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Population, urbanisation and farm output in early modern Japan, 1600-1874: a review of data and benchmark estimates

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Abstract

The aim of this paper is to provide revised estimates of population totals, primary-sector output and urbanisation rates between 1600 and 1874 – covering the entire Tokugawa era plus the Tokugawa-Meiji transition period – with new benchmark years. Having checked previous estimates and data, both Tokugawa and early Meiji, on which those estimates were based, several revisions and improvements have been made. The new benchmark estimates of these indicators will serve as a good preparation for estimating historical national accounts of early modern Japan.

Population, the level of urbanisation and an indicator of output in the primary sector are the most fundamental set of variables required for the estimation of GDP per capita for any country in early modern times. Agriculture was the largest sector in almost all countries before the industrial revolution, while the proportion of people living in cities gives a clue to estimate the corresponding proportion of non-agricultural goods and services. Early modern Japan is one of the few countries for which usable data for benchmark estimates of these indicators are available. In the well-known estimates of pre-1870 GDP per capita in the world, for example, Angus Maddison based his estimation for Japan on population and farm output estimates for various benchmark years, available from previous studies which utilised official and other statistical data, together with his own – largely non-quantitative – assessment of performance in the non-farm sector derived from its indicators such as urbanisation and market growth (Maddison 2001, pp. 237, 254-58).

In this paper, we will go over the official and other statistical data and estimates made by scholars on the basis of those databases to check if any kind of improvements may be made. Checks will be made at regional levels, which will enable us to find odd or inconsistent changes from one sub-period to another in individual regional data series. The paper begins with the estimated population totals (and population densities) for the period between 1600 and 1874. Then we will turn to the estimates of farm output made by Satoru Nakamura (1968) and to data on which he based his estimation. Finally, we will explore the existing estimates of urbanisation rates since the proportion of people living in cities and large towns to the population total is one of the major criteria that have influenced the researcher's assessment of the overall performance of the non-farm sector in any early modern country.

1. Population

As far as population is concerned, 'reasonably firm evidence' is readily available from 1721, when the Tokugawa shogunate took the first national survey of commoner populations (see Maddison 2001, p. 237). The second survey was conducted five years later; then virtually the same survey was taken at the interval of six years until 1846. Samurai and imperial nobilities, on the one hand, and outcasts and outlaws, on the other, were not surveyed but their exclusion has been corrected on the basis of early-Meiji population data. The current synthesis is set out in Miyamoto (2004), p. 38, and its regional breakdowns in Kito (1996), pp. 74-77. Both series tabulate estimates not just for the post-1721 years but also

cover the period between 1600 and 1700, a period for which no reliable data exist. There are two competing estimates for 1600. One is Akira Hayami's estimate of 10-14 million (Hayami 2009, pp. 75-98; see also Hayami 2001, pp.43-46), while the other is a crude one made by Yoshida (1910) more than a century ago, i.e. 18 million, based on the supposition that one *koku* of rice-equivalents of grain output would support on average one person a year (for this measure, see below). The average of the former's high and low estimates, 12 million, has long been accepted by many historians, but there are revisionists who argue that Hayami's is too low. For example, having noted that 'Yoshida's reasoning was crude but seems more plausible than Hayami's', Maddison adopted the estimate of 18.5 million (Maddison 2001, p. 237). We too believe that the population total at the beginning of Tokugawa rule must have been not very different from the Yoshida-Maddison figure. Saito's unpublished estimate of 17 million (but quoted with other estimates in Farris 2006, p. 262), derived by changing a set of assumptions Hayami made while keeping his parameters as they are, tallies with what a newly constructed, long-run series of country-wide famines implies (see Saito 2015, pp. 221-23). We thus set the level of population in 1600 at 17 million, while other benchmark estimates for 1721, 1804 and 1846 from Kito (1996), pp. 74-77 and that for 1874 from Fukao et al. (2015), app. 2.[1] When population totals are to be converted to population densities, we use early-Meiji disaggregated area data recorded in the first volume of the *Statistical Yearbook*.[2]

Table 1 sets out our estimates of the country's population and population densities, 1600-1874, in a two-region format, which are compared with alternative estimates in figure 1. There are some seemingly noteworthy differences between these alternatives, but two of them – one between the Maddison and other estimates around 1720 and the other between the Hayami-Miyamoto and the Kito series in the mid-seventeenth century – are due primarily to the differing choice of benchmark years. The most substantial difference is the one found between the Saito-Takashima and Maddison estimates, on the one hand, and the Hayami-Miyamoto and Kito series with respect to the seventeenth century. While the latter imply a dramatically high average annual rate of population growth, 0.8%, the former suggest a more moderate increase in population, 0.5% per annum, over the century.

[1] Ezochi and Ryukyu (now Hokkaido and Okinawa prefectures) are excluded from the estimation for Tokugawa years; statistical data are scanty for those two regions in the Tokugawa period as they were neither under direct control of the shogunate nor of any daimyo government. The matching of provinces, prefectures and regions in Tokugawa and early Meiji settings is shown in appendix table 1.

[2] Areas in the *Statistical Yearbook* are recorded in square *ri*, which are converted into *chō* (1 square *ri* = 1,555 *chō* = 15.42 km^2).

[Insert Table 1 and figure 1 here]

2. Primary-sector output

For farm output, there is another set of 'reasonably firm' benchmark estimates although the degree of firmness may not be as high as for population in the 1721-1846 period. All the existing discussions about the levels of and trends in farm output during the Tokugawa period have been made in relation to the so-called *kokudaka* data. *Kokudaka* meant the amount of products of land expressed in rice-equivalents – barley, wheat, millet, beans, and even cash crops, if grown on a parcel of the surveyed land, were all included in this single measure of *koku* of rice. The assessment of *kokudaka* began with a cadastral survey initiated by the predecessor of the first Tokugawa shogun in the 1580s, followed by repeated efforts under Tokugawa rule in the seventeenth century. The 1645 survey is said to have been thorough and thus offered the first reliable assessment of *kokudaka* of the country. The *kokudaka* data, therefore, can be interpreted as aggregate farm output expressed in *koku* of rice. However, one problem with this *kokudaka* assessment is that *kokudaka* per unit of land tended to remain unchanged over time since the surveys were not frequently made. The estimation method proposed by Nakamura (1968) addressed this problem. Having assumed that data from the 1645 cadastral survey and those from early-Meiji *Nōsan-hyō* (Nationwide Surveys of Farm Products), 1877-79, are more or less reliable, he made a supposition that the three-year averages of the *Nōsan-hyō* data represented the situation at the end of the Tokugawa period, i.e. 1867. Then, he estimated output for the remaining benchmark years (1600, 1700, 1830 and 1867) by using information about the number of civil engineering projects on land improvement, on the one hand, and on the increase in *kokudaka*, on the other. In other words, if productivity gains were associated with those land improvement projects, then the revised *kokudaka* figures of the Nakamura estimates should be regarded as reflecting changes in farm output during the Tokugawa period (Nakamura 1968, pp. 169-71). Since then, Nakamura's revised *kokudaka* figures have been widely accepted as estimates of primary-sector products in the Tokugawa period (see for example Maddison 2001, p. 255).

However, there are a few shortcomings. One is his supposition that *Nōsan-hyō* data of the late 1870s reflected the situation ten years earlier. Given the timing that the Treaty ports were opened up

in 1859, this is a little unrealistic. In this paper, therefore, the end year of the period to be covered is extended to the 1870s and an 1874 government survey (*Fuken bussanhyō*), more comprehensive than the *Nōsan-hyō* surveys, is used. A second shortcoming is that Nakamura did not pay attention to the possibility of omissions and under-recordings in the civil-engineering project list, which can only be detected at regional levels. A third problem is that while Nakamura pointed out a possibility of under-estimation in his *Nōsan-hyō*-based *kokudaka* estimates, suggesting that the discrepancy could have been 25-30% (Nakamura 1968, pp. 118, 170), he did not properly address that question. Now it is recognised that the discrepancy was even greater than Nakamura assumed; and this strongly suggests that not only the gap between the *Nōsan-hyō* aggregate of primary-sector output and the official *kokudaka* value at the end of the Tokugawa regime would be allocated back to Tokugawa-era *kokudaka* estimates according to the changing number of productivity-augmenting land development projects, but all the revised *kokudaka* estimates should also be shifted up. What Nakamura suggested is that 1.25-1.3 would be a correction factor, but in our estimation, the upward revision is made by referring to the discrepancy between the independently derived estimate of primary-sector output for 1874 and the *Fuken bussanhyō* aggregate: the correction factor we have adopted is 1.56 for the whole country, 1.61 for the East and 1.54 for the west (Fukao et al. 2015, table A1.5, p. 236).

The revised *kokudaka* series are therefore calculated for 14 regions, at which comparison is made with the estimates of value added derived from Fukao et al. (2015, app. 2), so that data corrections can be made in each regional context. Aggregation is made first with respect to eastern and western Japan, then to the whole country (for details of the estimation procedures, see Fukao et al. 2015, pp. 232-39). Finally, the *kokudaka* estimates thus modified are linked to the primary sector's value added at the beginning of the post-Meiji Restoration series (see Fukao et al. 2015, appendix A1.3).

Table 2 shows alternative estimates of primary-sector output, 1600-1874, in both *kokudaka* and 1990 international dollars and with two-region breakdowns. Clearly our new estimates come well above the levels of the previous estimates, but the average annual growth rate over the entire period does not differ significantly. According to the revised *kokudaka* series it was 0.32% for the 1600-1872 period, while our estimates imply a marginally higher growth rate, i.e. 0.34%, for the 1600-1874 period.

[Insert Table 2 and figure 2 here]

3. Urbanisation rate

Although some serious effort has been made to compile urban population statistics, there is no consensus concerting the levels of urbanisation and its trends in the Tokugawa period. The oft-quoted compilation of urban population is probably Seiji Saito (1984)'s, but his estimated rates of urbanisation exhibit a downward tendency from 1650 to 1850: 17.0% in 1650, 13.6% in 1750 and 12.2% in 1850. His effort to collect urban population figures for individual cities and towns is invaluable but there are a few reasons to believe that his conclusion cannot be tenable as it is. First, the high estimate for 1650, 17%, is undoubtedly due to the adoption of a too small national population total for 1600 (see section 1 above). Second, even the estimate of 13.6% for 1750 appears a little too high. Third, his criterion to select Tokugawa-era urban settlements is that the number of people living in the settlement was 10,000 or more in an 1978 published statistics, *Kyōbu seihyō* (Munitions and Mobilisation Statistics) compiled by the Department of the Army General Staff, which gives him a total of 64, representing 65% of 99 settlements he identified as having a population over 10,000 in 1878. His 'urban population' refers to the sum of population totals of the 64, but a cursory look at the table reveals that in each benchmark year there is a non-negligible number of settlements of less-than-10,000 population. In fact, the number of such settlements decreased from 19 in 1650 to 2 in 1850, which affects a trend in the estimated rate of urbanisation. Fourth, the sample represents only 65% of the 99. In order to inflate the results from the 65% sample, he applied a ratio of the total urban population for the 99 to that of the selected 64 in 1878. This implies that the population of the unknown 35 changed at the same rate of the known 64. However, all the unknown are small- and medium-sized cities and towns and it is not justifiable to assume that the small- and medium-sized behaved just like Edo or Osaka.

Given these problems, we have employed an extrapolation method based on region-specific growth rates of non-metropolitan urban population derived from the 64-town dataset. Our Meiji benchmark year is 1874, not 1878. We thus set 1873 as the starting point because a topographical book (*Nihon chishi teiyō*) gives us data for individual settlements. In that year, cities and towns with a population of 10,000 or over numbered 103. They are divided into 12 regional groupings used in Saito (1984)'s table (the 12 are Hokkaido, East Tōhoku, West Tōhoku, East Kantō, West Kantō,

Hokuriku, Tōsan, Tōkai, Kinki, San'in, Sanyō, Shikoku and Kyūsū). Each urban population is projected back by using the corresponding region's rate of urban population growth calculated from non-metropolitan population estimates reported in Saito (1984). In other words, Edo, Nagoya, Kyoto, and Osaka are excluded from this calculation.[3]

There are two modifications to the data from the 1873 topographical book. First, there are 12 towns whose reported population figures are dubious (they are Noshiro, Kawagoe, Kiryū, Ashikaga, Takefu, Shibata, Takada, Kōfu, Gifu, Ōgaki, Kōchi, and Nagasaki). In those cases, an adjustment is made by using the growth rate between 1850 and 1878. Second, many entries for Satsuma province exhibit implausibly large population figures. Since it is likely that districts' populations were listed as far as Satsuma is concerned, all entries except that for Kagoshima are excluded from the calculation.

All this enables us to go back to the Tokugawa period to select cities and towns with a population over 10,000 for each benchmark year. Since Seiji Saito worked with only three benchmark years, 1650, 1750 and 1850, estimates for three of our four benchmark years, 1721, 1804 and 1846 may be interpolated from the 1650, 1750 and 1850 figures. To estimate the 1600 percentage, previous estimates for cities in the pre-1600 period as well as in the very early years of the seventeenth century are consulted, and interpolation is made with the data for 1650. The number of cities thus identified is 16 for 1600, 91 for 1721, 97 for 1804, 99 for 1846, and 104 for 1874.

[Insert Table 3 and figure 3 here]

The results are set out in table 3 and figure 3, together with Seiji Saito's previous estimates. The pattern of change derived from our estimates, markedly different from Seiji Saito's, is consistent with the historiography of Tokugawa economic history (see Smith 1973; Saito 1983; Shimbo and Saito 2004). The seventeenth century was a period of town building with the proportion of people living in settlements of over 10,000 doubled from the level of 6%. The eighteenth saw this urban growth coming to an end, while in the nineteenth the metropolitan and castle-town sector was challenged by the rise of country towns with the urbanisation rate falling by 2-3 percentage points towards the end of the period.

[3] No comprehensive check was made with the entries in Saito (1984)'s table, but Edo's population has been revised for this exercise. For details, see appendix 2.

Table 1. Estimates of population and population density, 1600-1874

A. Population, 1600-1874

(1,000 persons)

	1600	1721	1804	1846	1874
The east	---	11,475	10,156	10,480	11,428
The west (incl. central)	---	19,815	20,536	21,732	23,088
Japan	17,000	31,290	30,691	32,212	34,516

Notes and sources: See text.

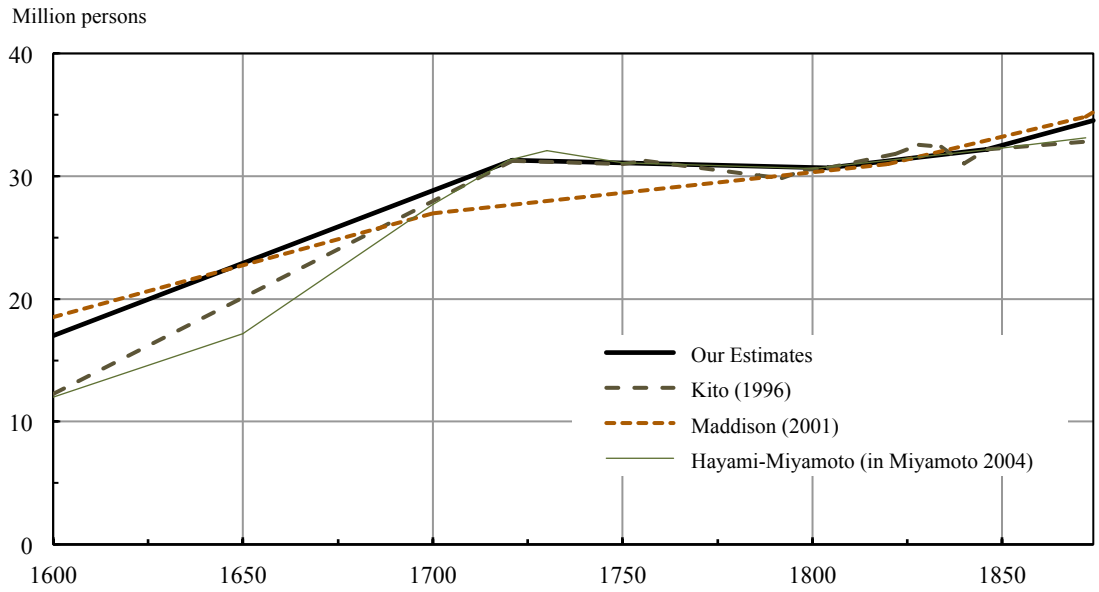
B. Population density, 1600-1874

(density per *chō*)

	1600	1721	1804	1846	1874
The east	---	0.83	0.73	0.75	0.82
The west (incl. central)	---	1.33	1.38	1.46	1.55
Japan	0.59	1.09	1.06	1.12	1.20

Notes and sources: Population densities are calculated by dividing various population estimates shown in table 1.A by the area recorded in the first volume of the statistical yearbook (*Nihon Teikoku tōkei nenkan*).

Figure 1. Alternative estimates of population, 1600-1874



Sources: Table 1, Kito (1996), pp. 74-77, Maddison (2001), p. 255, and Miyamoto (2004), p. 38.

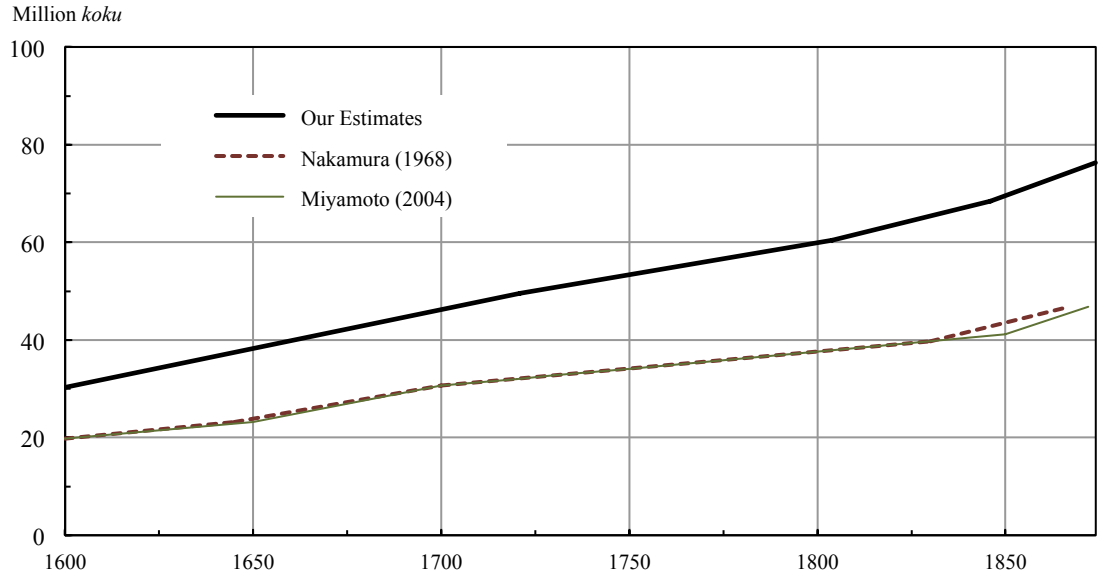
Table 2. Primary-sector output, 1600-1874

(1,000 *koku*)

	1600	1721	1804	1846	1874
The east	9,908	17,158	20,700	23,306	25,903
The west (incl. central)	20,334	32,455	39,795	45,183	50,448
Japan	30,243	49,613	60,495	68,489	76,351

Notes and sources: See text.

Figure 2. Alternative estimates of primary-sector output, 1600-1874



Notes: Miyamoto (2004) used Nakamura (1968)'s 1867 figure for 1872 because Nakamura's figure for 1867 was originally the average value of agricultural output for 1877-79.

Sources: Table 2, Nakamura (1968), p. 170 and Miyamoto (2004), p. 38.

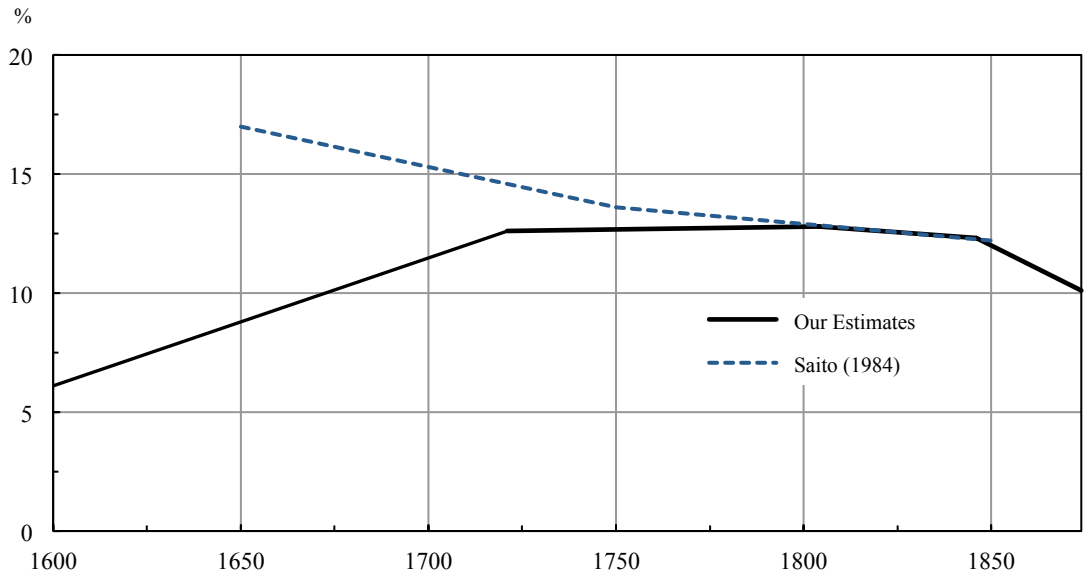
Table 3. Urbanisation rates, 1600-1874

(%)

	1600	1721	1804	1846	1874
The east	---	14.0	15.9	16.2	10.4
The west (incl. central)	---	11.8	11.3	10.4	9.9
Japan	6.1	12.6	12.8	12.3	10.1

Notes and sources: See text.

Figure 3. Alternative estimates of urbanisation rates, 1600-1874



Note: Saito (1984)'s urbanisation rate estimates include Ezochi and Ryūkyū (now Hokkaido and Okinawa prefectures).

Sources: Table 4 and Saito (1984), p. 53.

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Appendix

Appendix 1.

Regional division in Tokugawa and early Meiji Japan

The geographical division during Tokugawa and early Meiji Japan was different compared with current division into 47 prefectures. Tokugawa Japan consisted of around 70 *kuni* (old provinces). After the Meiji Restoration, Japanese regional division was reorganised into the prefectural system with three *fu* (metropolitan prefectures) and 306 *ken* (prefectures) as a result of the abolition of feudal domains and the establishment of prefectures in 1871. In 1874, the last benchmark year, prefectures were merged into three *fu* and 61 *ken*. In most regions the boundaries changed during the transition from *kuni* to prefectures, although the extent of these changes differs. The correspondence between *kuni*, prefectures, and regions in Tokugawa and early Meiji Japan is shown in table A.1.

Table A.1. Regional division in Tokugawa and early Meiji Japan

Region			Tokugawa-period provinces	Early-Meiji prefectures in 1874	Current prefectures
1	Eastern Japan	East Tohoku	Mutsu (Rikuo, Rikuchu, Rikuzen, Iwashiro, Iwaki)	Aomori, Iwate, Miyagi, Mizusawa, Fukushima, Iwamae, Wakamatsu	Aomori, Iwate, Miyagi, Fukushima
2		West Tohoku	Dewa (Uzen, Ugo)	Akita, Yamagata, Sakata, Okitama	Akita, Yamagata
3		North Kanto	Hitachi, Kozuke, Shimotsuke	Ibaraki, Tochigi, Niihari (partial), Kumagaya (partial)	Ibaraki, Tochigi, Gunma
4		South Kanto	Musashi, Sagami, Kazusa, Shimosa, Awa	Tokyo, Saitama, Chiba, Niihari (partial), Kumagaya (partial), Kanagawa, Ashigara	Tokyo, Saitama, Chiba, Kanagawa
5		Tosan	Kai, Shinano, Hida	Yamanashi, Nagano, Chikuma, Gifu (partial)	Yamanashi, Nagano, Gifu (partial)
6	Central Japan	Niigata / Hokuriku	Sado, Echigo, Etchu, Noto, Kaga, Echizen, Wakasa	Niigata, Aikawa, Niikawa, Ishikawa, Tsuruga	Niigata, Toyama, Ishikawa, Fukui
7		Tokai	Izu, Suruga, Totomi, Mikawa, Owari, Mino	Hamamatsu, Shizuoka, Aichi, Gifu (partial)	Shizuoka, Aichi, Gifu (partial)
8	Western Japan	Kinai	Yamashiro, Yamato, Izumi, Kawachi, Settsu	Kyoto, Osaka, Nara, Hyogo, Sakai	Kyoto (partial), Osaka, Nara, Hyogo (partial)
9		Around Kinai	Omi, Iga, Ise, Shima, Kii, Harima, Awaji, Tanba, Tango, Tajima	Shiga, Mie, Watarai, Shikama, Toyooka, Wakayama, Myodo (partial)	Kyoto (partial), Shiga, Mie, Wakayama, Hyogo (partial)
10		Sanin	Inaba, Hoki, Izumo, Iwami, Oki	Tottori, Shimane, Hamada	Tottori, Shimane
11		Sanyo	Mimasaka, Bizen, Bitchu, Bingo, Aki, Suo, Nagato	Hokujo, Okayama, Oda, Hiroshima, Yamaguchi	Okayama, Hiroshima, Yamaguchi
12		Shikoku	Awa, Sanuki, Iyo, Tosa	Myodo (partial), Ehime. Kochi	Kagawa, Tokushima, Ehime, Kochi
13		North Kyushu	Chikuzen, Chikugo, Hizen, Iki, Tsushima, Buzen, Bungo	Fukuoka, Mizuma, Kokura, Saga, Nagasaki, Oita	Fukuoka, Saga, Nagasaki, Oita
14		South Kyushu	Higo, Hyuga, Osumi, Satsuma	Shirakawa, Miyazaki, Kagoshima	Kumamoto, Miyazaki, Kagoshima

Notes: Details on boundary changes associated with the transition from provinces (*kuni*) to prefectures are from the *Kyōbu Seihyō* [Munitions and Mobilisation Statistics] compiled by the Rikugun Sanbōkyoku [Department of the Army General Staff] in 1875, from the *Dai-Nihon fuken bunkatsuzu* [Japan's Prefectural Arrangements of Administrative Units] compiled by the *Naimushō Chirikyoku* [Geography Bureau at the Ministry of Home Affairs] in 1881, and from the diagrams in Fujiwara (1964).

Appendix 2.

Edo's population

Surveys of population taken by the shogunate only tell us about commoners living in Edo's town, shrine and temple areas: their population totals are available from Koda (1972), Minami (1978) and *Suijinroku*, a document collection of the Tokugawa shogunate compiled by a former Tokugawa government official, Katsu Kaishū, in the Meiji period. The populations of samurai, migrant workers, Shinto priests, Buddhist monks, and residents in Shin-yoshiwara (licensed pleasure district) were not officially covered by the surveys.

In this paper, the missing population is estimated by using previous studies and various pieces of fragmentary evidence. The population of Shinto priests and Buddhist monks are recorded as a population outside the boundaries of town place in the surveys of townspeople. The number of people in the Yoshiwara quarters is estimated from figures in *Suijinroku* and guides to Yoshiwara (*Yoshiwara saiken*) which list the names of individual *geisha*, both from Nishiyama and Yamashiro (1975) and Yamashiro (1976). For migrant workers, information is taken from the works of Koda (1972), Minami (1978), and various primary sources.

For samurai's population, there are estimates by Sekiyama (1957). His estimates were made by dividing the samurai class into four categories; (1) Direct retainers of the Tokugawa shogunate (*hatamoto* and *gokenin*) and their family members and vassals, (2) Samurai from each *han*, stationed in Edo permanently or temporarily in accordance with the requirements of the alternate attendance (*sankin kōtai*) system, (3) Servants and unskilled workers who belonged to the Houses of Tokugawa, daimyo, and *hatamato*, and (4) Masterless samurai. However, Sekiyama's way of estimating the samurai's family members is crude while his estimation of the number of temporarily residing samurai seems to reflect the situation only in the early eighteenth century. Undoubtedly there remains room for fine tuning.

Having set the number of direct retainers and their vassals at 23,000 and 100,000 respectively during the Tokugawa period, estimates of their family members are made by referring to the average family size derived from the actual data provided by Murakoshi (2009, 2011). For samurai stationed in Edo, the population of the permanent-resident group is said, according to Sekiyama (1957), to have been 30,000 during the Tokugawa period. Their family members are estimated by multiplying the same family size as adopted above to the number of direct retainers. The number of temporarily

residing samurai was also 30,000 according to Sekiyama's estimates, but this refers only to the first half of the eighteenth century. Estimates for other periods are made by referring to the findings from Saito (2014)'s study of alternate-attendance travellers by period. Finally, the number of servants and unskilled workers in the Tokugawa, daimyo, and *hatamato* households, and that of masterless samurai is 100,000 and 20,000 respectively throughout the Tokugawa period, as Sekiyama (1957) suggested.

The results of our estimation are set out in the table A.2.

Table A.2. Alternative estimates of population in Edo, 1600-1878

(1,000 persons)

	Saito (1984)	Our Estimates
1600		60
1650	430	
1721		1,138.5
1750	1,220	
1804		1,076.5
1846		1,137.8
1850	1,150	
1874		593.8
1878	671.3	

Notes and sources: The first column is from Saito (1984), p. 61. For the second, population estimates in 1600 and 1874 are taken from Chandler (1987) and Inoue (1875) respectively. 1721 and 1804 are aggregated figure of the population in each class. 1846 is linearly interpolated between 1845 and 1849.

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