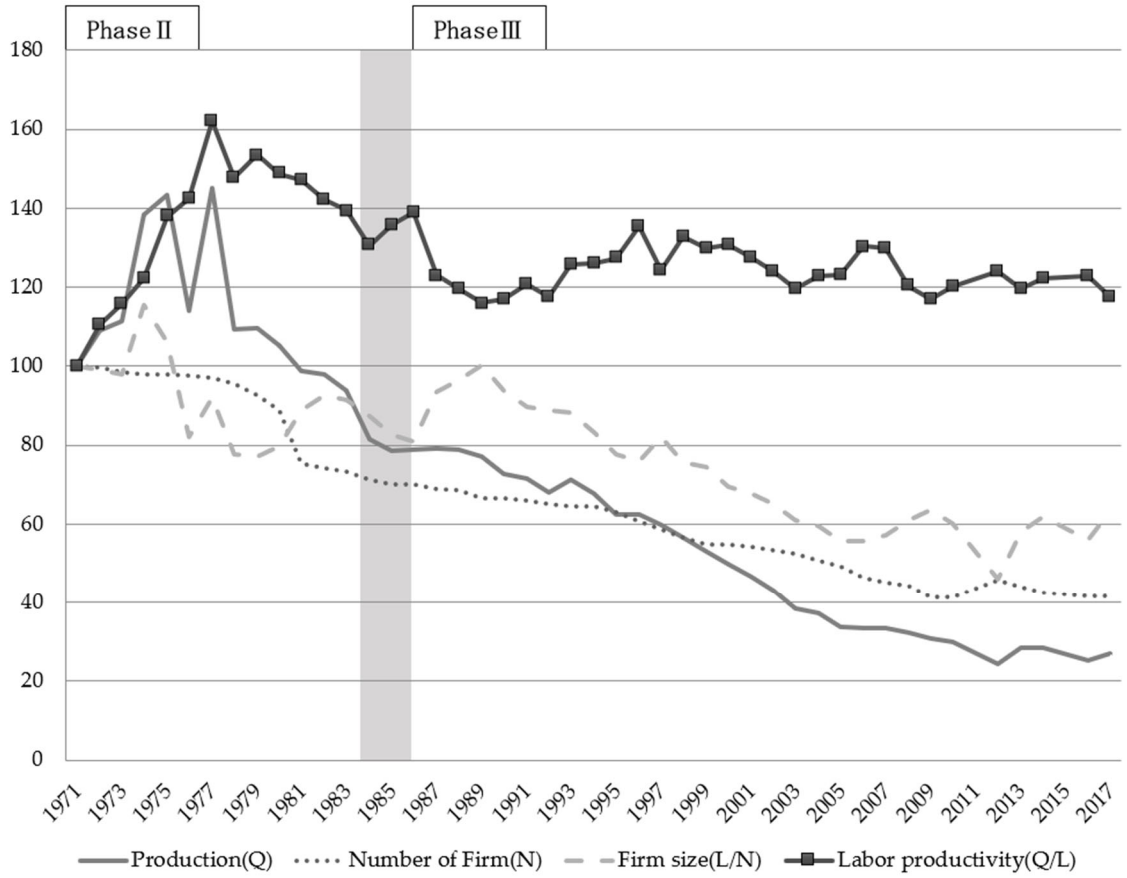

Figure 4. Indices of number of firms, production, firm size, and labor productivity in Hyogo, 1971–2017 (1971 = 100)

Notes: All indices were set to 100 in 1971.

Sources: Hyogo no Kogyo – Kogyo Tokei Chosa-kekka Hokoku (1953-2017).

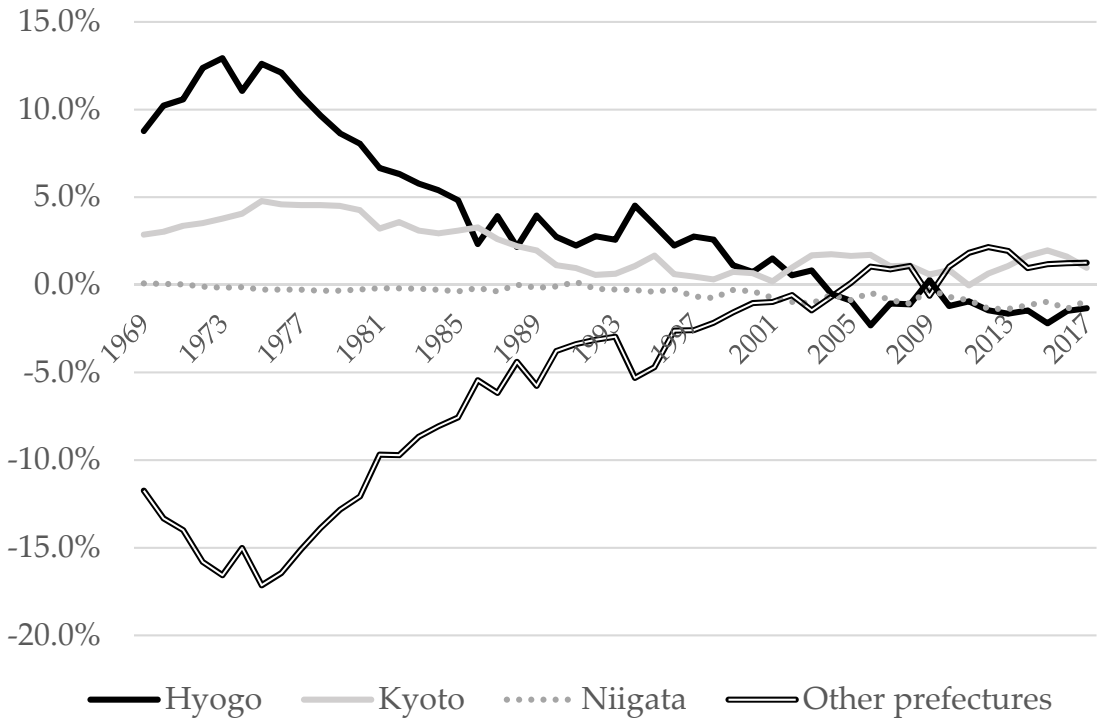

Figure 5. Changes in the ratio of subcontracting transactions in top three prefectures
Notes: (1) The ratio of subcontracting transactions is calculated by taking the difference between the market share of shipments and that of production, based on Ito (2000). (2) Shipments refer to the quantity of sake that is finally bottled and shipped, including purchased sake. In contrast, production refers to the quantity of sake, excluding purchased sake. Thus, the difference between the market share of shipments and that of production refers to the ratio of subcontracting transactions.
Sources: Kokuzeicho Tokeinenpo (1969-2017).

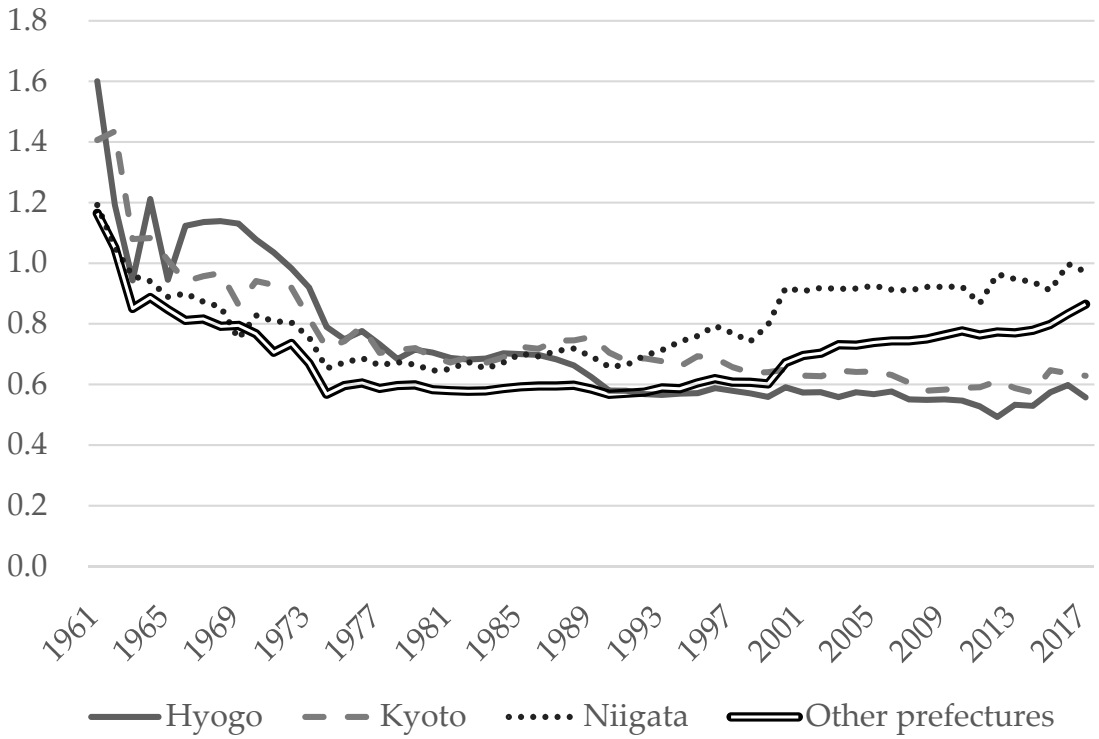

Figure 6. Changes in the real price of sake per kl in top three prefectures
Notes: (1) Prices are calculated by dividing the value of shipments by the quantity of shipments. (2) Shipments refer to the quantity of sake that is finally bottled and shipped, including purchased sake. (3) Real prices were calculated by deflating from the Consumer Price Index (Statistics Bureau of Japan 2017).
Sources: Kogyo Tokei Chosa-kekka Hokoku (1953-2017).