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Rice Price, Grain Wages of Carpenters, and Skill Premium in Kyoto ca. 1260-1600 A Comparison with London, Florence, Istanbul, and Cairo

Jean-Pascal Bassino[a], Kyoji Fukao[b], and Masanori Takashima[c]

Japan is a country made up of various islands and divided into 66 kingdoms… The people are white and cultured; even the common folk and peasants are well brought up and so remarkably polite that they give the impression they were trained at court. In this respect they are not only superior to other Eastern peoples but also to Europeans as well. They are very capable and intelligent, and the children are quick to grasp our lessons and instructions. They learn to read and write our language far more quickly than the children in Europe. The lower classes in Japan are not so coarse and ignorant as those in Europe; on the contrary, they are generally intelligent, well brought up and quick to learn.

Some parts of the country are well supplied with rice, the staple diet, and some wheat is also grown; other regions are barren and hilly. On the whole, Japan is one of the poorest and most barren countries in all the Orient.

Alessandro Valignano, *Historia del Principio y Progresso de la Compania de Jesus en las Indias Orientales, 1542-1564*.[1]

I. Introduction

How poor and unequal was Japan before the Tokugawa period (1603-1868)? European visitors of the 16th century[2] such as Alessandro Valignano[3] describe the country as one the poorest in Asia, but also suggest that literacy was at least comparable to European levels (admittedly still

[a] Associate Professor of Economics, University of Montpellier III, and Associate Research Fellow, Institute of Economic Research, Hitotsubashi University; corresponding author. E-mail: jpbassino@gmail.com
[b] Professor of Economics, Institute of Economic Research, Hitotsubashi University. E-mail: k.fukao@srv.cc.hit-u.ac.jp
[c] Research Fellow, Institute of Economic Research, Hitotsubashi University. E-mail: macha.takashima@gmail.com
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[1] *English translation: Copper (1965, 4).*
[2] The very first ones were Portuguese merchants who arrived in 1542 on Tanegashima, a small island off Kyushu. They were followed by the Jesuits missionaries, including Francis Xavier, one of the founders of the Company of Jesus (*Societas Iesu*), in 1549.
[3] Alessandro Valignano (Chieti, Italy, 1539 - Macao, China, 1606), doctor in law from the University of Padova (Italy). He joined the Company of Jesus in 1566, studied philosophy and theology in Rome, and became priest in 1570. In 1573, he was appointed Superior General of Jesuit missions in the East Indies (India, China, and Japan) answerable only to Jesuit Superior General in Rome. He visited Japan in 1579-1582, 1590-1592, and 1598-1603 (Braga 1942).

low at that time), and that income inequality was not particularly high. This picture is fascinating as it reminds us of what was perceived by Western observers of Meiji Japan as the paradox of high literacy and social cohesion amid poverty, a distinctive feature that was later regarded as a major explanation for the Japanese economic miracle of the 20th century.

Unfortunately, Jesuit reports provide little quantitative evidence regarding the Japanese living standards of the time; therefore, we should consider with caution a description by a high rank Jesuit of an exotic country in which people are poor in the material sense but rich in the spiritual one. Apart from being a rhetoric figure highlighting the potential for expansion of Christianity in Japan, it was also aimed at persuading the Jesuit hierarchy to send financial resource to the Japanese missions (Moran 1993, 128-144). What we know with certainty is that Japan experienced a long period of peace under the rule of Tokugawa shogunate[4] that is generally regarded as a period of regional integration, specialisation in economic activities, and relative prosperity. The sophistication of market mechanisms and the blossoming of various forms of art suggest a high level of human capital accumulation, and a remarkable quality of life.

However, the Euro-Asian comparison of living standards in the 18th and 19th century, based on the calculation of welfare ratio, equivalent to those measured for European urban workers by Allen (2001), indicates that the real wages of Japanese unskilled workers were barely equivalent to the lowest European levels (Bassino and Ma 2005) and broadly similar to those observed in China (Allen et al. 2007). Considering that population roughly doubled during the 17th century and stagnated afterward, it is worth investigating whether Japan fell, in the late 17th or early 18th century, into a Malthusian high level equilibrium trap akin to the one described for early modern China by Elvin (1973). The alternative explanation would be that Japanese living standards were already low in the pre-modern period.

In order to assess living standards and inequality among urban commoners in pre-modern Japan, we measure the purchasing power of wage earners in Kyoto and estimate the magnitude of the skill premium. Low levels of inequality in human earnings can be regarded as indicative of comparatively high levels of human capital accumulation. Data reported by Saito (1978, 2005) suggests Japanese urban carpenters earners more than 4 times more than unskilled workers in the early 18th century, which is much higher the European standards of the time.[5] Without better quantitative evidence, one cannot know whether the situation was similar in the earlier centuries. This paper presents a first attempt to construct historical series of purchasing power of carpenters and other urban workers in pre-modern Kyoto. We have assembled available information for the Kamakura (鎌倉), Kenmu restoration (建武の新政), Muromachi (室町), and Azuchi-Momoyama (安土桃山) periods (1185-1333, 1333-1336, 1336-1575, 1573-1603, respectively) compiled by Japanese historians.

We concentrate on the period 1260-1603 during which well-documented institutional and technological changes occurred. We focus on living standards in Kyoto that was by far the largest city, and the seat of the imperial court and of major religious institutions. As such, it had the main concentration of craftsmen, particularly carpenters working on temples, imperial palaces, and estates of aristocrats. Kyoto was home to about 100,000 people around 1280 (Farris 2006, 27) and perhaps 200,000 in 1450 (ibid 151).[6] It was also the major urban market for foodstuffs (rice, other grains, and dried fish in particular), and cottage industry items such as clothes, Japanese paper (washi 和紙), and ceramics.

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[4] Actually, only after the suppression of the *Shimabara* rebellion (島原の乱) of 1636-1637, in southern Kyushu following the implementation of seclusion (*sakoku* 鎖国) policy that included the restrictions on foreign trade, except with China, Korea, the Kingdom of the Ryukyu, or via the Dutch traders, and the prohibition of Christianity (seclusion edict of 1635).

[5] 1.3 to 1.8 in most European cities in the second half of the 17th century (Zanden 2009, Table 1, 127).

[6] Urban population accounted for 3 percent of total population around 1280 (Farris 2006; 26, 86, 151), the same percentage in 1450 (Ibid. 98) and 5 percent 1600 (ibid. 245). By 1600, Japan was one of the most urbanized countries in the world, with a network of at least 321 cities, of which 202 appeared after 1450; 67 arose as political centres, 51 developed from temples or shrines, 47 were post stations, 26 were ports, and 11 were markets towns (Farris 2006, 245).

The remainder of this paper begins with a reconstruction of unit prices series of rice in Kyoto, based on values in copper coins recorded by major Buddhist temples in and around Kyoto, and in other neighbouring provinces. We then use information on the labour rewards that the same institutions paid in copper (or in rice) to carpenters and other wage earners in and around Kyoto, to estimate nominal daily wages series for Kyoto, and to measure the skill premium. Finally, we calculate grain wages in Kyoto and cast these indicators of living standards and income inequality in international perspective by relying on available estimates for London and Florence, as well as some information for Istanbul and Cairo.

II. Climate variations, technical change, population growth, warfare, and rice price in Kyoto

The Kyoto rice price depended heavily on supplies of rice, the main staple food in urban areas, from neighbouring provinces. Due to high transportation costs, most of the rice originated from areas located at a distance of less than 200 km.[7] Irrigated rice cultivation techniques were among the most advanced of Japan in the Kinai region.[8] Nevertheless, the capital experienced recurrent difficulties in food provision due to crop failures in the Kinai, caused mostly by drought.[9] In these circumstances, many residents of the capital fled to the surrounding mountains in search of emergency food. Kyoto's food provision improved gradually from the late 13th century. In 1440-42, for the first time in history, migrants moved into Kyoto "begging through the city and assembling in wealthy *zen* temples" (Farris 2006, 111).

In appears that an improvement of agricultural techniques, associated with a decline in the prevalence of famines, and a rise of living standard occurred after 1250, particularly during the period 1370-1450 that Farris (2006) describes as "Muromachi optimum" (Ibid, 101). Kito (1996, 2000) estimates that Japan's total population increased from about 6.8 millions around 1150 to 12.2 in 1600, and that demographic growth was particularly strong in the Kinai region during the same period, from around 0.5 to 2.3 millions. This implies that Japanese food supply increased more smoothly and rapidly than population as a result of the diffusion of improvement of irrigation techniques for paddy fields and the diffusion of double cropping (rice in summer and wheat or barley in winter). Although population growth continued during the period 1450-1600, the higher prevalence of famines suggests that living standards may have declined, particularly during the 16th century due to warfare among the domains lords (*daimyo*) and local warlords.

In order to assess the impact of climate variations on rice price, we can rely on information recorded by the *Toji* (東寺) Buddhist temple, a major religious institution in Kyoto, collected by Momose (1959). Two series of unit prices are combined in Figure 1. The first one is the unit-price of rice delivered to Toji Temple in Kyoto (series labelled Yamashiro-Toji) covering most of the period 1365-1544, with some gaps in the early 15th century. To fill the gaps and check the consistency of the data, this series are combined with price recorded in Yano-sho (矢野庄), a rice estate owned by Toji temple and located in Harima province (number 27 on the map) that covers most of the period 1403-1460 (series labelled as Yano-Harima). Harima province was a major supplier of rice consumed in Kyoto. Some of the spikes observed on the series can be related to widespread famine that occurred in 1428, 1437, 1460, 1511, 1519; other spikes could be related to local famines in 1393, 1412, 1423, 1482-83, 1485, 1491, 1526-30, and 1538 (Farris 2006, 106-107, 175-176).

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[7] Other grains consumed included barley, wheat, millet, buckwheat, red beans (azuki 小豆), and soybeans. Grains other grains than red beans and soybeans were cheap substitute used as staples by lower income households and were traded at some distance only in time of famine.

[8] This area includes the provinces of Yamashiro (the province of Kyoto), Settsu, Izumi, Kawachi, and Yamato (numbered 38, 33, 34, 35, 37 on the map, respectively).

[9] 21 years of widespread famine are recorded between 1150 and 1250 (Farris 2006, 59). The frequency of famines is also certainly explained by high transportation costs that hindered the shipment of grain from surplus to deficit regions.

The rice price in Yamashiro is measured in copper coins (*mon*) per *gegyo-masu* (下行枡), a volume unit used when providing rice and other supplies to dependents (equivalent to one *sho,* about 1.2 liter). The rice price in Harima was measured using *kuden-masu* (公田枡), a standard measure of volume used by producers in those periods. We converted all unit-prices in *gegyo-masu* with at a ratio of 0.75 *kuden-masu* per *gegyo-masu*. As expected, prices were lower in Harima, a region with a structural exportable surplus, than in Yamashiro, a province with a structural deficit due to the presence of Kyoto. The comparison for the years for which both Harima and Yamashiro prices are available indicates that rice price in Yamashiro was 71 percent higher than in Harima, on average. Since the standard deviation of price gaps relative to the mean value is only 0.18, it appears acceptable to multiply by 1.71 price data recorded in Harima for generating data missing for Yamashiro; this composite *Toji-Yano* (TY) series is the first step toward the reconstruction of Kyoto rice price series.

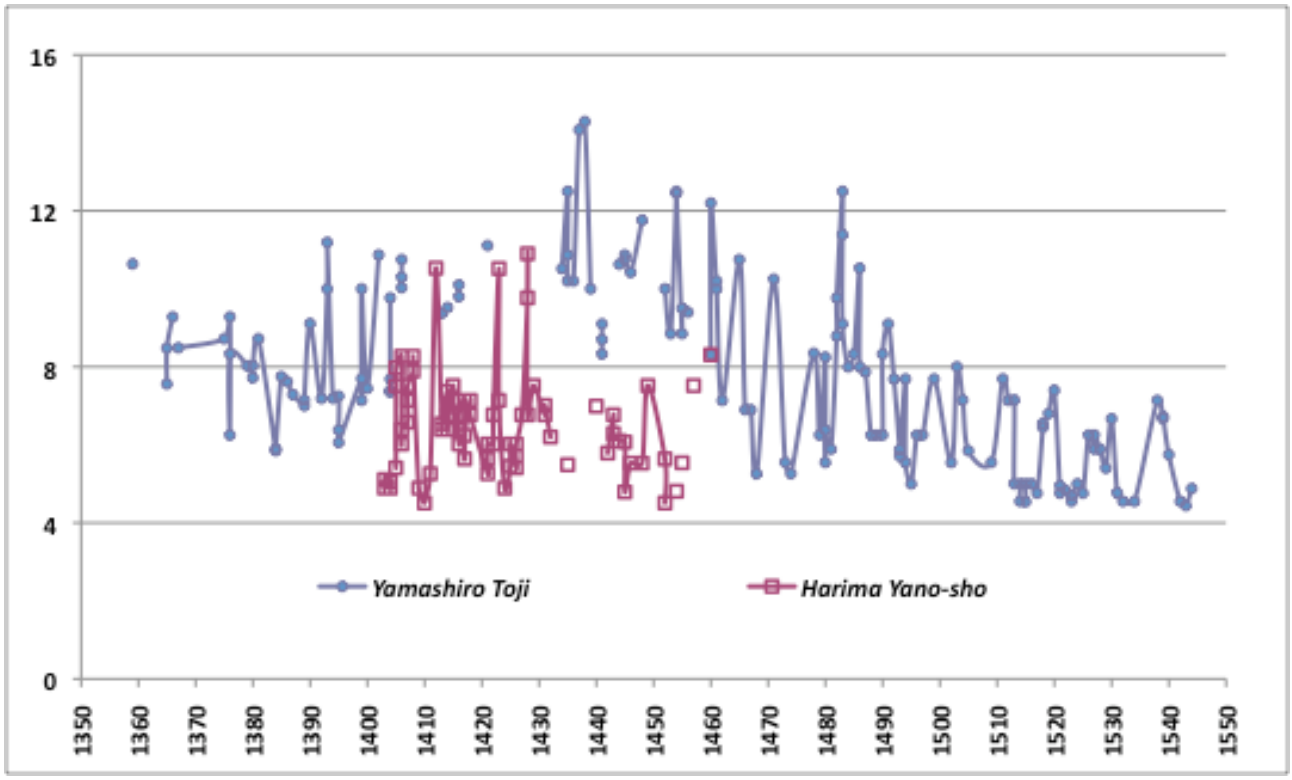
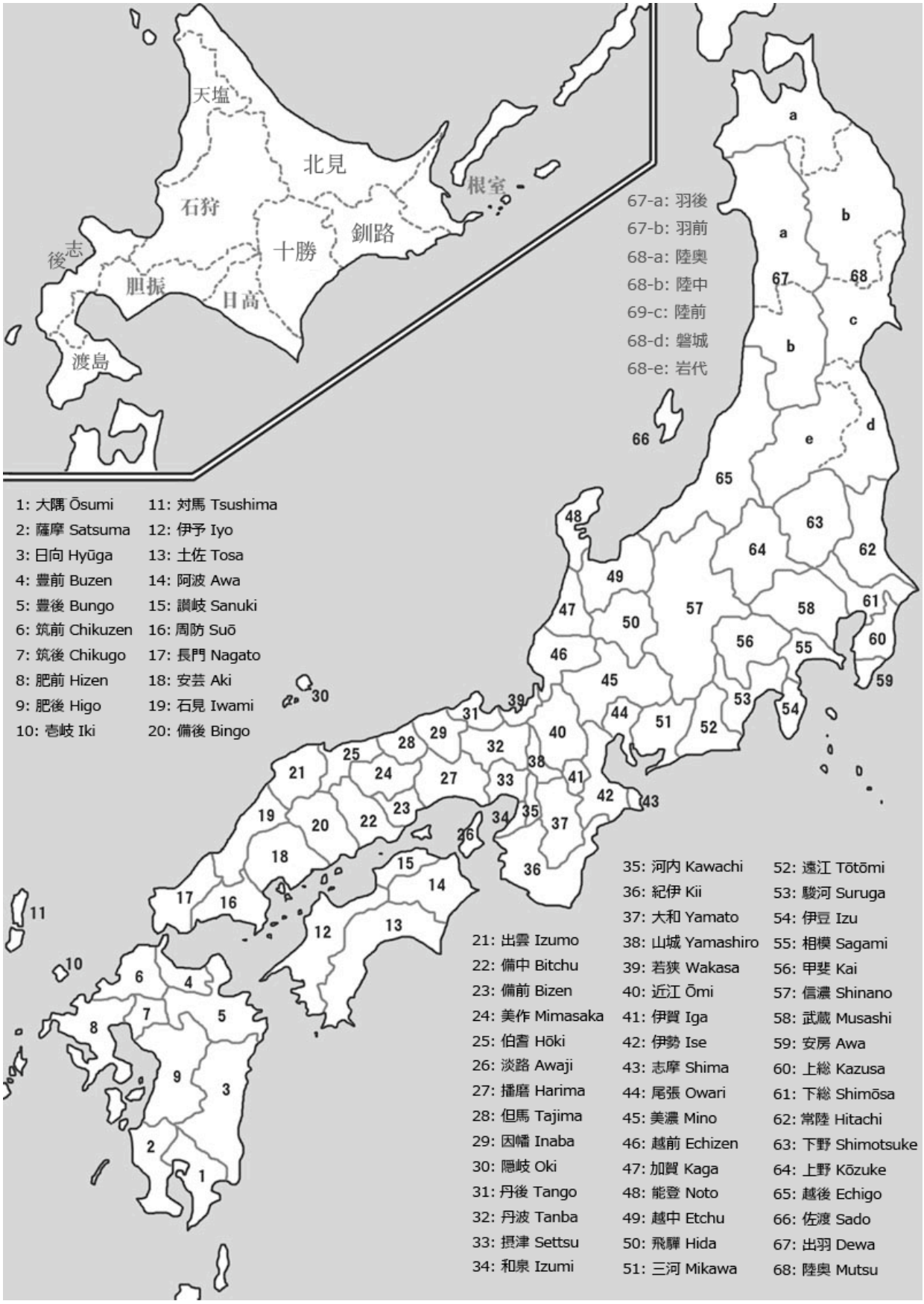


Figure 1. Rice price in Yamashiro and Harima provinces in copper coins per *gegyo-masu*
Source: Momose (1959).
Note: Yamashiro and Harima provinces are numbered 38 and 27 on the map, respectively.



Map of Japanese provinces (*kuni)*

Notes: *kuni* are administrative districts established in the 7th century; the map remained almost unaltered until 1868. Alessandro Valignano mentions only "66 kingdoms"; Dewa and Mutsu, n° 67 and 68 on the map, were still to a large extent land frontier areas in the 16th century.

For the conversion of unit-prices in *sho* into value in metric unit, we can use information regarding the size of one *koku* (1 *koku* = 100 *sho*). According to Farris (2006, 19) the *koku* used from Heian period (794-1185) was only 62.7 percent of official unit established in the early Tokugawa period, but 1.5 larger than the *koku of* Nara period (710-794). Since the Tokugawa period *koku* was a volume of 180 litres equivalent to 150 kg of husked rice, we can consider that the *sho* used between 1260 to 1603 was equivalent to 0.627 x 150 kg = 94.05 kg. Sawada (2007) provides a more precise calculation based on measures of *Shosoin* storage rooms[10] and old documents. He estimates the content of one *koku* of the Nara period at 2800 cubic sun (1 sun = 3.03 cm), which is equivalent to 77.9 litres.[11] Since Heian *koku* was 50 percent larger, its volume was 116.85 litres. Using the rate of 150 kg per 180 litres of husked rice as in Tokugawa, one *koku* is equivalent to 97.375 kg in the case of husked rice, and one *sho* to 0.97375 kg. This is the conversion ratio we will use in this study. From the mid 14th to mid-16th century, rice price per kg fluctuated therefore in a range between 5 and 15 copper coins, with an overall average of around 8.

We can link TY series with rice price data covering the period 1260-1593 that have been collected by researchers of the National Museum of Japanese History (Rekihaku 2009)[12], and additional data collected and compiled in a volume by a research team of the University of Kyoto working on pre-modern prices (KKB 1962)[13] for the period 1567-1603. The data reported in these sources originated from records of Buddhist temples and are therefore comparable to the TY series.[14]

III. Seasonality and regional differences in Rekihaku rice price data

The Rekihaku (RH) rice price data set we use consists of 1624 observations for which it is possible to calculate unit price by dividing the value of the transaction in copper coins by the volume of rice sold or purchased.[15] Most quantities are expressed in one of the four main units of the Japanese decimal system of volume: *koku (石)*, *to (斗)*, *sho (升)*, and *go (合)*, with 1 *koku* = 10 *to* = 100 *sho* = 1000 *go*. A few data were corrected when there were obvious errors of reporting in the source (unit price 10 times or about 1/10 or the price recorded in the same place during the same period, which implies that the volume was recorded as measured in *to* although it was in fact a volume in *koku* or *sho*).

We should take into account regional price differences. Information regarding the province in which the transaction took place in reported for only 862 observations (out of 1624) with 21 provinces mentioned.[16] Most prices were recorded in the Kinai region, particularly in Harima and Yamashiro. Assuming that the subset of 862 observations is representative for the geographical

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[10] *Shosoin* (正倉院) is a granary located in the central part of the *Todaiji* (東大寺) Buddhist temple in Nara.

[11] One *koku* of the Nara period was 2800 cubic sun (1 sun = 3.03 cm). Hence, 1 koku = 3.03^3 x 2800/1000 cm^3 = 77.9 litres.

[12] Rekihaku is the Japanese acronym of National Museum of Japanese History (*Rekishi Hakubutsukan* 歴史博物館). Rekihaku (2004) indicates here the price data we use have been extracted from the Ancient and Medieval Urban Life (Prices) Database (古代・中世都市生活史（物価）データベース) established in 2004 that we accessed from Rekihaku website http://www.rekihaku.ac.jp/doc/t-db-index.html (in August 2009).

[13] KKB stands here for *Kyoto Daigaku Kinsei Bukka Kenkyukai* (Japanese denomination of the "research team on pre-modern prices of the University of Kyoto" that authored the collective volume).

[14] Mostly in western Japan but also in eastern Japan, where the shogunal power was located, in Kamakura (in Sagami province), until 1333;. It was later moved to central Japan, in various locations between Nagoya and Kyoto.

[15] The RH data set includes 109 additional observations that were dropped since either the value or the volume, or both, are missing. It should be noted that red rice cultivation expanded in Japan in the 15th century (Itani & Ogawa 2004). Red rice, that was more resilient to drought but less appreciated by consumers, is usually mentioned as such in Rekihaku series; the comparison of unit price data suggested that the discount relative to white rice was about 10 to 20 percent.

[16] In decreasing order: Harima 340 observations, Yamashiro 251, Tanba 55, Aki 47, Yamato 34, Sagami 26, Wakasa 29, Kii 18, Bitchu 15, Musashi 11, Inaba 6, Kaga 8, Mino 6, Suo 7; 2 each for Kazusa and Hizen (the later reported in the source as Nagasaki, which was the main city); 1 each for Buzen, Chikugo, Echigo, Hitachi, and Iga.

distribution of the entire data set, we use all the 1624 observations included in the RH data set. It is nevertheless desirable to gauge the plausible level of price differential for each province. For that purpose, we refer to the magnitude of the price gap between Harima and Yamashiro and compare distance from each province to Kyoto (the duration of the return trip was shorter due to trade imbalance; transporters had few bulk goods to bring from Kyoto). Table 1 provides information on walking distance to Kyoto for provinces for which the transportation of a shipment to the capital required 7 days or less. Harima province, for which data are particularly abundant, is located at 5 days from Kyoto and the average speed is close to the mean steed (unweighted average is 27 km per day; weighted average is 22) and can therefore be regarded as representative for transportation cost (per day or km) from the province supplying Kyoto.

Table 1. Walking distance to Kyoto, in days, distance in km, and average speed in km per day

Province (a)	City of origin(b)	Days to Kyoto	Distance in km(c)	Km per day(d)
Omi (40)	Otsu	1	12	12
Tamba (32)	Kameoka	1	22	22
Yamato (37)	Nara	1	44	44
Kawachi (35)	*Higashi Osaka*	1	44	44
Settsu (33)	*Osaka*	1	47	47
Iga (41)	*Iga*	2	58	29
Izumi (34)	Izumi	2	72	36
Wakasa (39)	Obama	3	76	25
Mino (45)	Tarui	4	95	24
Kii (36)	Wakayama	4	115	29
Awaji (26)	Awaji	4	121	30
Ise (42)	Ise	4	128	32
Harima (27)	*Himeji*	5	122	24
Tango (31)	Fukuchiyama	7	84	12
Owari (44)	Inazawa	7	125	18
Echizen (46)	*Takefu*	7	129	18
Tajima (28)	*Hidaka*	7	143	20

Sources: Kurosaka (1952, 601-602) for distance in days.
Notes: (a) code of province on the map in parenthesis; out of 68 provinces, those selected are at less than 8 days to Kyoto (Yamashiro province, n°38 on the map); (b) the city of origin is the ancient capital city of the province or, in italics, the present name of the area; (c) distance in km calculated using Google maps; a trip from the Island province of Awaji implied crossing by boat a strait of around 2 km between the northern tip of the island and the coast of Harima province; (d) Unsurprisingly, the speed was particularly low when mountainous areas had to be crossed (for instance from Wakasa, Tango, Echizen, or Tajima).

Another issue to consider is price seasonality. For 1584 observations of the RH data set (out of 1624) information on both year and month of record are available. Years and months are in the Japanese *kyureki* (旧暦) calendar[17] and were therefore converted into Gregorian calendar years and months using information reported in Uchida (1975).[18] More records had been made in January (130), February (83), and especially March (446), April (284), May (197), and June (137) than during the rest of the year (59, 54, 51, 55, and 19 in July, August, September, October, November, and December, respectively). March is by far the month for which the most data are reported. This is consistent with the fact that shipment of rice over relatively long distance took place in winter, a

[17] The *kanreki* calendar indicates the *n*th year of the reign of Emperor *X* and *y*th day of *z*th months; until the 1late 19th century, Japan use a lunar-solar calendar, with leap months (閏月) inserted once every few years for adjustment. Since few data reported in Momose (1959) include information on the month of the year, no attempt was made to convert into Gregorian calendar when constructing the *Toji-Yano* series.
[18] And on the following website: http://maechan.net/kanreki/

relatively slack season, and in spring before the barley and wheat harvests. Rice was plentiful after the harvest that took place in late August and early September in western Japan, which explains the small number of transactions recorded by temples in autumn. A variant of the price regression was performed with dummy variables for each month (and October, the first month after the end of the harvest, as omitted dummy variable). Positive and significant coefficients were observed only for a few months. No attempt was made to adjust data for seasonality: prices were recorded in various regions, and therefore are not necessarily comparable.

Walking distances reported in Table 1 are official measures in days in Heian period (794-1185) reported in *Engishiki*.[19] There is no similar comprehensive set of data for the 13th to 16th century but it seems that conditions for land transportation did not change much, particularly in the area around Kyoto. The same source mentions duration of the trip by sea route; it was usually longer but probably cheaper. Shipment of rice to Kyoto by sea route (and river navigation for the final leg of the journey) was therefore economically feasible in normal circumstances. Coastal provinces of northern Kyushu (Chikugo, Hizen), western Honshu (Aki, Bitchu, Inaba, Suo), central Japan (Iga, Mino), eastern Japan (Hitachi, Kazusa, Musashi, Sagami), and Hokuriku region on the Sea of Japan (Echizen, Kaga, Wakasa), had a structural or occasional exportable surplus. Shipments from these regions were of critical importance during years of crop failures in the Kinai region and surrounding provinces (Tanba and Kii, in particular). It appears that, for a given sub-period of a few years, unit-prices recorded in provinces surrounding Kyoto were above Yamashiro-level. The most likely explanation is that, as observed in Figure 1, transaction prices in Harima and other in exporting provinces were expressed in *kuden-masu* while prices in Kyoto were measured in the smaller *gegyo-masu*. Therefore, unit price were not adjusted for regional differences.

IV. Construction of a composite rice price series for Kyoto

The first step of the construction of a composite rice price series fro Kyoto consists in linking the RH and TY series. The RH yearly rice price series is generated by calculating the average price for each year's data supplying months. Figure A2 (in the appendix) shows that, for a majority of years between 1260 and 1570, at lest one monthly average was available. The RH series of unit prices measured in copper coins per *sho* is then compared to the TY series in copper coins per *gegyo-masu*. For the year for which both RH and TY data are available, the ratio is 0.96 on average. This confirms that one *gegyo-masu* can be regarded as equivalent to one *sho*. Considering that the TY price series is essentially based on prices in Kyoto, the regional heterogeneity of RH data can be seen in terms of deviation from the Kyoto level.

Table 2 indicates the 20-year averages of TY and RH prices in copper coins per *sho* and of their ratio (Ratio TY/RH) calculated in order to assess the stability of the gap. The ratio was usually close to one, in a range between 0.88 and 1.05, except in 1360-79 when it was 1.34. One explanation could be that most RH data reported in 1360-79 are for Harima, or other relatively distant provinces such as Wakasa and Kaga, and only a few from nearby Tanba province, while data recorded from Yamashiro account for a larger share of observation for the later period. Since RH price data recorded before 1240 were mostly from provinces other than Yamashiro (or from unspecified provinces), it seems safe to adjust upward RH data by a factor of 1.34 in order to generate the composite Kyoto price series for the period 1240-1359. Similarly, the composite series for the period 1360-1559 was obtained on the basis of TY series with missing data generated from available RH data by adjusting upward or downward using the ratio TY/RH of each 20-year sub-period.

[19] *Engishiki* (延喜式) is a Japanese corpus of regulations for governmental administration and ceremonies in fifty books. The compilation of these procedures was initiated in 905.

The second step of the construction of a composite Kyoto rice price series consists in extending the coverage from 1560 to 1600 by using data, reported in KKB (1962), of rice prices in copper coins (*mon* 文) per *koku* recorded between 1467 and 1595 (314 observations in a range between 137 and 4800 *mon*), and between 1575 and 1603 in silver *monme*, a weight of 3.75 grams with a pure silver content of about 3.3 grams (22 observations in a range between 8 and 21.47). For almost all observations, we have information regarding the province in which the price was recorded (as well as the volume of rice traded; the relation between the unit-price and the volume is negative and significant, as expected). Since most of the prices were recorded in Kyoto (or elsewhere in Yamashiro province) or in nearby Nara (or elsewhere in Yamato province), observations recorded in other provinces were dropped and yearly averages for Yamashiro and Yamato provinces were computed.

Table 2: Rice prices in copper coins per *sho* (20-year periods averages)

	Toji-Yano (TY) price series	*Rekihaku* (RH) price series	Ratio TY/RH	*Yamashiro-Yamato* (YY) price series	Composite Kyoto price series
1240-59	*na*	6.1	*na*	*na*	8.2
1260-79	*na*	9.2	*na*	*na*	12.4
1280-99	*na*	10.3	*na*	*na*	13.8
1300-19	*na*	8.9	*na*	*na*	12.0
1320-39	*na*	7.4	*na*	*na*	10.0
1340-59	*na*	8.4	*na*	*na*	11.2
1360-79	9.5	6.9	1.34	*na*	9.4
1380-99	7.8	7.2	1.03	*na*	7.7
1400-19	10.5	8.8	1.11	*na*	10.4
1420-39	11.6	10.4	1.06	*na*	11.4
1440-59	10.5	9.2	1.12	*na*	10.3
1460-79	7.7	8.4	0.88	10.2	7.4
1480-99	7.4	8.8	0.98	9.7	7.5
1500-19	6.1	6.2	1.01	7.8	6.2
1520-39	5.5	5.7	0.93	14.6	5.3
1540-59	5.4	4.8	1.05	12.7	5.3
1560-79	*na*	6.8	*na*	7.8	6.2
1580-99	*na*	*na*	*na*	9.9	10.0

Sources: See text.
Note: one *sho* is about 0.97375 kg.

The results, presented in Figure 2, exhibit wide variations. It is likely that some of the relatively high unit-prices were data expressed in low quality coins (*bitasen* 鐚銭)[20] that accounted for a large share of copper coins imported from China from the mid15th to the late 16th century.[21] For a number of observations, the source reported in KKB clearly indicates that payment was made in *bitasen*. Since unit-price in *bitasen* was two to five times higher than the lowest unit prices recorded in the same period (when that comparison is possible), we can suspect that some of the highest prices for which the quality of the coins is not mentioned were also measured in low quality copper coins. When comparing prices in Yamashiro and in Yamato, we can observe that for the years for which both are available (unfortunately, only 9 years), unit-prices were most of the time higher in

[20] Also called, in some cases, *akuzeni* 悪銭, *i.e.* low quality coins, or *usuzeni* 薄銭, thin coins, *shichusen* 私鋳銭, or *mochusen* 模鋳銭.

[21] On low quality coins imported from China, see for instance Sasaki (1972), Sakurai (1996), Sakurai & Nakanishi (2002), Currency Museum (2009). Various kinds of *bitasen* were also produced in large and small cities (or even villages) across the country. The major production centres were Kyoto (mid-14th century), Kamakura (early-15th century), Hakata (from 15th century to early-16th century), and Sakai (from mid to late-16th century). It is however difficult to assess bitasen's production volume in Japan and the overall share of local and imported *bitasen* in the total circulation.

Yamashiro. This could indicate that *bitasen* were more commonly accepted in a large city like Kyoto than in the countryside. There is unfortunately no way to sort out possible prices in *bitasen* from prices corresponding to crop-failure periods. Since our main concern is to extend the coverage up to 1600, the easiest way is to generate a Yamashiro-Yamato price series (YY) based on yearly averages of prices in these two provinces (20-year averages are presented in Table 2); these figures are used only for the period 1571-1595 for which neither TY nor RH price data are not available. YY prices for that period are at historically low levels for 10 data points (between 5.5 and 6.25 *mon* in 1571-76, 5.0 in 1582, between 6.19 and 6. 97 in 1591-93, 6.25 in 1595). The comparison of calculated rice wages (presented in detail in section V) with available information on wages actually paid in rice in the late 16th century indicates that price levels of about 10 copper coins per *sho* or above are indeed plausible for the late 1580s. Finally, linear interpolation was used for estimating one-year and two-year period intervals of missing data on the composite Kyoto price series. No attempt was made to estimate other missing data. The final result is presented, along with a three-year moving average, on Figure 3.

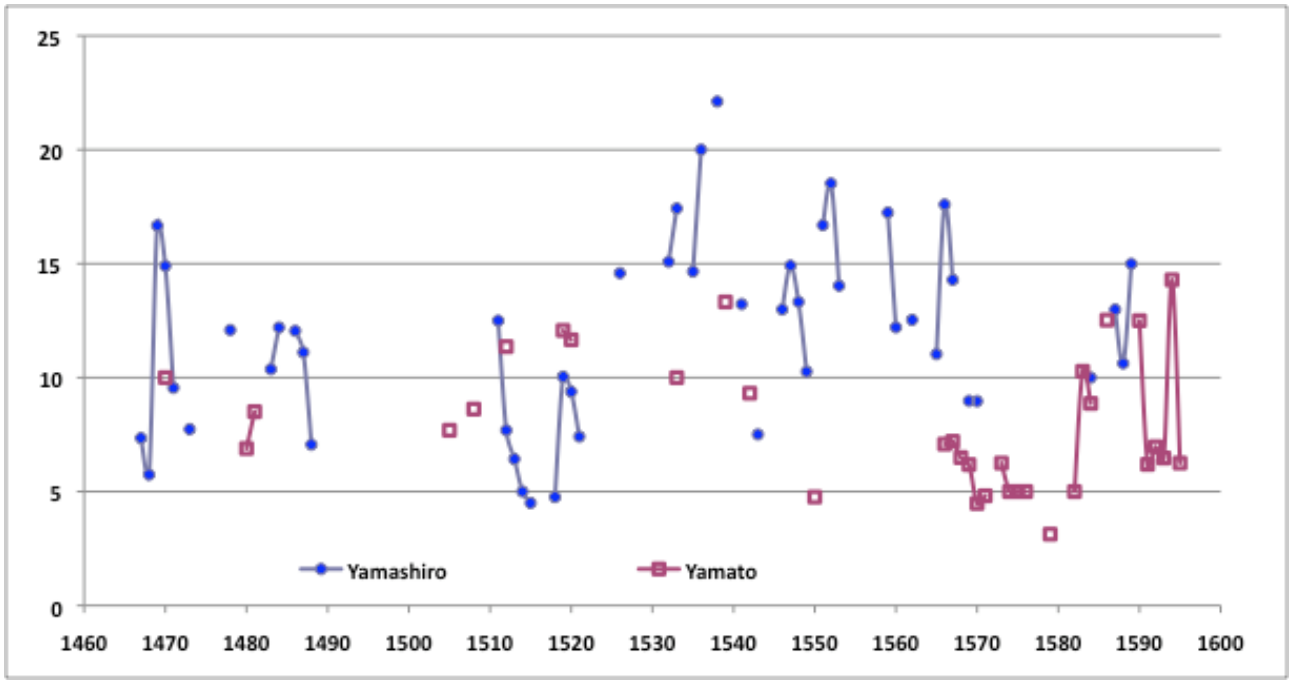

Figure 2. Average yearly rice prices in Yamashiro and Yamato provinces (copper coins per *sho*)
Source: calculation based on data reported in KKB (1962); for details, see text.

The first of the two most notable findings is that rice prices were far from stable between 1260 and 1600, which is consistent with narratives highlighting the impact and frequency of crop failure induced famines. Still, the level of volatility measured as the coefficient of variation (CV) over 3-year periods is only 0.15 on average for the period 1260-1600, which is slightly lower than the CV of rice price in Osaka for the period 1703-1857, measured in silver currency (0.16).[22] It is also lower than the volatility observed on wheat prices series for London and Florence during the same period (0.20 and 0.22, respectively).[23] A second observations is that long swings can be observed: a downward trend up to around 1390, then an upward between 1390 and 1430, that is the core of the period identified by Farris as the *Muromachi Optimum* (1370-1440), and finally a long downward trend between 1430 and 1550. It is difficult to be conclusive about the last decades of the 16th century; the volatility observed could be the consequence of political instability and warfare. In

[22] Calculation based on yearly price series reported by Iwahashi (1981, 462-465).
[23] Wheat price series for London and Florence used in Allen (2001) accessed from files prepared by Robert Allen accessed from the GPIH website: http://gpih.ucdavis.edu/Datafilelist.htm

any event, the low price levels and volatility implies that, if nominal revenues remained stable, a phase of prosperity extended during at least one century after the end of the *Muromachi Optimum*. In order to assess whether or not living standards changed, we need therefore nominal indicators of per capita revenue and of personal inequality.

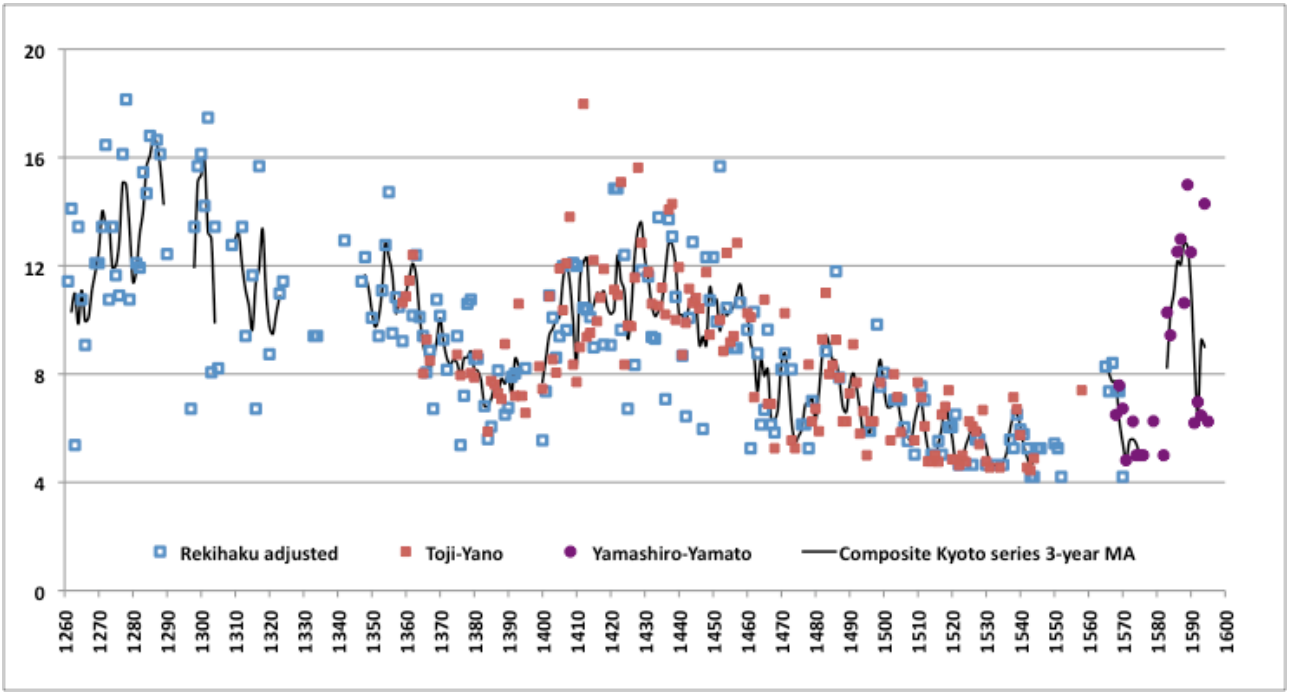

Figure 3: Nominal rice prices in copper coins (*mon*) per *sho*

V. Wages of carpenters and other craftsmen in copper coins, silver, and rice

In this section, we combine available data on nominal wages paid to skilled workers in copper coins, silver, and rice in Kyoto between 1260 and 1600 for estimating rice wage series. We focus on carpenters (大工) because information on wages paid to this category of skilled workers appears particularly abundant and reliable. Another motivation is that, since all building, including temples, imperial palaces, and estates of aristocrats, were entirely made of wood (except roofs made of tiles or metal sheets), these skilled workers can be regarded as the Japanese counterparts of skilled construction workers (masons) of per-modern Europe and the Middle East. In order to assess the magnitude of skill premia in Japan, we use information on daily wages paid to different types of unskilled workers and semiskilled (craftsmen's assistants, service workers, and transporters).

The first point to emphasize is the very existence of a labour market. It is well documented that carpenters and most other urban workers received daily wages in copper coins (*mon*), and/or in rice. As the main staple food of urbanites, rice was the most important cash crop and a quasi-currency. Rice was relatively easy to sell since it was by far the main consumption expenditure item of most urban household. Another consideration is that most grains that tend to spoil during the hot and humid Japanese summer, while unhusked rice is relatively easy to store.[24] Most payments of labour rewards recorded by Buddhist temples are measured in copper coins, though actual payment was perhaps made in some cases in rice owned by the temple. Considering the wide fluctuation of

[24] Rice can be carried over for several years without loosing too much of its nutritional content, particularly when stored unhusked.

rice price, particularly during famines, and the fact that religious institutions owned rice estates, the prevalence of payment in cash indicates that wage earners were not particularly keen to receive payment in kind. This is explainable in a context of downward trend in rice prices, if nominal cash wages were sticky. When rice price is on upward trend, which was the case in the first decades of the 15th century, some upward adjustment of nominal wages could be expected.

A second point to stressed is that the daily nominal wages in copper coins recorded by Buddhist temples are labour rewards paid to ordinary workers. Some craftsmen were part of a sort of aristocracy of quasi-artists; as in the earlier Renaissance period in Italy, the concept of artist did not exist in pre-modern Japan; a number of craftsmen regarded as particularly skilled and knowledgeable were paid at piece rates, and apparently relatively well paid. We know for instance that, in 1238, a sculptor received a piece of land of 0.425 *tan* (around 400 square meters; presumably urban land in Kyoto) as payment for carving one Buddha statue, while another one, in 1496, received 200 *koku* rice for a similar accomplishment.[25] We also know that, in 1498, a sculptor of Sanskrit letters received 20 copper coins (at that time, worth around 3 kg rice) per letter carved (Rekihaku 2004, craftsmen files).

Table 3 presents information on wages paid to carpenters recorded by various Buddhist temples in the Kinai at various dates between 1232 and 1600. These data give the impression that nominal wages rates were fairly stable until the 1520s, and that new arrangements combining payment in cash and in kind were introduced in the second half of the 16th century, perhaps in response to a higher rice price volatility. Information on wages reported in the Rekihaku data set confirms the first impression.[26] Out of 304 records of payment (mostly during the period 1300-1540), we have 95 and 49 observations of nominal daily wages of 110 and 100 coppers coins, respectively. Other rates corresponding to multiple of 10 are also observed but with a far lower frequency.[27] This concentration of nominal wages at around 100 copper coins per day shows that there was indeed a standard for labour reward of carpenters, although lower wage levels corresponding implicitly to skill levels can be identified, with two clusters at around 10 mon and 50 mon.[28] The most likely explanation is that relatively unskilled workers were involved in some tasks. Rekihaku files also report total payment above 140 *mon* for a number of workers unspecified. We can presume that these payments were made to an artisan for his entire team. In some cases, neither the number of workers nor the number of days worked in not mentioned, which explain payments as high as 2600 *mon*.[29]

The study of wages paid to other craftsmen (blacksmith, dyers, lacquerers, tailors, etc.) reported in the Rekihaku data set provides a confirmation of the existence of a three cluster of nominal wages at 100, 50, and 10 mon. Out of 140 payment record for which the exact amount of the wage is mentioned (or can be calculated on the basis of information on total payment and number of workers), we find 26 observations at 100 mon, 9 at 110 mon, and 50 observation at 50 *mon*.[30] Most craftsmen such as blacksmiths (鍛冶師), dyers (染物師), lacquerers (塗師), wooden bucket makers (桶師) or tailors (裁縫師) received 100 mon.[31] We know with certainty that these workers were skilled because the job descriptions include the Chinese character used for designing

[25] Around 19 tons, assuming 94 kg per koku; a quantity of rice sufficient to nourish around 100 people during one year.
[26] Most or these data were recorded by temples situated in the Kinai region, particularly in Yamashiro and Yamato. Information regarding the province is unavailable for some observations, but only for a minority and almost exclusively before 1310.
[27] 10 *mon*: 19 observations; 20 *mon*: 14; 30 *mon*: 6; 40 *mon*: 8; 50 *mon*: 12; 51 *mon*: 8; 60 *mon*: 9; 70 *mon*: 8; 80 *mon*: 5; 100 *mon*: 49; 110 *mon*: 95; 120 *mon:* 4; 130 *mon*: 2; 140 *mon*: 2.
[28] See figures B1, B2 and B3 in appendix.
[29] It could be a payment to 2 workers x 13 days x100 *mon*, or a combination of 100 *mon* wages and lower wages for a certain number of days.
[30] A downside is that most of these data were recorded in the 15th century; carpenter wages data suggest a stability of nominal wages over time, and we can therefore assume a similar feature for labour rewards of other craftsmen (for more information on other craftsmen wage data, see Figures C1, C2, C3 in appendix).
[31] But some of the tailors received only 90 *mon*.

a master in a craft or an art (師).[32] We also find in Rekihaku data 5 observations at 130 *mon* and 8 at 150 *mon*; these were the wages received by paper hangers (表具師)[33] and ship carpenters (船大工), respectively. These highly skilled workers were presumably in high demand due to the relatively recent development of theses crafts. For the large number of observations at wage rates of 50 *mon*, there is usually no information regarding the field specialisation; this suggest that these workers were relatively unskilled. Since there were involved in tasks performed under the supervision of craftsmen, they should be regarded as semi-skilled workers, while those receiving around 10 *mon* as unskilled workers or apprentice.

Table 3. Nominal wages of carpenters in copper coins in the Kyoto and surrounding areas

Year	*Wage*	*Payment currency*	*Temple / Shrine*	*Area*
1232	6 sho	Rice	Kasugasha	Nara
1309	100 mon	copper coins	Kairyuoji	Nara
1419	100 mon	copper coins	Katorisha	Chiba
1422	100 mon	copper coins	Koyasan	Wakayama
1443	111 mon	copper coins	Koyasan	Wakayama
1445	100 mon	copper coins	Koyasan	Wakayama
1458	100 mon	copper coins	Koyasan	Wakayama
1459	100 mon	copper coins	Kamosha	Kyoto
1459	110 mon	copper coins	Gionsha	Kyoto
1464	100 mon	copper coins	Koyasan	Wakayama
1496	100 mon	copper coins	Rinsenji	Kyoto
1497	110 mon	copper coins	Gionsha	Kyoto
1498	100-105 mon	copper coins	Rinsenji	Kyoto
1498	100 mon	copper coins	Daitokuji	Kyoto
1506	100-105 mon	copper coins	Rinsenji	Kyoto
1517	105 mon	copper coins	Rinsenji	Kyoto
1521	110 mon	copper coins	Rinsenji	Kyoto
1525	115 mon	copper coins	Daitokuji	Kyoto
1526	115 mon	copper coins	Daitokuji	Kyoto
1545	80 mon, 1.3 sho	copper coins, rice	Daitokuji	Kyoto
1548	110 mon	copper coins	Rinsenji	Kyoto
1566	80 mon, 1.2 sho	copper coins, rice	Daitokuji	Kyoto
1568	80-81 mon 1.5 sho	copper coins, rice	Daitokuji	Kyoto
1587	10 sho	Rice	Daitokuji	Kyoto
1592	111 mon	copper coins	Daitokuji	Kyoto
1594	8.5 sho, other	rice, *makanai* rice	Daitokuji	Kyoto
1600	8 *bu*	silver weight	Daitokuji	Kyoto

Sources: Endo (1956), Tanaka (2007).
Notes: *makanai* is food provided to the workers (it is estimated here at 1/2 *sho*, and total wage in therefore regarded as 9 sho); one *bu* is 1/10 *monme*, i.e. 0.375 gr (about 0.330 gr of pure silver).

Combining information presented in Table 3 and Rekihaku data, we can regard standard nominal wages for carpenters as equal to 100 *mon* until 1499, 105 in 1500-1539, 100 in 1540-

[32] This Chinese character is not used for carpenters but there is general agreement that they were regarded as skilled workers.
[33] A paper hanger (hyogushi 表具師) is a craftsman making hanging scrolls (kakejiku 掛軸), folding screens (byobu 屏風) and sliding doors (fusuma 襖). He is not a painter artist (eshi 絵師).

1579[34], and 110 thereafter. This nominal wage series in *mon* is converted in rice wages on the basis of the composite Kyoto rice price series. The results presented in Figure 4 include available information on wages paid in rice reported in Rekihaku files (8 and 9 sho rice in 1304 and 1477, respectively) and in Table 3 (10 and 9.5 sho in 1587 and 1594, respectively). Information on silver wages in 1600 (table 3) was combined with rice price data in silver reported in KKB (1962), relatively stable in the last years of the 16th century, in order to estimate rice wages for that particular year.

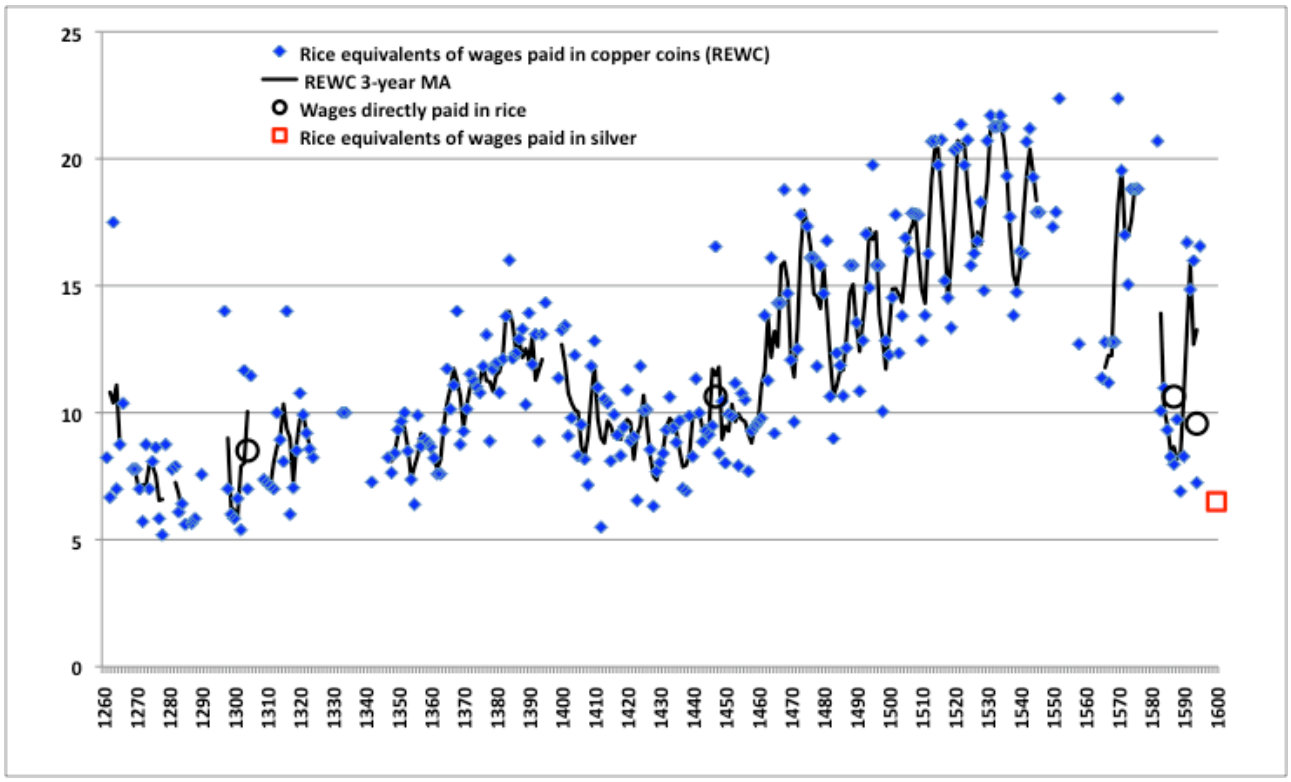

Figure 4. Rice wages of carpenters in *kg* per day
Notes: calculation based on the composite Kyoto rice price series, assuming nominal wages of 100 copper coins per day in 1260-1399, and 105 thereafter. Converted into kg assuming 0.9405 kg per *sho*.

VI. Wages of transporters and urban service workers, and skill premium in Kyoto

A prerequisite for assessing the skill premium is the identification of standard wage rates paid to various categories of workers. For that purpose, we can rely on additional Rekihaku data regarding transporters, on the one hand, various kinds of urban service workers, on the other hand. Most data on transporters recorded in Rekihaku files are for a journey from Harima to Kyoto, presumably shipments to the capital from rice estates owned by the temples recording the transaction.

Religious institutions used to hire two types of professionals transporters: horseback carriers called *bashaku* (馬借) and cart drivers called *shashaku* (車借).[35] Considering that there were many swamps and rivers to cross on the road from Harima to Kyoto, *bashaku* was the only option (man

[34] Labour rewards combining cash component in copper coins and an inkind component in rice for 1545, 1566, and 1568 (reported in Table 3) suggest that nominal wages in copper coins were around 90 *mon*, but another observation indicates a much higher level in 1548 (110 *mon*).
[35] They used mostly cattle, in general one per cart.

portage, that was probably common in mountainous areas, seems unlikely over such a long distance). A fairly abundant iconography on *bashaku* indicates that the normal carriage was 2 bags per horse.[36] As everything else in Japan since Nara period, the content of rice bags was standardized: each bag, made of rice straw, had a volume of 1 *hyo* (1 *hyo*= 1/5 *koku* = 20 *to* = 20 *sho*).[37] Hence, 1 *hyo* would be a volume equivalent to 19.4 kg of polished rice. Other sources indicate that, in the 16th century, the volume of one *hyo* increased to 4 *to* (i.e. 40 *sho*).[38] Considering the relatively small size of Japanese horses, it is implausible that the charge of rice carried by horseback over long distance doubled in the 16th century to about 80 kg. Even the horses owned by the military elite were barely strong enough to bring the samurai on the battlefield and, with a few exceptions, were not suitable for use in combat by an armoured cavalry. It seems therefore safe to assume that even if the content of the *hyo* doubled, the charge of *bashaku* remained constant at 2 bags of 20 *sho* each.

In the 325 observations available in Rekihaku files of payment to transporters, a cluster is visible at 150 *mon* (64 observations) and others for multiples of 150 (93, 12, and 16 for 300, 450, and 600 *mon* respectively). This suggests that 150 *mon* was the standard rate for one horseback charge of 2 *hyo* from Harima to Kyoto; the iconography indicates that it was common for transporter to travel in small caravans of 2, 3 or 4 horses (in general with the same number of horses).[39] It took 5 days to bring a shipment from Harima province to Kyoto (around 122 km), and 3 days for the return journey with no charge or a very light one (Kurosaka 1952). The total duration of the trip would be 8 days. Therefore, 150 *mon* can be considered as the value of the service provided during a 8-day period by one transporter (and one horse) carrying a volume of 20 *sho* rice. Hence, gross revenue can be calculated as 150/8=18.75 *mon* per day on average. The daily cost of using one horse was almost the same as daily labour reward of porters in early Edo period[40], and presumably in the same range earlier. Taking into account the cost of capital (horse and saddle), pure labour reward could be less than 10 *mon* per day. But because most land transportation occurred in autumn and winter during the agricultural slack season, the opportunity cost of services provided by horses, was relatively low. This may explain why a number of payments for transportation are at about 100 *mon*. In the case the temple contracting the transporter provided a horse, 100 *mon* could be pure labour reward, and daily wage would be around 12.5 *mon*. In order to avoid given an overoptimistic picture of living standards pre-modern Japan, we will adopt the 10 *mon* per day figure as standard nominal wage.

Since most Rekihaku data of payment to transporters were recorded in the second half of the 14th century and first half of the 15th century, we can calculate implied rice wages using Toji-Yano series, which showed that the unit price of rice first declined from 12 to 6 *mon* per *sho* and then rebounding up to around 12 *mon* in the early 15th century. In spite of these price variations, it seems that nominal labour reward of transporters remained sticky both upward and downward, inducing a variation in rice wages from around 0.8 kg per day to around 1.4 and then back to the initial level. We cannot exclude that the payment actually included some in kind allowance in rice that mitigated the relatively low level of rice wages but there is no positive evidence of it. We can check the plausibility of the estimated rice wages of transporters by comparing with the price differential between Harima and Kyoto implied by Toji and Yano series that are overlapping in first half of the 15th century.[41] On average, the price differential was 172 *mon*, and the 150 *mon* transportation costs accounted for 87 percent of the price differential. This result implies that other transaction costs

[36] See for instance http://www.archives.pref.fukui.jp/fukui/07/zusetsu/B11/B111.htm a picture in the collection of the prefectural archives of Fukui, the area corresponding to Echizen province (number 46 on the map).
[37] The ratio 1 *hyo* = 20 *sho* is also implied by Rekihaku price data recorded for instance, in April 1392 in Bitchu province by the same religious institution, two of these in *sho* and one in *hyo*.
[38] http://ja.wikipedia.org/wiki/%E4%BF%B5_(%E5%8D%98%E4%BD%8D)
[39] See also figures 3A, 3B, and 3C in appendix.
[40] Hoshino (2001); see also Table 1.
[41] Momose (1959); see also Figure 1.

were low. This seems reasonable in the case of a religious institution arranging the shipment to Kyoto from an estate that was part of his possessions.

Finally, another set of Rekihaku data provides information on wages paid to urban service workers recorded mostly in Yamashiro, Yamato, and Harima provinces. Daily wages in *mon* were calculated on the basis data reported for each transaction in terms of total payment, number of workers, and number of days worked (either the number of workers and/or of days was missing in some cases); the division of a total by a number of workers explain that some figures obtained do not indicate an exact number of *mon*. Out of 397 observations, different levels can be identified with six main clusters: 5 to 6 *mon* (40 observations), 10 to 11 (144 observations), 30 to 35 *mon* (34 observations), 50 *mon* (15 observations), 100 and 110 *mon* (15 and 32 observations respectively). These 10, 30 and 50 *mon* rates are recorded throughout the period from the late 14th to the mid-16th century.[42] This dispersion indicates that different skill levels existed among service workers.Daily wages paid in rice are also reported for the mid14th century that confirms the wide dispersion and the presence of different levels, in a range from 0.5 to 4 *sho* rice per day. The 10 to 11 mon level is by far the major cluster of service workers wages data recorded. It is also the implied daily wages for transporters. Information for the late 14th century urban service workers suggest that the lowest standard rate was around 7 *mon* per day but this not confirmed by other sources. It seems therefore preferable to use the 10 *mon* level as standard nominal wage rate for unskilled workers throughout the period.

Table 4: Daily rice wages in kg rice, and composite skill premium

	Carpenters (C)	Semi-skilled Workers (S)	Average unskilled (U)	Average S&U	Composite skill premium index (C/S&U)
1260-1279	7.6	4.1	0.9	2.7	3.2
1280-1299	6.8	3.6	0.8	2.4	3.1
1300-1319	7.8	4.2	0.9	2.8	3.2
1320-1339	9.4	4.8	1.0	3.1	3.3
1340-1359	8.4	4.2	0.9	2.8	3.2
1360-1379	10.0	5.2	1.1	3.4	3.3
1380-1299	12.3	6.3	1.3	3.9	3.4
1400-1419	9.4	4.7	1.0	3.1	3.4
1420-1439	8.6	4.5	0.9	2.8	3.4
1440-1459	9.6	5.0	1.0	3.0	3.4
1460-1479	13.3	6.6	1.4	4.1	3.5
1480-1499	13.1	6.5	1.4	4.1	3.5
1500-1519	15.8	7.8	1.6	4.8	3.6
1520-1539	18.5	9.0	1.9	5.5	3.6
1540-1559	17.8	9.1	1.9	5.6	3.5
1560-1579	15.1	8.0	1.7	4.9	3.4
1580-1599	10.4	5.3	1.1	3.4	3.6

Rekihak data point to the existence of at least one more cluster of nominal wages at around 30 to 50 *mon* per day paid to semi-skilled craftsmen of service workers. They received three to five times the level of unskilled workers, but only one third to one half the level of skilled workers. Table 4 presents 20-year averages of rice wages of skilled, semi-skilled, and unskilled workers, and a measure of the skill premium based of the calculation of an unweighted average of the rice wages of semi-skilled and unskilled workers. The result is a composite index of skill premium fluctuating in a range between 3.0 and 3.8 (3.4 on average of the period, the average being 2.0 and 9.3 for relative to semiskilled and to unskilled workers, respectively). It should be noted that the variation

[42] See also figures 4A, 4B, and 4C in appendix.

is entirely due to changes in skilled workers' nominal wages, the labour rewards of semi-skilled and unskilled workers being constant in copper coins.

VII. Grain wages and skill premia in Kyoto in comparison with London, Florence, Istanbul, and Cairo

Judging from information on wheat prices and nominal wages of skilled workers in London and Florence (Allen 2001). Figure 5 offers a comparison of grain wages showing that grain wages of carpenters in Kyoto were much lower than by European standards until around the mid15th century. The Black Death that resulted in a sudden increase of real wages in Florence amplified the difference with Kyoto in the short term (Japan did not suffer from the Black Death). Grain wages went up in Kyoto in the second half of the 14th century, reaching temporarily the level of Florence in the 1390s, but then reverted to a lower level while Florence and London wages reached an apex in the mid-15th century. The gap then entirely disappeared in the early 16th century due to a combination of upward trend in Kyoto and downward trend in Florence and London from the late 15th century. The inclusion of the few data available on Cairo and Istanbul before 1600 confirms this impression; grain wages were almost constantly lower than in Cairo in the late 13th and first half of the 14th century, but roughly at the same level as in both Cairo and Istanbul in the late 15th century, and well above Istanbul during most of the 16th century.

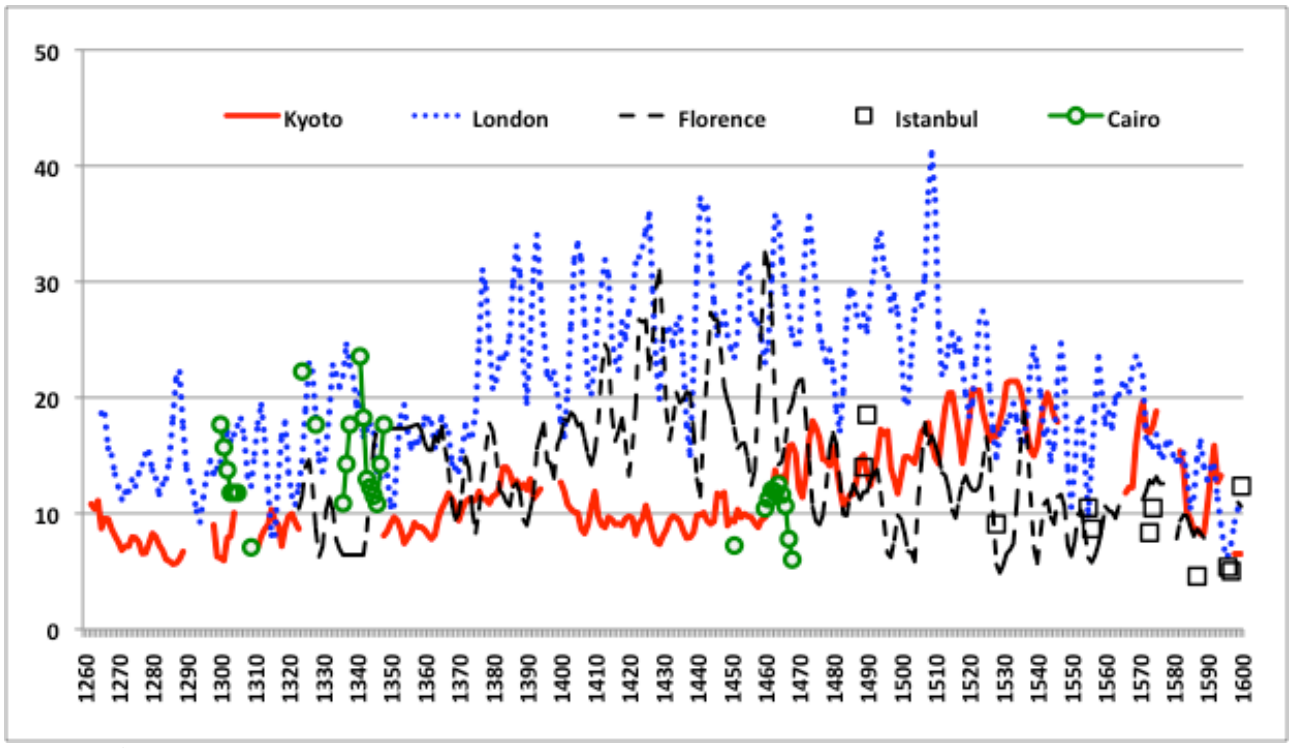

Figure 5. Comparison of grain wages series for skilled craftsmen in Kyoto, London, Florence, Istanbul and Cairo (in kg per day; 3-year moving averages).
Sources: Florence and London: Allen (2001); Istanbul: Pamuk (2001), Cairo (Gray, Cooper, Lindert 2007; based on Ahstor 1969); Kyoto: see text.
Note: grain is rice in Kyoto, wheat in other cities.

It should be noted that for measuring the purchasing power of labour rewards in terms of grain wages, rice is used in Kyoto and wheat in the other cities. Available price data for Kyoto do not allow comparing relative price structure in Japan and Europe. We have therefore to focus on grains. Since rice and wheat have comparable caloric contents per kg[43], the first impression is that it is indeed an acceptable measure of purchasing power parity. Rice was the main staple in Kyoto and so was wheat in the Europe and the Middle East.[44] Wheat should be processed first as flour and then as bread, whereas rice cooking implies less expense. The result tends to underestimate living standards in Kyoto but probably only to limited extent. Wheat was in Japan a relatively cheap substitute (along with barley). Until the early 20th century, rice has been a prestige food in Japan (Onuki-Tierney 1993) and Rekihaku price data suggests that this was also the case in the pre-modern period. The magnitude of the rice premium can be gauged for three items: it was about 100 percent above the price of wheat and barley (price data usually indicate only one price for what and barley, although it is likely that wheat was more expensive).

Wheat and barley played an important role in Japan in the event of a rice crop failure. In normal circumstances, staple grains other than rice, excluding therefore red beans (*azuki)* and soybeans, certainly accounted for only a tiny share of food consumption of carpenters in Kyoto, but probably more than half of total Japanese food supply. Perhaps less in the Kinai where paddy fields accounted for the major of the cultivated acreage, but in the meantime double cropping (barley or wheat in winter; rice in summer) was more common around Kyoto than in most other regions. Japan had therefore the advantage to rely on two different types of staples: winter crops cultivated in dry fields and harvested in late spring (wheat, barley, millet and buckwheat), and rice that was mostly irrigated (particularly in the Kinai region) and was harvested at the end of the summer. Rice was therefore almost insensitive to spring drought. By contrast, the staples cultivated in Europe (wheat, barley, oats, and rye) were all harvested during the same period, in late spring or the very first weeks of summer in Mediterranean countries, during the summer in England. The bulk of the food supply was therefore strongly affected in the advent of climate anomalies such as low spring rainfall, in the case of Mediterranean countries, or wet and cold summer, in the case of northwestern Europe.

The diversity of staples in Japan had favourable implications in terms of wellbeing not only in the event of a food crisis but also in normal circumstances. The relatively low price volatility observed in Kyoto is consistent with the availability of cheap substitutes with different periods of cultivation and harvest than rice. In the event of a rice crop failure, the production of other grains was not necessarily affected since most of these staple are mostly winter crops and therefore less sensitive than rice to spring and summer drought. Rice price spikes resulted in spikes for other grains, and in a contraction of the relative premium for rice, but these substitutes remained comparatively cheap. This is the most likely interpretation for the search by Kyoto resident for emergency food in the mountainous areas (in which little rice was cultivated) during famine episodes. The implication is that Kyoto wage earners were less exposed to food supply shocks than their counterparts of Europe where wheat accounted for a larger share of staple consumption than rice. When living standards were at a similar level, losses in welfare due to extreme climatic event were therefore lower in Kyoto than in European cities.

We should also take into consideration the existence in Japan of substitutes even cheaper than wheat. In Kyoto, the rice premium was 200 percent above the price of millet or buckwheat[45] ,

[43] Rice has a slightly higher caloric content than wheat, but a lower protein content: 3620 kcal and 75 g of protein per kg in the case of brown rice; 3420 kcal and 113 g for hard white wheat (*Triticum aestivum*), and 3390 kcal and 137 g for durum wheat (*Triticum durum*). USDA website: http://www.nal.usda.gov/fnic/foodcomp/search/ Ishige (2000, 19-20) argues however that higher content in essential amino acid proteins makes rice a much more balanced source of nutriments than most other cereals.

[44] Wheat was also commonly consumed in Japan, either boiled (usually mixed with other grains) or processed as pasta.

[45] In most cases, price data do not distinguish the different varieties of millet and buckwheat. These grains are described in the original source reported in Rekihaku data as miscellaneous staple grains (*zakoku* 雑穀) a term that remained

which seems a higher unit-price differential than in the Europe and the Middle East. The availability of cheap substitute is to make more plausible an estimation of labour rewards of unskilled workers in Kyoto lower than one kg rice in the late 13th century, and only slightly above thereafter. Converting half this volume into barley, millet, or buckwheat allowed keeping a worker above subsistence level, although not a family.[46] The international comparison of skill premia should perhaps be regarded in light of the availability of cheap substitute.[47] Data for Florence and London (Allen 2001), and in Istanbul (Pamuk 2001) indicates that skilled workers (masons and other construction workers) earned only twice the wages of unskilled workers (their helpers). But, while in London and Florence the volume of grain affordable was in almost exact proportion of nominal wages, unskilled Japanese remained at subsistence level even if their rice wages, measured in weight, were lower than the wheat wages of their European counterparts.

However, this is only one part of the explanation of the large difference in skill premium, and possible a small part of the story. While the estimates for Kyoto presented above are mostly based on individual data, data for London, Florence and Istanbul are standard wage rates. The consequence is information on wage dispersion is unavailable. The most striking surprise in European data is the absence of casual unskilled workers: rural labourers moving to city during the slack season, women from low income urban households willing to offer labour at bargain rate as helpers on construction sites, and above all young apprentices of craftsmen. Similarly, there is no information on menial jobs in the service sector that were not too much demanding in term of physical expenses; these jobs were suitable for people whose opportunity cost was very low, even if the reward was nothing more than the equivalent of two meals.[48] Our interpretation is therefore that those described as unskilled in data for London, Florence and Istanbul could be in fact semi-skilled workers comparable to those paid 50 *mon* per day in Kyoto. Hence, the skill premium may well have been of the same magnitude in Kyoto and in Europe (around 100%), if the term skill premium is used in a narrow sense to describe the gap between the wage of craftsmen and the labour reward of their most skilled helpers.

VIII. Conclusion

The results presented in this paper clearly indicate that pre-Tokugawa Japan was probably not as poor and barren as what Alessandro Valignano's description might suggest. An investigation based on a representative basket of consumer goods is desirable in order to achieve a comparison in terms of welfare ratios using baskets comparable to those computed for Europe by Allen (2001).[49]

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used until now to described a mix of millet, barley, and buckwheat, sometimes boiled together with proportions depending of the local availability of the different grains.

[46] Hence, half kg rice could purchase at least one kg of other staple grains that are comparable to rice in terms of nutritional content; about 3400 calories per kg, which is the requirement for adult hard working male labourers such as transporters walking a distance of around 25 km per day. Caloric and protein contents of millet (*Panicum miliaceum*) are 3780 kcal and 110 g; the figures are 3430 kcal and 123 g in the case of buckwheat (*Fagopyrum esculentum*).

[47] It appears that the wheat premium, compared to the less preferred grains, was of a similar magnitude, about 100 percent, in Japan and in Europe. In rural medieval England, the cheapest grain was oats that was sold for less than half the price of wheat (Campbell 2000, 224). In early 17th century Milan, wheat commanded a premium of about 105 percent relative to rye, and 110 percent relative to millet (average for 1605-1620 calculated using the data reported on the spreadsheets Prices and Wages in Northern Italy, 1286-1914 prepared by Robert C. Allen (available at website of University of Oxford's Department of Economics).

[48] Interestingly, we find these job descriptions for Cairo: porters, water carriers, custodians, and doorkeepers. Although the number of observations is limited, we can estimate a skill premium in a range between 4 and 7 (in comparison with craftsmen who, according to data reported by Ashtor, were Jewish workers working 26 days per month).

[49] The cost of Japanese baskets used for Euro-Asia comparison by Bassino and Ma (2005) and Allen et al. (2007) cannot be calculated at the moment for want of unit-price data for a number of items in Japan before 1700. It could be noted that the Japanese basket would include only small quantities of animal protein, reflecting to a large extent consumers' preferences. It should be noted that the diversity of food items was certainly larger in Kyoto than in London

Nevertheless, on the basis of available data on rice price and daily wages of carpenters, it appears that rice price volatility was somehow lower in Kyoto than in London or Florence, an indication of well functioning markets, and that grain wages of carpenters in Kyoto were roughly at same level as in Florence in the late 15th century and early 16th century, at the time of *Michelangelo* and *Botticelli*, and as high as in London in the second half of the 16th century, during the *Elizabethan Renaissance*. Interestingly, living standards of Japanese carpenters were still relatively low at the time of the construction in Kyoto in 1397 of the Golden Pavillon (*Kinkakuji* 金閣寺), a magnificent villa turned as zen Buddhist temple that epitomize the prosperity of the Muromachi period. It is only with the decline of the shogunal power and the emergence of local lords (*Daimyo* 大名), that the prosperity of Kyoto carpenters apparently reached the English level, in spite of the destructive impact of warfare during the Warring States period (*Sengoku jidai* 戦国時代) of the late 15th and 16th century. There was no remarkable landmark in religious architecture during that period, but a large number of castles owned by local lords, and a general improvement of the techniques used for urban and rural houses of commoners, particularly in the Kinai region.

To reconcile this finding and the picture of relatively low living standards of unskilled workers in Tokugawa Japan, in comparison with Europe, we have to consider plausible changes in the skill premium and the different skill levels. The pre-1600 data suggest the existence of three tiers in the urban labour market: highly skilled workers receiving daily wages of about 100 *mon*, semiskilled workers earning only about half, and unskilled workers earning only one tenth. On the basis of data recorded in Kyoto by Mitsui trading house (Mitsui Bunko 1989), we can calculate rice wages of unskilled workers of the late 18th and early 19th century and observe that the level was roughly the same as those of their counterparts of the 16th century (daily wages of about 1.8 kg rice). That the upper level of skilled workers earning ten times as much as unskilled workers had disappeared in the Tokugawa period: urban carpenters of the early 19th century received only about 4 times as much as unskilled workers. This implies a contraction of the skill premium as a result of a diffusion of existing techniques to a larger pool of craftsmen during the 17th and 18th century.

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(and probably also larger in Florence that in London). Since diversity matters in terms of utility, the relatively high level of animal protein consumed in England compensates to some extent for the lack of diversity. In the case of carpenters, considering the relatively high grain wages, in Kyoto as well as in London and Florence, it seems desirable to include non-food items, in particular cultural goods, in the international comparison of living standards.

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APPENDIX

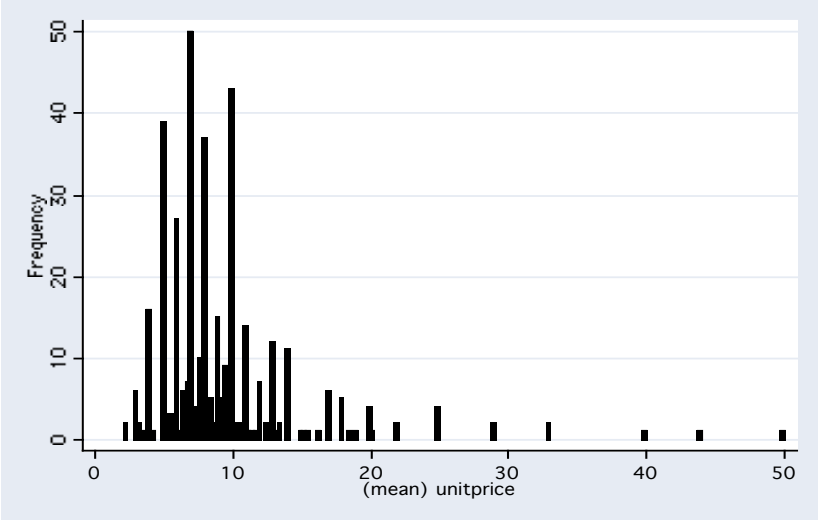

Figure A1. Histogram of rice unit price implied by *Rekihaku* data (*mon* per *sho*)

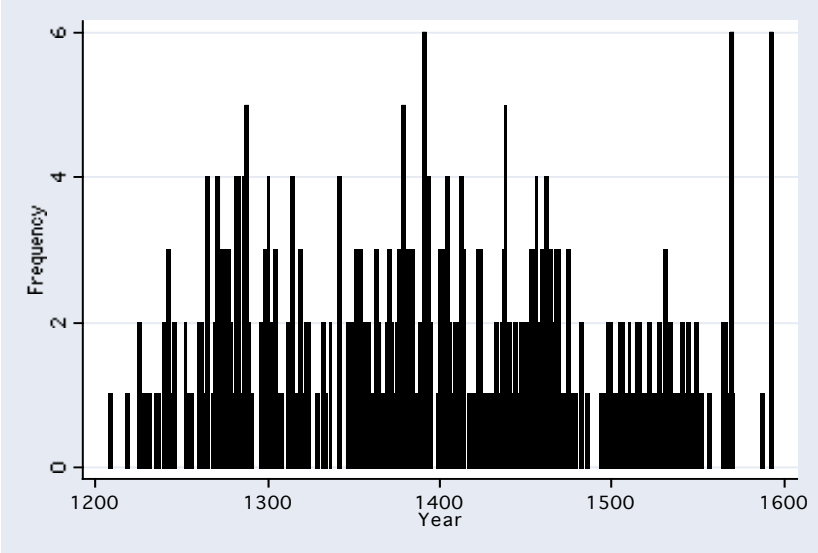

Figure A2. Histogram of mean monthly *Rekihaku* rice price data by on-year period

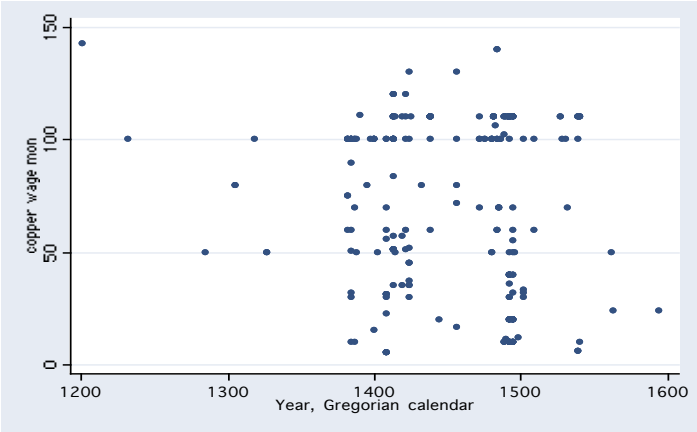

Figure B1. Nominal wages of carpenters in copper coins
Note: 284 observations (20 data points above 150 dropped; total sample size 304)

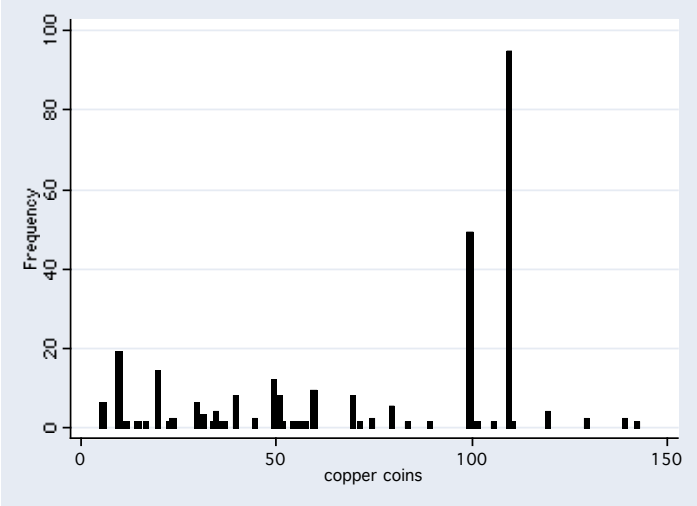

Figure B2. Histogram of carpenters copper wages (by *mon* per *sho* intervals)

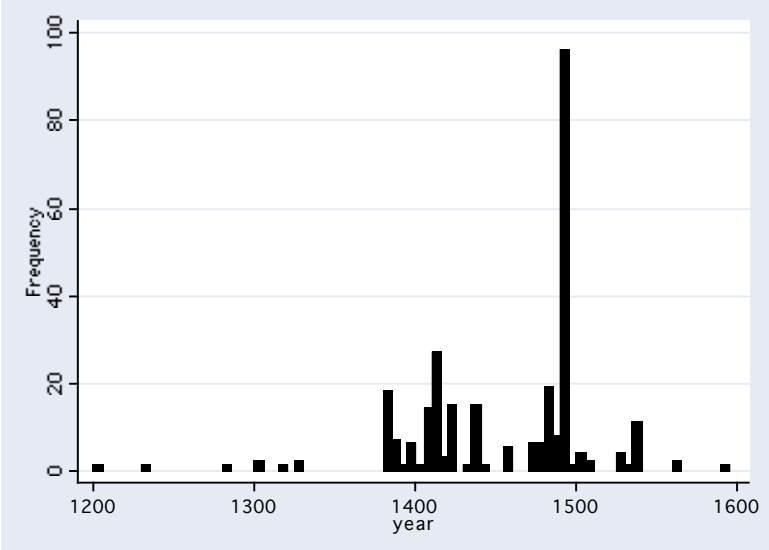

Figure B3. Histogram of carpenters copper wages data, by 5-year sub-periods

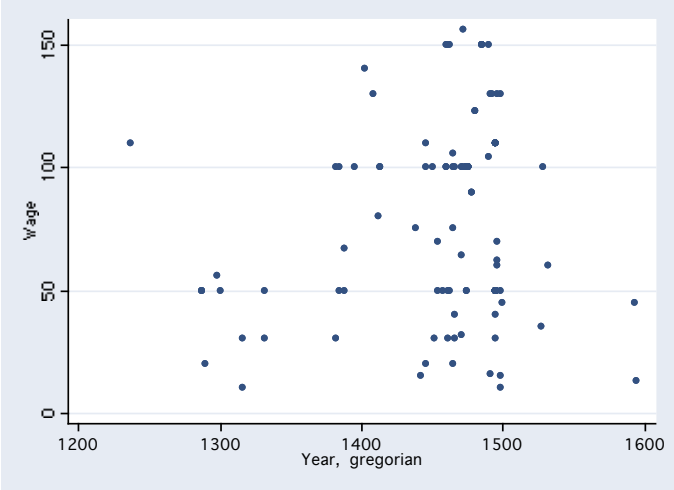

Figure A1. Nominal daily wages of blacksmith, dyers, lacquerers, and other craftsmen (in copper coins)
Note: 138 observations (2 data points above 150 dropped; total sample size 140)

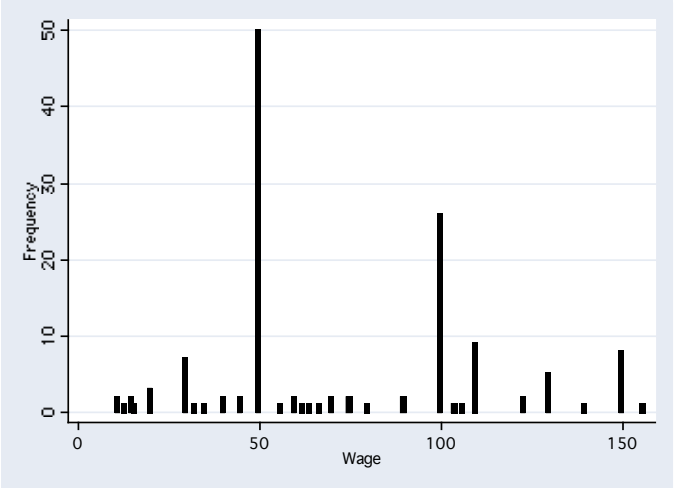

Figure A2. Histogram of other craftsmen copper wages (by *mon* per *sho* intervals)

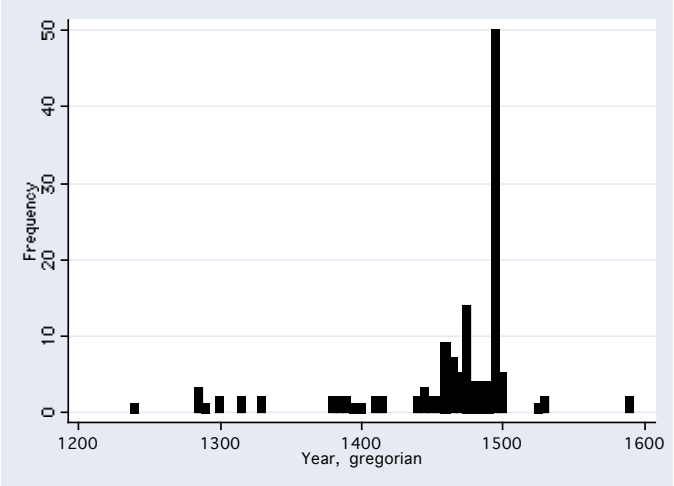

Figure A3. Histogram of other craftsmen copper wages data, by 5-year sub-periods

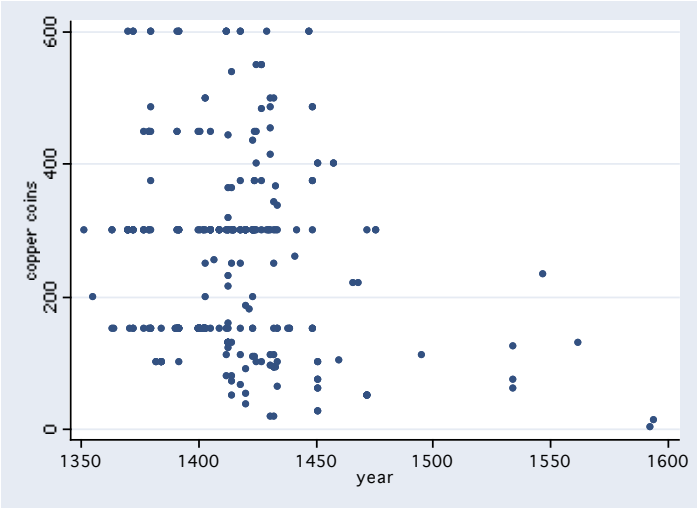

Figure C1. Payment of transporters for carriage from Harima to Kyoto (in copper coins)
Note: 305 observations (20 data above 600 dropped; total 325 obs.).

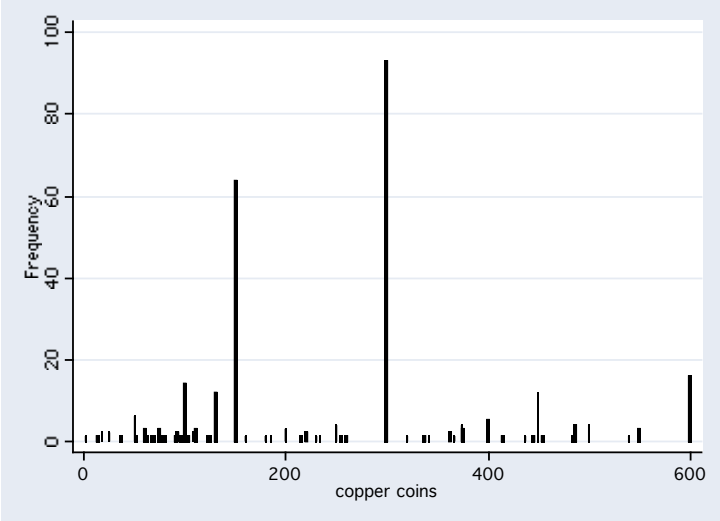

Figure C2. Histogram of transportation workers copper wages (by *mon* per *sho* intervals)

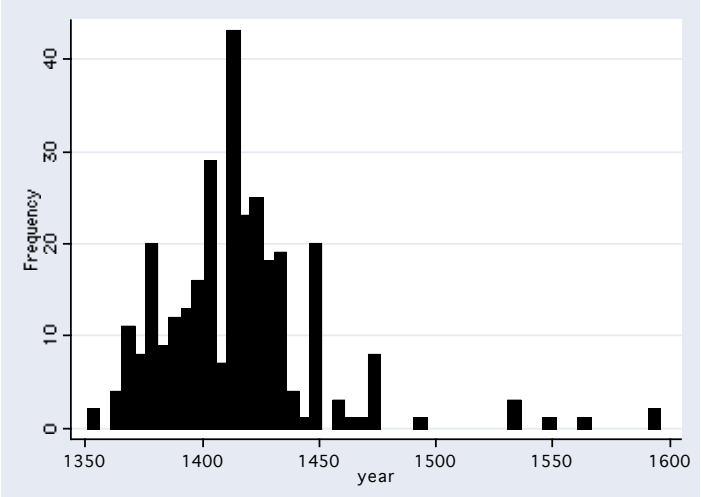

Figure C3. Histogram of transportation workers copper wages data, by 5-year sub-periods

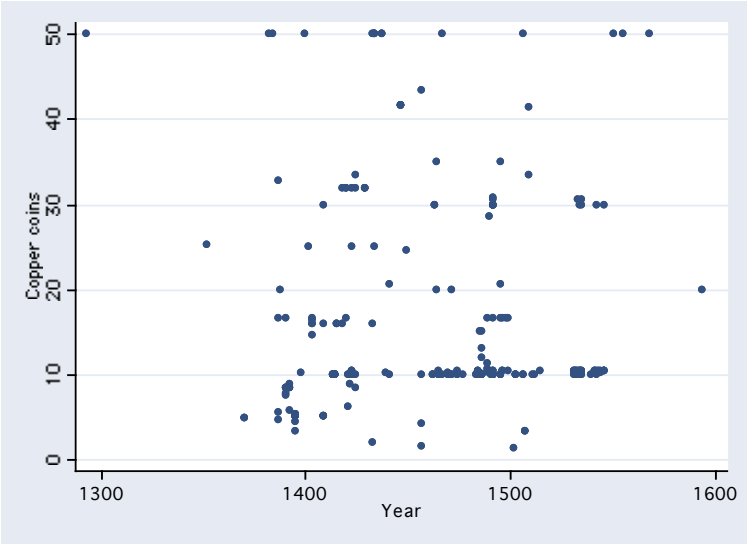

Figure D1. Daily nominal wages in the service sector (in copper coins)
Note: 299 observations, of which 98 data above 50 were dropped (397 observations).

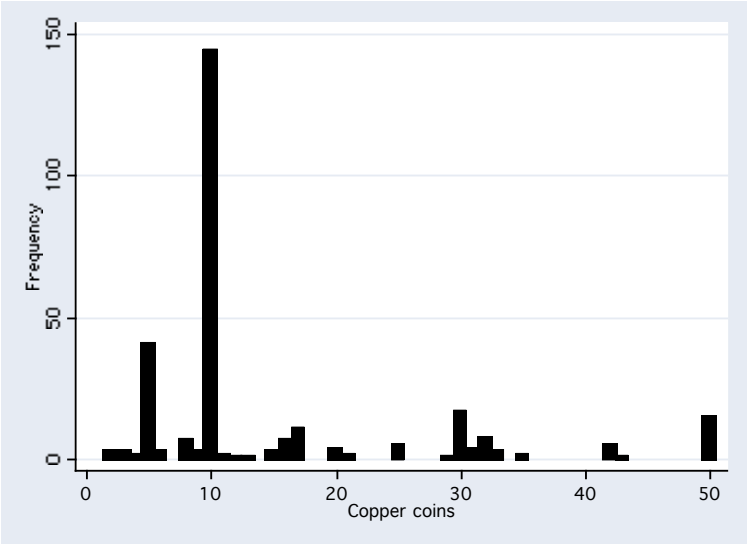

Figure D2. Histogram of service workers copper wages (by *mon* per *sho* intervals)

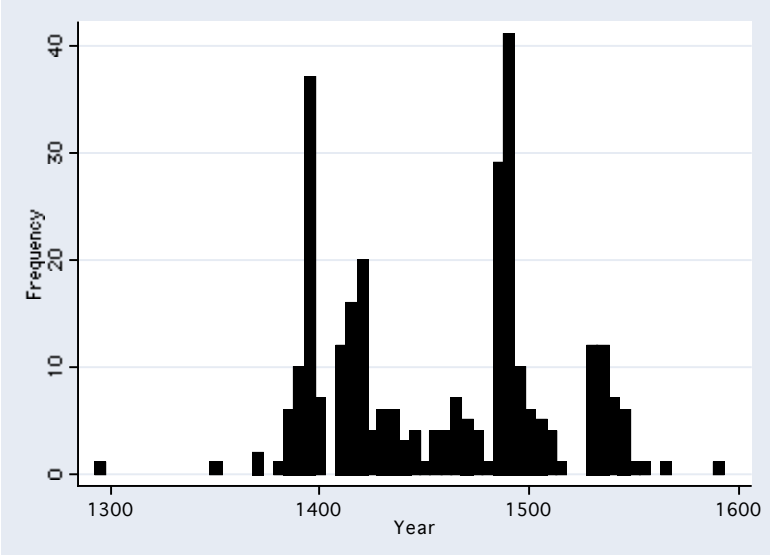

Figure D3. Histogram of service workers copper wages data, by 5-year sub-periods