Appendices

A The Price Basket

A.1 Rice Prices



Figure 1 The Price of 1 koku of Rice in Various Regions

Sources: Iwahashi (1981), Kimura (1987) as uploaded in GPIH

 For the Tokugawa Period, rice prices are retail prices from multiple location including Hiroshima and Osaka in silver prices, and Nagoya, and Edo (Tokyo) in gold prices Iwahashi (1981) and Kimura (1987) in the case of Osaka, 1600-50.[[1]](#footnote-1) I assume the Osaka prices are representative of prices in the country as a whole due to market integration. The reason for focusing on Osaka is twofold. First, many other available price series, such as that from Nagoya and Edo, are from domain sources meaning they may not reflect true market prices. Second, the Osaka price series is the only one which spans most of the period. Even if I use different price series for each region, I would have to somehow impute the prices using Osaka prices for some of the period.



Figure 2 Rice Prices Variation across 15 Japanese Cities, 1875-1884

Sources: Respective years of Nihon Teikoku Tōkei Nenkan

 The use of Osaka prices do not appear to cause regional bias as other markets tracked the prices in Osaka (see Figure 1). The prices have all been converted to silver using exchange rates as described below. The prices remain similar with the exception of famines where rice market integration was violated. These results are different from the claim of price divergence between the East and West of Japan raised by Crawcour and Yamamura (1970). This was purely a nominal phenomenon due to shifting exchange rates. The results will not be affected by the choice of location. For the Meiji period when regional prices are well documented in the *Nihon Teikoku Tōkei*, the coefficient of variation of rice between 1875-1884 averaged 0.11 which is very low considering transportation costs would cause variation in a well-integrated market (see figure 14).

 As even the Osaka rice prices are not available for all years in the 17th century, I impute the missing prices using price data from Hiroshima. Specifically, I estimate the specification below using data predating 1710 (after which rice prices are unstable) and predict the missing values.



Figure 3 The Price of 1 koku of Rice (Real and Imputed) 1600-1910

Source: Iwahashi (1981), Kimura (1987) LTES online database

 Rice prices in Osaka were in silver *monme* per *koku* of rice, where 1.435 *koku* of rice provides 2100 kcals of rice per day for one year (assuming 534 kcals per 0.001 Koku). The resulting rice price index is shown in figure 3. The price of rice increased greatly in the 17th century before stabilizing at roughly 60 monme per koku. This was most likely driven by rapidly increasing demand due to population growth. Some things to note are the effects of the great famines in the 1640s, 1730s, 1780s, and 1830s, causing spikes in the prices. The other big spike of the 1710s are due to the Hōei devaluation causing the price of silver to plummet. Rice prices became more unstable in the 1850s, as the country opened up to foreign trade and eventually entered a civil war. The prices in the period 1864-1867 are highly unstable and are not included in the graph. Rice prices was anywhere between triple to eighteen times the standard price.

 For the period after 1867, I use rice prices from Mitsui-Bunko (1989) up to 1871, Yamasaki (1911) for 1872-78, and retail rice prices from the Long Term Economic Statistics available online at the Research center for Information and Statistics of social sciences, Hitotsubashi University for 1879 onward.

A2. Other Goods

 Barley prices are from Kusano (1996) which originate from Harima province, just west of Osaka. I use the relative prices of rice to barley in Harima to approximate the barley price in Osaka. The relative price of barley averages 74% of rice prices which is higher than the proportion used by Bassino and Ma (2006) who estimated 51% based on statistics from Meiji. As the less desirable barley was relatively more expensive, I additionally proportionally increase the relative price of buckwheat to 0.6 of the price of rice for the Tokugawa period estimates. This means the basket is slightly more expensive than the other study.

 The other prices from the Tokugawa period are from the Mitsui series compiled by Bassino and Ma (2006) as available on the GPIH website. For other beans, I used the price of azuki beans. I also add prices for edible oil, clothing, soybeans, and wheat where available from Mitsui-Bunko (1989). I adjust soybeans prices to have the same average price as rice, as they were of high quality.

 For the period after 1874, I mostly use the available retail prices from the Long Term Economic Statistics. One ambiguous unit is the lamp oil in cans of oil. I assume one can is ten gallons to compute liter prices as suggested by Ito (2009). As barley prices were unavailable, I used the price ratio of rice to barley from the Teikoku Tokei to estimate barley retail prices. Edible oil prices were mostly unavailable so I used the available rapeseed and sesame prices to estimate the oil price (Tsuji, 1916; Noshōmu shō Nōmukyoku, 1919). I use available edible oil prices from 1895 onwards to estimate seed to oil price ratios. I find 1 liter of oil averaged 3.63 times the price of 1 koku of seed in the case of rapeseed and 3.57 times the price in the case of sesame seed. Using these ratios and the seed prices from 1874, I estimate the edible oil prices assuming a 50:50 ratio.

B Currency

 The currency used in Japan differed widely by region. In general, silver was used in the west while the east used gold. Copper was used everywhere for smaller transactions. Due to my basket being denominated in silver, I take the exchange rate of gold/copper and silver in Edo to make other currencies comparable. I use data from Murakami and Takahashi (1986). The choice of Edo is due to data availability but the



Figure 4 Gold/Copper Exchange Rate for Silver in Edo (Partially Imputed as explained in text) 1600-1868

Source: Murakami and Takahashi (1986)

difference in exchange rates between Edo and Osaka are unsurprisingly minor when both are available. For

years in which Edo data is unavailable, I impute the values using data from Kyoto, in a procedure identical to that for rice prices. For cases in which there are up to three year gaps in data, I linearly impute values. In the case of silver, due to the near absence of exchange rate data before 1682, I assume 60 monme per ryō which appears consistent with the limited available data.

 The resulting exchange rates are graphically presented in figure 4. The value of silver per unit remained fairly stable at 60 *monme* per *ryō* with the exceptions of devaluations and the period following the opening of trade in the 1858 when the value of gold increased. In contrast, the value of *mon* fluctuated far more. Its value fell in the late 17th century from approximately 15 *monme* per 1000 *mon* to 10 *monme* per 1000 *mon*. There is some concern that the copper exchange rate before 1640 is unreliable due to the prevalence of bad (*bita)* copper coins. However, there is only one observation where this occurs where gold was the primary form of payment and there was a supplementary copper component worth 1.7% of the total transaction. If I remove this observations, my results below are unchanged.

C Interest Rates

 I assume an interest rate of 20% to adjust the nominal pay that was received in advance. The main evidence comes from servant contracts where both a wage and a loan carrying interest was received. These were short term loans that tended to be small and comparable to wages in value. In terms of risk premium, the risk of loss is therefore comparable. The median and mean value of the annual interest rate was 20% with some variation between 10-25%.

 To confirm this value, I also estimate interest rates using shorter run work contracts (*tema hōkō*) from the Ijiri family in Kai province, by Mount Fuji and west of Tokyo. The contracts specified workers to work a few days each month for one year to pay for interest on a small loan. These loans were small in value and comparable to wage payments by the same employer. Using contracts from 1750-1799, it is clear that the payment of interest for a loan of 1 *ryō* of gold was calculated to be worth 4 days of work per month. This seems to have been based on a formula as almost all contracts adhered to this pattern. I link this to annual servant contracts by the same employer, which were almost all mixed contracts including both a loan and wage component. Assuming 4 days of rest per month, as was common in many contracts from this employer, I calculate the number of days required for a wage payment of 1 *ryō* after deducting the days worked for interest payment. This suggest 258 days of work per year for receiving an advance wage payment of 1 *ryō*. After accounting for discounting on the advance wage payment, the implied interest rate is 23% per year.

 This short run interest rate is also highly consistent with the 20% interest rate used in the paper. It is much lower than the interest rate implied from large value long-run loans within the dataset where interest rates were much higher and closer to 60%. This is consistent with how interest rates are determined for short/long term loans today.

D Wage Estimates

 I show the regression table for the preferred specification in table 1. This is a poisson regression so the coefficients cannot be interpreted directly. The time period for 1610-50 is not shown because it is the base period and the time period dummies for other periods are shown in relation to this. The predicted coefficient and 95% confidence interval of the wage when taking loan dummy as 0, contract length as 1 year, and regions weighted by population can be found in the figure 5 in the main paper. Some of the time period dummies are cut off at some irregular times due to the following reasons. 1696, 1707, 1719, 1735 are cut-offs due to devaluations/revaluations that likely led to discontinuities in the nominal wage. Rather than use a dummy for these devaluations, which will lack power, I cut off the time periods at these dates. 1867 is a cut off due to the Meiji revolution and a subsequent transition to a gold based currency from 1868-1869. The contract length dummy takes the nearest month and groups observations.

 The detailed regional-time period breakdowns are as follows with before (after) 1750. There are 1 (515) observations for Chūgoku region, 6 (10) from Hokuriku, 121 (571) for Kantō, 16 (219) for Kinai, 48 (131) for Kōshin, 6 (10) for Kyūshū, 60 (209) for Tōhoku and 6 (29) for the Tokai region.

 Most of the coefficients for the non-time period dummies are as expected (see table 1). Some of the contract dummies have unexpected signs but this is due to small sample size for contracts of specific lengths. However, I use only contracts that are of 12 months in length as a robustness test and the results are broadly similar.

 I also estimate the wage using the rice basket and respectability basket in figure 5. The results are very similar to that from the barebones basket due to the relative basket price remaining mostly stable. The main difference is in the levels. The respectability basket is most expensive so wages look lower. The pure rice basket consisting of 2,100 kcal of rice per day is slightly cheaper making wages look higher.
 I present all of the main estimates with 95% confidence intervals against the averages from 1 year wage contracts in figures 6 and 7. The few deviations seen in figure 6 are likely driven by the lack of regional controls conducted in the regression. The estimates are also not radically different from the averages.

 Figure 8 shows comparisons between my estimates based on servant wages with others based on day wages. I make them comparable by assuming 325 days of work per year for servants. The rural day wages are higher but this may be for a number of reasons. First, wage premium from the risk of an insecure job. Second, day laborers were likely hired in seasons with labor shortages that required extra laborers. Thus, there could be a seasonality premium. In contrast, servant wages average both productive seasons and less productive seasons where there was not much to do. Third, this is also only one series of wages with one observation per year. It is not uncommon to find single servants earning wages similar to these day laborers. Urban day wages are much closer to the servant wages. As urban wages are expected to be slightly higher than my rural wages based on servant contracts, due to higher costs of living and a risk premium, it suggests the lack of a significant wage rural-urban wage gap.

 Finally, Figure 9 shows a robustness check whereby I assume in-kind payments were respectability baskets but measure wages using barebones baskets in the case of Japan. This is not a useful exercise when looking at only Japan because it would be preferred to interpret the data with respectability baskets. However, this could be useful for international comparisons where all baskets are barebones. One issue is that this may overestimate wages, especially during the period of low wages circa 1700 when in-kind payments may have been less generous. This measure shows wages are slightly higher by about 0.8 baskets but the main narrative remains unchanged beyond brining Japan more in line with Bengal wages.

 A supplementary file is available containing the main results and the results for the regional regressions. This includes the nominal predicted wage in addition to the basket prices used to convert these wages.

Table 1 Poisson Regression Results of Preferred Specification



Table 1 Continued



Note: This is a poisson regression where the dependent variable is the nominal wage/loan within the contract. The sample size is 1,596 observations. I omit 1610-50 for time period dummy, 12 months for contract length, and Chugoku region pre-1750 for the region dummies.



Figure 5 Male Annual Farm Wage Estimates using Alternative Baskets
Source: Servant wage dataset and price dataset



Figure 6 Main Estimates with 95% Confidence Intervals and Averages of 1 Year Wage Contracts
Source: Servant wage dataset and price dataset



Figure 7 Regional Estimates with 95% Confidence Intervals
Source: Servant wage dataset and price dataset



Figure 8 Servant Wages per Day compared to other Day Wage Estimates
Source: Servant wage dataset, price dataset, Saito (1975), and Bassino & Ma (2006)



Figure 9 *Alternative International Day Wage Estimates assuming respectability in-kind payments*Note: All units are in number of one person’s worth of basket purchasable. I use the barebonesbasket for Japan to make it comparable to the estimates for China. Sources: GPIH websitewages as originally used by originally used by Clark (2007), Allen et al. (2011), Allen et al.(2011), Zwart and Lucassen(2020)

E Price Baskets for England, Italy, China, and India

 I use the baskets given in table 3. The baskets are not radically different from their original sources except they keep to the criteria outlined in the main text. The calories/protein content per unit are as follows. Bread: 2450 kcals/100g protein, Oats: 3790 kcals/131.5g protein, Rye: 2434 kcals/131.5g protein, Sorghum: 3390 kcals/113g protein, Beans: 1125 kcals/71g protein, Chickpeas: 3640 kcals/205g protein Meat: 2500 kcals/200g protein, Butter: 7286 kcals/7g protein, Olive Oil: 8840 kcals/0g protein, Oil: 8133 kcals/1g protein, Ghee: 9000 kcals/0g protein, Sugar: 3890 kcals/0g protein.

Table 2Bare-bones Basket by Location



Sources: Allen (2001), Clark (2007), Allen et al. (2011) and Zwart and Lucassen (2020)

F Land Rental Income Estimates

 How significant were land incomes in a feudal economy such as Tokugawa Japan, where peasants lacked the rights over land? The average tax rate by the government was 40% of estimated yields. This refers to tax in proportion to the yield estimated by the government in 1868, as calculated by Steele et. al. (2017). Due to a political system that granted autonomy to the over 300 lords there was considerable heterogeneity in tax policy across the country. Moreover, there has been no systematic studies of taxation policy of the lords due to decentralized tax collection. We only know that some governments had fixed tax rates (*Jyomen-hō*), while others had proportional tax rates (*Kemi-hō)*. The rate of taxation varied widely by region. These high tax rates imply small land rental incomes net of taxation during this period.

 However, the real tax rates became lower over time because the cadastral surveys of the mid-17th century became outdated, and the lord's did not conduct new surveys to update the yield of their lands.

Table 3 Land Rental Income Calculation



*Note: Yields taken from Bassino et al. (2019) and Okurashō-Sozeiryō (1873)*

This was partly because cadastral surveys could lead to peasant revolts which were costly to deal with. Moreover, they were existential threats to the lords because the shogun could use such instability as an excuse to confiscate their lands. Therefore, the lords were definitely aware of increased yields but strategically turned a blind eye towards it (Steele et. al.; 2017). Therefore, tax rates were based on outdated yields allowing for tax evasion.

 Tax was evaded via two channel, increased productivity and increased land area. Increased productivity was pocketed by peasants as increased wages and land rent net of taxes. Increased land area was partially taxed because some fields entered official cadastral surveys while others remained hidden.

 In table 4, I show estimates of land rental incomes based on a tax rate of 40% and a wage share of 50% that was fixed from 1600 onward. The wage share comes from typical land rental contracts where yields were often split 50:50 in the 19th century. The landholder would then keep the land rent net of taxation. A similar wage share must have also existed in the 17th century when landholdings clearly had value despite 40% of yields commonly being taken by lords. Had the landholder not kept more than 40% of the yield, the landholdings would have had negative value as the landholder gets no benefit. However, land sales were commonly occurring in the 17th century, as seen by the need felt by lords to ban permanent land sales in 1643, which suggests lands were valued as assets.[[2]](#footnote-2)

 I account for tax evasion over time via increased productivity and increased land area by using the official government yield in 1872 as an indicator for total taxed yields. I assume such fields were linearly bought into cultivation after the cadastral surveys of the 17th century. I assume the fields that were recorded by the lords were taxed at 40%. Given these conditions, I can calculate the land's share of yield which is the landholder’s share net of tax.

 I use this information to construct table 3 in the paper. The distribution of lands is taken from Kumon (2019) which uses village censuses that list landholdings by each household to estimate the average distribution of land within Japanese villages. This gives the best estimates of how the land rental incomes were distributed.

G Servant Wage Sources

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1. Both of these sources are uploaded in electronic format on the Global Price and Income History website. I also have prices for Echizen and Aizu but the prices diverge greatly from central market locations. This is likely due to the Aizu source being from domain sources, while Echizen prices are from one large landholder who was opportunistically selling rice to markets. This may explain this divergence and why they are unreliable. [↑](#footnote-ref-1)
2. Land sales were banned but there were many ways of getting around this regulations. Peasants continued to sell lands by other means after the ban. [↑](#footnote-ref-2)