Social Science Japan Journal Vol. 23, No. 2, pp 147–184 2020
Advance Access publication September 28, 2020

doi: 10.1093/ssjj/jyaa023

Property Systems and Economic Growth in Japan, 730–1874

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New estimates on the premodern economic growth of Japan, based on more concrete evidence, have been presented. We revise the estimates of Japan's gross domestic product (GDP) from the mid-eighth century to the mid-19th century and its population in the 12th century and describe the institutional transformations that correspond to the output changes. The revision of output and population results in updated estimates of per capita GDP for the medieval period and extension of the growth estimates in the early modern period to the annual series for 1651–1841. This study employs the techniques of quantitative inference and descriptive interpretation of the estimated performance. The findings show that: (a) Both the GDP and population significantly declined towards the 12th century, stagnated and experienced recovery from the 13th century onwards, and then continued to grow through the 17th century; (b) GDP growth accelerated in the 18th and 19th centuries; and (c) per capita GDP growth began to rise in the 13th century after a sharp decline from the 10th to 12th centuries. It continued to rise through the 16th century but declined again in the mid-17th century and finally rose again from the late 17th century onwards.

Keywords: *early modern period; economic institutions; GDP; medieval period; productivity*

1. Introduction

Major advanced economies, including Japan, began to experience accelerated productivity growth in the early modern period, that is, around the 17th and 18th centuries, before being fully modernised in the 19th century. Globally, the East and West diverged in that period. Regionally, northwestern Europe advanced within Europe, and Japan advanced within East Asia at that time. An inquiry into early modern changes is thus critical to understanding how major advanced economies emerged. Furthermore, to understand the early modern ascendance of these economies, we need to pay attention to their stagnant or much more modest growth in the medieval period. Acceleration of the productivity growth over the centuries has also accompanied institutional transformations. The direction of causality, however, is hard to pin down. Institutions might affect technological changes and economic developments, as Hegel (1986) and North (2005) argued. Alternatively, as Marx (1986) discussed, economic developments might bring about institutional changes. To disentangle

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* The authors are thankful for insightful suggestions from two anonymous referees and thank Editor-in-Chief Gregory W. Noble, Managing Editor Meredith Shaw, and Special Issue Editor Susumu Cato for their helpful advice. They also appreciate discussions with Gabriel Alejandro Facchini Palma, Rok Spruk, Hyunjoo Yang, and Anthony Rossiter during the recording process and Q & A time of our session at the Econometric Society Virtual World Congress 2020. This work was supported by the JAPAN SOCIETY FOR THE PROMOTION OF SCIENCE KAKENHI Grant Numbers JP18H03630, 16H06322, 19K13755, and the JAPAN CENTER FOR ECONOMIC RESEARCH.

the complexity, we may construct a time series of gross domestic product (GDP) per person, an indicator of productivity, for each country from the ancient and medieval periods to today and match institutional changes with economic performance throughout the past to comprehend how our current economy has been formed, and possibly, to identify the causality between changes in institutions and economic performance. The late Angus Maddison's project on the per capita GDP of nations was one such attempt.[1] Although per-country performance evidence was not particularly strong in Maddison's project, it certainly represented a breakthrough as a political economy approach. Maddison suggested that current economic performance can be forecast by past performance over a few centuries and hence, in all probability, by the past changes in institutions in the past few centuries. Updating the estimates was a task left to subsequent scholars.

Regarding Japan's past, studies by Fukao *et al.* (2017b), Fukao *et al.* (2017a), Takashima (2017), and Bassino *et al.* (2019) are some of the recent works estimating Japan's GDP from the 730s to the 1870s, effectively replacing the estimate by Angus Maddison. Unlike Maddison's work, the new estimates depend more on historical documents of the supply side, except for the period between the 13th century and the 15th century for which they estimate output by estimates of demand. These publications are part of a project by the Institute of Economic Research at Hitotsubashi University.[2]

First, we revise the output estimate for the medieval period presented by Fukao *et al.* (2017a), Takashima (2017), and Bassino *et al.* (2019). In these works, the authors estimate the agricultural output using historical documents on paddy fields with respect to the supply side for the seventh to 12th as well as the 16th centuries and onwards. The output for the 13th to 15th centuries was calculated using an estimate of demand based on the real wage estimates by the authors and the population estimate by Farris (2006, 2009).

In a later study, Midorikawa (2019) estimates the rice output from the mid-eighth century through the late 16th century only using historical documents of paddy fields such as taxation records and ancient encyclopaedias. Thus, the author provides estimates based on supply-side data through the ancient and medieval periods. Further, the author accounts for climate cooling from the 10th to 12th centuries and considerably revises the previous estimates downwards. Adjusting the estimate by Midorikawa (2019), we construct a consistent estimate of agricultural output from the eighth century to the late 16th century based entirely on supply-side data.

The Midorikawa (2019) estimate also helps us revise the population estimate by Farris (2009). In Farris (2006, 2009), the population is estimated based on historical documents on the surface of farmland as well as the author's assumptions of land productivity and living standards. Thus, the downward revision of land productivity for the 12th century by Midorikawa (2019) motivates us to revise the population estimate by Farris (2009) simultaneously.

Second, we extend the output estimate for the early modern period by Fukao *et al.* (2017b) and Bassino *et al.* (2019). Fukao *et al.* (2017b) present the output estimates for several years from the 17th century to the 19th century. Imamura and Nakabayashi (2017) further revise the estimate by Nakabayashi (2012) of the annual agricultural output of the Edo (Tokugawa) shogunate (1600[1603]–1867) domain for the mid-17th century through the mid-19th century. Combining the estimated national output by Fukao *et al.* (2017b) and the shogunate's annual agricultural output by Imamura and Nakabayashi (2017), with adjustment for possible oversight in cadastral surveys, we construct the national annual output estimates for the mid-17th century through the mid-19th century.

Third, we summarise the performance of the annual national output in the form of per capita GDP from the medieval to early modern periods. With our updated estimates of the GDP and population

[1] http://www.ggdc.net/maddison/oriindex.htm/, last accessed on 29 August 2019.

[2] Kunitachi, Tokyo, Japan. http://www.ier.hit-u.ac.jp/histatdb, last accessed on 29 August 2019.

for this period, our new estimate shows a sharp decline towards the 12th century and recovery from the 13th to 16th centuries, whereas the previous estimates of the GDP per person show extended stagnancy between the ninth and 14th centuries. For the early modern period from the 17th century onwards, we provide an annual estimate from 1651 to 1841.

Fourth, we empirically show that the agricultural output in the early modern period was responsive to prices, indicating that farmers were exposed to the market.

Fifth, surveying qualitative arguments based on descriptive works, we review the institutional changes behind the intensive and extensive margins of growth from the ancient to modern periods estimated herein. We observe a considerable change in the productivity in the early modern period, as peasants' smallholdings were protected as property rights. By property rights, we mean two connected rights: residual control rights, which allowed landholders to use their land as they determined, but within the constraints of the law, contracts, and customs; and residual claims, which were the leftovers after the holder performed all financial obligations under the law, contracts, and customs (Hart 1988). If farmers were exposed to the market, the protection of their property rights would provide them with incentives for productivity improvements. Our quantitative results on productivity and the output's responsiveness to prices are consistent with the emphasis on the protection of smallholders' property rights by qualitative arguments.

Our contribution to the literature is two-fold. First, our revision and extension of the output estimates by Fukao *et al.* (2017a), Fukao *et al.* (2017b), Takashima (2017), and Bassino *et al.* (2019) as well as our revision of population estimates by Farris (2009) provide a more reliable and detailed estimate of the output and population of Japan through the mid-19th century. Notably, we find that the productivity recovery in the medieval period began in the 13th century and that the early modern acceleration of productivity growth began in the late 17th century. Second, our results offer a rigorous viewpoint for two debates on the 'little divergence in Asia' and the 'state capacity' of pre-industrial societies.

As Bassino *et al.* (2019) demonstrate, and as we review in section 4, Japan's per capita GDP surpassed China's for the first time in its history in the 18th century, and Japan has continued to widen the lead since then. Its per capita GDP came close to those of peripheral European countries by the early-19th century. This development resembles the divergence between northern and southern Europe and is considered the 'little divergence in Asia' (Bassino *et al.* 2019). Meanwhile, from the early-19th century onwards, notably after the Napoleonic war, European nations accelerated their productivity growth by opening their markets, enabling free international trade, and allowing cross-border technology transfer. Thus, the shogunate's isolationist policy exacerbated Japan's relative backwardness with respect to the West (Schreurs 2019; Broadberry and Fukao (Forthcoming)).

As presented in sections 2, 3, and 4, and discussed in section 5, the rise in productivity began in the period of the Kamakura shogunate. It accelerated in the 15th to 16th centuries, when the manorial (*shoen*, estate) system collapsed and local feudal lords gained power. Later, productivity accelerated further from the late 17th century onwards under the Edo shogunate. Under the manorial system, the largest recipients of the land tax revenue were manorial lords in imperial Kyoto. Thus, the transition of power accompanied a decentralisation of the land tax revenue. This fiscal decentralisation financed the nation-wide reclamation of alluvial plains in the lower reaches and city buildings in the 17th century under the Edo shogunate federation. Further, the shogunate and local lords in developed domains vested farmers with property rights in the 17th century. The protection of property rights provided smallholders with incentives to improve productivity.

Our new output estimates are relevant to the debate on 'state capacity'. State capacity denotes the ability to levy a tax in order to provide public goods, and it is measured by the tax rate over the output. We know that British ascendance in the West and Japanese ascendance in the East were accompanied

by higher state capacities (Dincecco (2009, 2011); Dincecco and Prado (2012); Dincecco and Katz (2014); Sng and Moriguchi (2014); Aoki, Che and Nakabayashi (2016); Dincecco and Onorato (2016); Koyama, Moriguchi and Sng (2018); Cox and Dincecco (Forthcoming)). In the 17th century, when the shogunate established farmers' property rights, the tax rate reached 30% of the GDP in return for property rights protections. Though the rate declined over time as productivity grew, it remained at 14% in the mid-19th century. This rate was comparable to the English rate in the late 1810s after the Napoleonic Wars (O'Brien and Hunt 1993: 175), and higher than Spain's 10% rate in the 17th century (Comín Comín and Yun-Casalilla 2012: 244), China's 8% rate in the mid-19th century (Deng 2012: 342), and Turkey's less than 8% rate in the mid-19th century (Pamuk 2012: 321). Institutional arrangements to protect farmers' property rights under the Edo shogunate not only provided farmers with incentives to improve productivity but also bequeathed substantial state capacity to Meiji Japan for modernisation.

We organise the rest of the article as follows. In section 2, we revise the Fukao *et al.* (2017a) estimate of Japan's GDP in the medieval period by incorporating a new estimate by Midorikawa (2019). Based on Midorikawa (2019), we also revise the Farris (2009) population estimate for the 12th century. In section 3, we extend the Fukao *et al.* (2017b) GDP estimate in the early modern period by combining it with the estimate by Imamura and Nakabayashi (2017). Section 4 summarises our estimates of the output and population in the form of the GDP per person from the eighth to 19th centuries. We then empirically test whether the agricultural output responded to prices in the early modern period. The output's price responsiveness indicates whether farmers were exposed to the market—if not, then they would not have significantly responded to the prices, and the incentive effects of smallholders' property rights protection in the early modern period would have been quite limited. Thus, the empirical test is critical to the qualitative evaluation. Next, section 5 reviews the institutional changes consistent with the evolution of economic performance. Finally, section 6 concludes the article with a summary of the estimate results as well as a discussion of the implications of historical legacy from the examined period.

2. Estimates for the Medieval Period

2.1. Agricultural Output

The GDP estimates of Fukao *et al.* (2017a) and Bassino *et al.* (2019) are based on the estimates of agricultural products by Takashima (2017). For the years 730, 950, and 1150, Takashima (2017) estimates the agricultural output from existing documents by the imperial court and ancient encyclopaedias. For the year 1600, Takashima (2017) uses documents left by feudal lords.

For the years 1280 and 1450, Takashima (2017) estimates the demand for food by his estimates of real wages and the population estimates by Farris (2006, 2009). Takashima (2017), Fukao *et al.* (2017a), and Bassino *et al.* (2019) accordingly extrapolate the agricultural output. This demand-side approach will be refined in the same way as the real wage estimates are updated (Saito and Takashima 2020).

For the years 730, 950, 1150, 1280, and 1450, Takashima (2017) presents ranges of estimates. The output estimates by Fukao *et al.* (2017a) and Bassino *et al.* (2019) adopt a median of ranges estimated by Takashima (2017).

Meanwhile, Midorikawa (2019) estimates rice crops from the early eighth to the late 15th century using ancient encyclopaedias and documents such as the taxation records left by the imperial court. Thus, for the entire ancient and medieval periods, Midorikawa (2019) adopts the approach taken by Takashima (2017) for the period between 730 and 1150. Figure 1 compares these estimates.

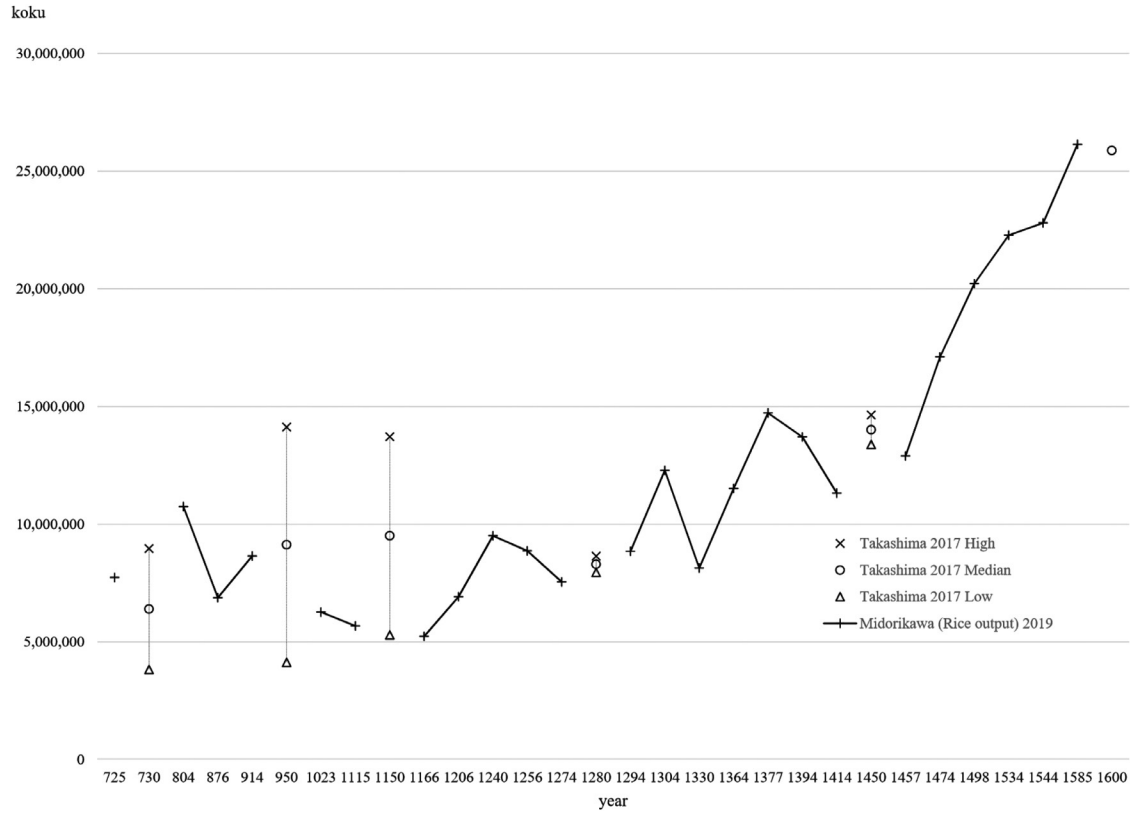

Figure 1. Comparison of Takashima and Midorikawa's Estimates. *Source*: Takashima (2017: 101) and Midorikawa (2019: 22).

First, we find that, except for the year 1150, the median estimates of the total agricultural output by Takashima (2017) are comparable with the estimates of the rice output by Midorikawa (2019), including the years for which Takashima (2017) estimates the agricultural output by the demand-side approach based on real wages and population estimates.

The unit of output used by Midorikawa (2019) is the taxation unit that Midorikawa (2016) examines. There were two alternative hypotheses for the taxation unit used from the eighth to 10th centuries: Midorikawa (2016) persuasively infers that farmers could not have survived on parcels of farmland allocated by the rules of the Taiho Imperial Legal Code (*Taiho Ritsu Ryo*) of 701 if the pessimistic hypothesis had been correct. The author concludes that the unit supported by the optimistic hypothesis was thus applied.

The rice-denominated unit for taxation did not necessarily correspond to rice plants. In general, agricultural output was denominated by rice and then taxed. An example is the payment of land taxes and rents in cash. The Japanese economy was rapidly monetised after the 12th century as part of the Chinese currency sphere (Sakurai 2008; Segal 2011: 45–65; Honda 2017). The mountainous regions were among the first to accept money in the earliest phase, as rice there could not be cultivated and land-tax payments in cash were preferred (Oyama 1979). We infer that the 'rice' output estimated by Midorikawa (2016) covers the entire agricultural output.

Second, for the years 1280 and 1450, the estimates by Takashima (2017) and Midorikawa (2019) are mutually complementary. While the estimate by Takashima (2017) uses the demand-side evidence, Midorikawa (2019) relies on supply-side evidence. Nevertheless, both reach similar estimates, indicating the degree of accuracy of both approaches.

Third, the median of the estimate by Takashima (2017) substantially differs from that by Midorikawa (2019) for the year 1150. For this year, both Takashima (2017) and Midorikawa (2019) adopt the source that indicates the surface of farmland. The difference primarily depends on the assumption of land productivity, which was affected by the intensity of farming. Notably, consecutive famines struck Japan from the 12th to mid-13th centuries: the Tenei Famine in 1110; the Genei Famine in 1118–1119; the Daiji Famine in 1127–1128; the Chōshō and Hōen Famine in 1133–1135; the Kyūan, Ninpei, and Kyūju Famine in 1150–1156; the Ōhō Famine in 1161; the Yōwa Famine in 1181; the Jōan and Angen Famine in 1174–1175; the Kanki Famine in 1230–1231; and the Shōka Famine in 1258–1259 (Isogai 2008). In this regard, the downwards trend portrayed by Midorikawa (2019) seems conceivable. From the trend of the adjacent estimate years, we adopt the low estimate of Takashima (2017) for 1150.

2.2. Division of Labour and Urbanisation

Manorial lords in Kyoto and Nara in the medieval period ruled manors all over Japan. They collected half of the agricultural output in the 11th and 12th centuries. Although the rate declined with improvements in productivity, the distribution of agricultural produce to manorial lords still amounted to one-third of total output in the 14th and 15th centuries (Nishitani and Nakabayashi 2017). This income distribution, which was enormously skewed towards manorial lords who lived in Kyoto and Nara, created a substantial demand for consumer goods (Wakita 1975).

Therefore, in the early stage of the manorial system from the ninth to 11th centuries, manorial lords strengthened the division of labour within and among manors by protecting merchants and artisans. Manorial lords vested the privilege of regional monopoly in guilds of merchants and artisans. These guilds contributed to the expansion of the secondary and tertiary sectors. The division of labour and trade of commodities within and among manors expanded trading among local merchants, artisans, and consumers, particularly from the 12th century onwards when copper coins imported from China began to circulate as currency. Local markets, especially the Kyoto market, emerged from the division of labour under the manorial system (Suzuki 2017; Watanuki 2017; Sakurai 2018).

For the population, the census presided over by the shogunate has been available since 1721. For periods before the shogunate census began, Farris (2006, 2009) estimates the population from the eighth to 15th centuries and Saito (2018) from 1600 onwards. In the method by Farris (2009), the acreage of farmland is divided by the productivity assumed to be necessary to sustain a person, which is expressed as *tan* (= 0.1 *cho* = 0.140 *ha*). Farris (2009) assumes that it was 2.17 *tan* for 950 and 1.975 for 1150 (Farris 2009: 24–27).

However, Midorikawa (2019) demonstrates that the land productivity of wet-rice farming fell drastically from the 10th to the 11th centuries because of climate cooling. Midorikawa (2019) estimates the land productivities for the years 876, 914, 1023, 1115, 1166, and 1206. From the estimates, the average of years 876, 914, and 1023 is obtained as 1.01 *koku* per *tan* and that of 1115, 1166, and 1206 is 0.78 *koku* per *tan* (Supplementary Appendix A.I.2). Thus, land productivity around the mid-12th century fell to 77.23% (=0.78/1.01) of its value from the mid-10th century. Therefore, accepting 2.17 as the divider of the acreage for the year 950, we obtain $2.810 \simeq 2.17/0.7723$, instead of 1.975 for the year 1150 as provided by Farris (2009: 24–27).

Regarding the acreage of paddy fields, the numbers adopted by Farris (2009) and the estimates by Midorikawa (2019) do not show a substantial discrepancy. Farris (2009) assumes that it was 717,419 *cho* for the year 1150 (Farris 2009: 22), while Midorikawa (2019) estimates the acreage of paddy fields to be 717,000 *cho* for the years 735, 804, and 876; 721,000 *cho* for 914; 725,000 *cho* for 1023; and 734,000 *cho* for 1115 (Supplementary Appendix A.I.2). Thus, dividing 7,340,000 *tan* by 2.810, we obtain 2,612,100. To include the population in non-farm sectors, we multiply the number by 1.4 and add the urban population, 200,000, following Farris (2009). We then obtain a population of 3,856,940. Rounding up the number, we estimate the population range in 1150 as 3.7–4.1 million. Our revised population estimates are presented in Table 1.

Figure 2. Medieval Cities, 1300. *Source*: Saito and Takashima (2017a: 72).

Figure 3. Medieval Cities, 1300–1500. *Source*: Saito and Takashima (2017a: 72).

Figure 4. Medieval Cities, 1500–1600. *Source*: Saito and Takashima (2017a: 72).

Table 1. Population and Urban Population, 730–1874

Year	Population			Urban Population (Thousands)	Urbanization Rate (%)
	High Estimate (Thousands)	Low Estimate (Thousands)	Mean (Thousands)		
730	6,400	5,800	6,100	124	2.0
950	5,600	4,400	5,000	135	2.7
1150	4,100	3,700	3,900	120	3.1
1280	6,200	5,700	5,950	208	3.5
1450	10,500	9,600	10,050	259	2.6
1600			17,000	1,088	6.4
1721			31,290	3,960	12.7
1804			30,690	3,940	12.8
1846			32,210	3,960	12.3
1874			34,840	3,588	10.3

Source: The total population for the year 1150: This study (see the text). For others, see Saito and Takashima (2017a: 76); Fukao *et al.* (2017a: 290); and Fukao *et al.* (2017b: 285). Farris (2006, 2009) provide the original sources for the years 730–1450 and Saito (2018) for 1600.

Meanwhile, Saito and Takashima (2017a) investigate cities and towns recorded in existing historical documents and estimate an urban population with more than 1,000 residents. As figures 2, 3, and 4 show, cities and towns emerged around the junctions of trade centres such as ports.

Among the cities and towns they identified, Saito and Takashima (2017a) and Fukao et al. (2017a) counted cities with an estimated population of 10,000 or more, defining population in such cities as

urban population, and compared the number with population estimates by Farris (2006, 2009), as in Table 1.

Smith (1937[1776]) argues that the depth of the division of labour tends to increase with the size of the market (Smith 1937[1776]: 17–21), which, in turn, can be approximated by population density and urbanisation (Malanima 2005, 2010). Saito and Takashima (2016) estimate the weights of the secondary and tertiary sectors for 1600, 1721, and 1846 by projecting the relationship between the secondary and tertiary sectors, population density, and the urbanisation rate in 1874.

Fukao *et al.* (2017a), Fukao *et al.* (2017b), and Bassino *et al.* (2019) apply the same relationships between the output of the non-farm sector, population density, and urbanisation rate to the ancient and medieval periods, and thus estimate the sectoral output composition of the GDP from the eighth century, as shown in Table 2. The estimates might not be perfectly precise, but we believe that the estimation of the non-farm sector using population data is straightforward and tractable.

2.3. Gross Domestic Product

As discussed, referencing Midorikawa (2019), we adopt the low estimate of agricultural output by Takashima (2017) for 1150 and the median estimates for the other years. As estimated by Fukao *et al.* (2017a), we assume here that the agricultural output amounted to 84.36% of subtotal of the primary sector. Using the sectoral composition shown in Table 2, we obtain the GDP estimates, as shown in Table 3.

By connecting the agricultural output estimates by Takashima (2017) and Midorikawa (2019), we add estimate points for GDP to those by Fukao *et al.* (2017a) (Supplementary Appendix A.I.1). Figure 5 shows the estimates of the GDP from 730 to 1600 in terms of the 1990 international Geary–Khamis dollar.

Table 2. Sectoral Composition, 730–1874

Year	Primary (%)	Secondary (%)	Tertiary (%)
730	86	6	8
950	87	5	8
1150	87	6	8
1280	85	6	9
1450	82	7	11
1600	74	9	18
1721	63	11	26
1804	63	11	26
1846	63	11	26
1874	60	12	28

Source: Fukao *et al.* (2017a: 293); Fukao *et al.* (2017b: 285); and Bassino *et al.* (2019: 13).

Table 3. Gross Domestic Product, 730–1600

Year	Primary		Secondary	Tertiary	Total	
	Agriculture	Primary Subtotal				
	koku	*koku*	*koku*	*koku*	*koku*	Thousands of 1990 International Geary–Khamis Dollars
730	6,329	7,502	478	713	8,693	2,367
950	7,990	9,471	579	885	10,924	2,975
1150	5,299	6,281	399	588	7,262	1,977
1280	8,298	9,836	673	1,090	11,600	3,159
1450	14,016	16,615	1,374	2,223	20,212	5,504
1600	25,879	30,677	3,663	7,284	41,624	11,334

Source: 1150: This study (see the text). Other years: Takashima (2017: 101) and Fukao *et al.* (2017a: 202–293).

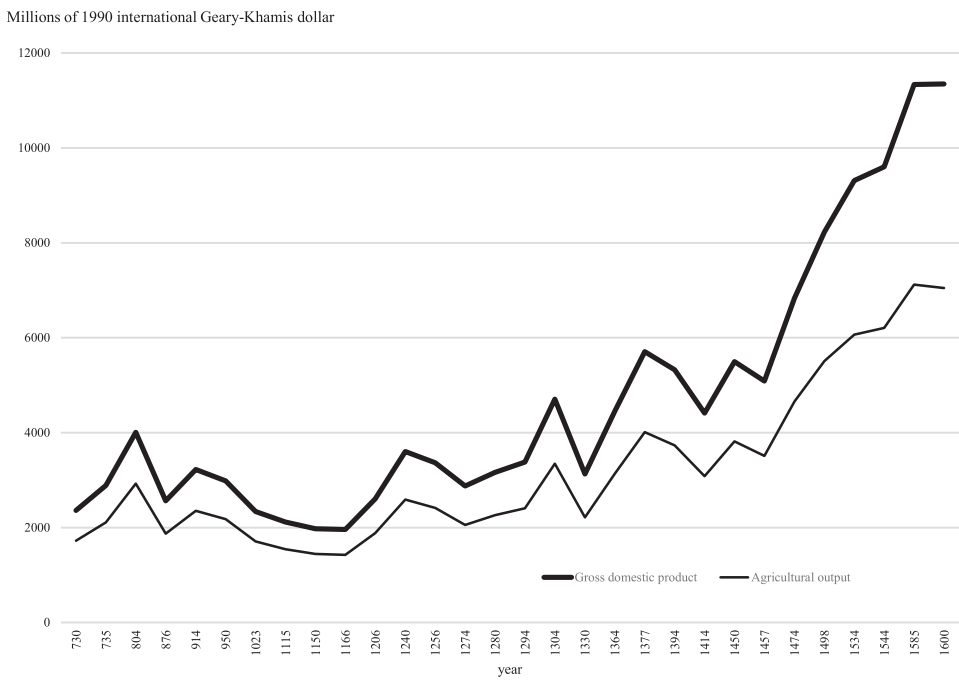

Figure 5. Gross Domestic Product, 730–1600. *Source:* Supplementary Appendix A.I.1. Takashima (2017: 101) and Fukao *et al.* (2017a) provide the original sources for the years 730, 950, 1150, 1450, and 1600. For the other years, the source is Midorikawa (2019). *Notes:* For 1150, we adopted the low estimate of agricultural output by Takashima (2017: 101). We convert the output in terms of *koku* by applying 1 *koku* = 272.31 1990 international Geary–Khamis dollars.

3. Estimates for the Early Modern Period

3.1. Output of the Shogunate Domain

The Edo shogunate governed all of Japan as the central government from 1600 to 1868. Tokugawa Japan was a federation in which the shogunate and lords were fiscally independent, and the shogunate solely relied on the tax revenue from its domain (Ravina 1999: 16–45). Regarding the shogunate domain, the output and predicted land taxes transcribed by shogunate officials for 1651 to 1841 are available.[3]

Land tax was based on cadastral surveys conducted by samurai officials. In cadastral surveys the shogunate specified each parcel of farmland, identified the stem family who cultivated the parcel, estimated the average output from the parcel, and decided the officially predicted output and land tax for the parcel. In the shogunate domain, the cadastral survey was completed in the 1670s to match every parcel of farmland with a specific farming household.If a family paid the land tax decided by the cadastral surveys, the shogunate court protected the property rights of the family against bystanders (Nakabayashi 2020).

While the land tax was payable either in cash or in kind by rice, the unit of representation of the output and land tax was that of rice, *koku*, where 1 *koku* equals 180.38 litres. While rice was widely grown in early modern Japan, other kinds of crops were also grown. All agricultural output was converted to the equivalent amount of rice, recorded in *koku*, and taxed. In Supplementary Appendix A.II, series a shows the recorded output, series b shows the land tax revenue, and series c shows the amount collected in rice out of the total land-tax revenue.

Thus, by tracking the tax basis recorded in *koku*, as seen in series a in Supplementary Appendix A.II, we know the officially predicted output of each region. However, raw output data (*koku daka*) tended to undervalue the actual output. As we discuss in section 5, the stability of the owner-peasant economy was essential to the shogunate. Meanwhile, the shogunate and lords pretended that they imposed a high tax rate. One solution was an allowance given when farmland was surveyed. When each parcel was surveyed, on average, 15% of the measured area was subtracted from the tax basis to provide a safety margin to stabilise owner peasants.[4]

Therefore, even if we can assume that the shogunate could survey all the agricultural output, the actual output on average would be $1.176\,(\simeq 1/0.85)$ times the recorded output, as shown in series d $(=a/0.85)$ in Supplementary Appendix A.II.

In the Kyōhō era (1716–1736) under the reign of Shogun Yoshimune Tokugawa, the shogunate conducted a reform of land taxes. Before the reform, fixed-rate taxation had been implemented. The collected land tax amount was, technically, a fixed percentage of the inspected crop each year. The taxation policy was changed to a fixed amount in the Kyōhō era.

The last cadastral survey in the shogunate domain was conducted in the 1690s. Thereafter, no substantial cadastral survey was conducted until the shogunate's collapse in 1868. Effectively, the shogunate ceased trying to measure productivity growth after the Kyōhō era reform.

Thus, we assume that the shogunate tracked productivity growth up to 1715 and failed to do so from 1716 onwards. Given the assumption, we estimate the primary sector output based on the shogunate's

[3] Ono (1996: 441–448). The original document for 1651–1715 is 'Okouchi ke kiroku' (Records of the Okouchi family), Ono, ed (2008b: 106–130), and that for 1716–1841 is 'Mukoyama Seisai zakki oyobi zattetsu' (Memoranda and notes by Seisai Mukoyama), Ono, ed (2008a: 62–80).

[4] See Oishi (1969[1794]: 73); the author, Hisataka Oishi, was a county governor of the Takasaki Domain in the 18th century.

official record of output until 1715. Beyond 1715, the shogunate ceased to track growth in the agricultural output, and its record is considered to have been an underestimate of the actual output. Therefore, for years beyond 1715, we estimate the long-term trend of growth in the primary sector by the benchmark estimate years of 1600, 1721, 1804, and 1846 in Fukao *et al.* (2017b) and linear interpolation between the years. We then multiply the shogunate's recorded agricultural output by the estimated trend to obtain the actual agricultural output of the shogunate domain from 1716 onwards.

For productivity, Fukao *et al.* (2017b) present the estimates of the primary-sector output per person at the national level for the years 1600, 1721, 1804, and 1846. We construct annual series trends using linear interpolation between two-point estimates, as shown in series j in Supplementary Appendix A.II.

We conservatively assume that the shogunate gathered data on 90% of the actual output until 1715, as shown in series $e(=d/0.9)$ in Supplementary Appendix A.II. We also assume that the shogunate ceased to track productivity growth after 1716; hence, series a does not reflect changes in the agricultural output per person from 1716. Thus, we estimate the actual agricultural output in year t as $g_t = e_t \times j_t/j_{1716}$ from 1716, as shown in series g in Supplementary Appendix A.II. Series e is inserted into g for the period from 1651 to 1715. As Fukao *et al.* (2017a), Fukao *et al.* (2017b), and Takashima (2017), we assume that the agricultural output amounted to 84.36% of the subtotal of the primary-sector output in order to obtain the output of the primary sector, $i = g/0.8346$.

Fukao *et al.* (2017b) estimate sector composition at the national level for 1600, 1721, 1804, and 1846 (Table 2). We construct the annual series of the ratio of the primary sector based on the linear trends between two estimate years, as shown in series k in Supplementary Appendix A.II. Then, we show the gross domestic output of the shogunate domain as series $l = i/k$ in Supplementary Appendix A.II. By converting the l series in *koku* by 1 *koku* = 272.31 1990 international Geary–Khamis dollars, following Fukao *et al.* (2017b), we obtain the GDP of the shogunate domain in 1990 Geary–Khamis international dollars, as shown in series m in Supplementary Appendix A.II. Figure 6 draws the estimated output, recorded output, and land tax revenue.

The volatility in the 17th century reflects the effects of famines. As a response, the shogunate and lords mandated savings as community damage insurance. Note that, as we discuss in section 5, the shogunate prevented the financial industry in cities from penetrating rural villages. Damage insurance was to take the form of microfinance in village communities. One early case was adopted by Lord Masayuki Hoshina in the mid-17th century, who governed the Aizu domain (Western part of the Fukushima prefecture). Lord Hoshina not only reduced land tax in periods of poor harvests but also obliged farmers to save rice to insure themselves against famines. The shogunate under the Kansei reform led by Minister Sadanobu Matsudaira in the late 18th century mandated farmers and city residents to save against possible famines (Makihara 2017).

Such insurance also mattered for output in the following years. The shortage of food alone did not directly result in mass deaths. Famine, dysfunctional governance, lack of quarantine measures, poor savings to smooth consumption, and food shortages from poor harvests were followed by a pandemic and severe damage to output (Saito 2002, 2015a; Saito and Takashima 2017a).

3.2. National Output

Relying on cadastral survey documents by the shogunate and lords, Fukao *et al.* (2017b) estimate primary sector output; applying the approach of Saito and Takashima (2016), we estimate the output of the secondary and tertiary sectors, as shown in Table 4. In the early modern period, the division of labour and growth in the secondary and tertiary sectors were substantially driven by the growing

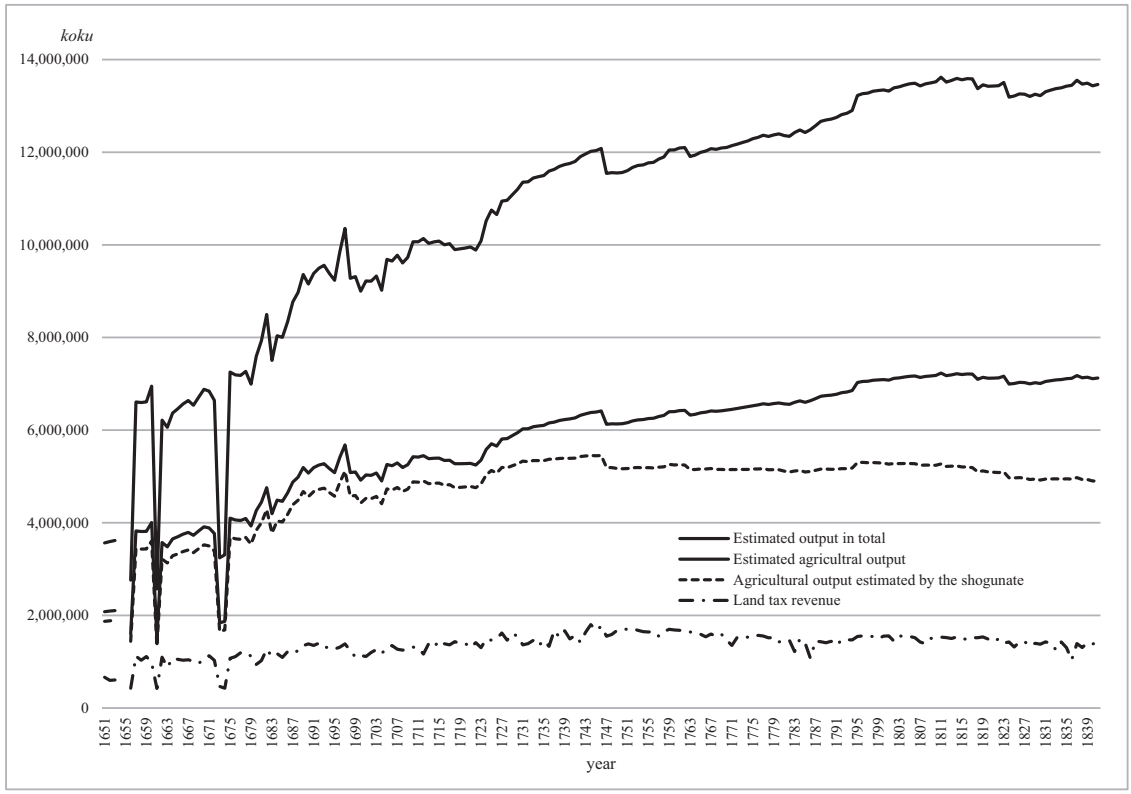

Figure 6. Output and Land Tax of the Shogunate Domain, 1651–1841. *Source*: Supplementary Appendix A.II. Original sources: Ono (1996: 441–448) (for 1651–1715, 'Okouchi ke kiroku' (Records of the Okouchi family), Ono, ed (2008b: 106–130); and for 1716–1841, 'Mukoyama Seisai zakki oyobi zattetsu' (Memoranda and notes by Seisai Mukoyama), Ono, ed (2008a: 62–80); Fukao *et al.* (2017b); and Oishi (1969[1794]: 73)).

allocation of seasonally slack labour within farming households. Under the shogunate's isolationist policy, the growing population was inevitably matched by growth in agriculture, the driving force of productivity growth. Demand in the secondary and tertiary sectors caused by urbanisation was met by side jobs taken up by farmers and young temporary workers who migrated temporarily from rural villages. Moreover, local towns surrounded by rural villages grew as industrial, commercial clusters in the 18th and 19th centuries. While skilled artisans gathered in such towns, they did not necessarily cut their ties with families in their home villages (Saito 1983, 2009; Saito and Takashima 2017b; Mandai 2019: 279–480). Therefore, the sectoral composition of the secondary and tertiary sectors was stably proportional to the primary sector throughout the early modern period.

Here, we apply the ratio of the output of the shogunate over the national output in 1721 to the period from 1651 to 1715. For 1722 to 1803, we fill in the linear trend of the ratio between 1721 and 1804, when point estimates by Fukao *et al.* (2017b) are available. For 1805 to 1851, we use the relative output of the shogunate in 1851 over the national output in 1846 to calculate national output in 1851 and thus fill in the linear trend of the ratio between 1804 and 1851. The constructed annual ratio is shown as series q in Supplementary Appendix A.II. Then, we obtain the annual series

Table 4. Gross Domestic Product, 1600–1874

Year	Primary (Million *koku*)	Secondary (Million *koku*)	Tertiary (Million *koku*)	Total (Million *koku*)	Millions of 1990 International Geary–Khamis Dollars
1600	30.700	3.600	7.300	41.600	11,328
1721	48.810	8.430	20.360	77.600	21,131
1804	58.800	10.090	24.400	93.300	25,407
1846	67.060	11.700	28.140	106.900	29,110
1874	77.103	15.888	36.551	129.541	35,275

Notes: We converted *koku* to 1990 international Geary–Khamis dollars bsy applying 1 *koku* = 272.31 1990 international Geary–Khamis dollars. Then we obtained the composition ratio of the output from the shogunate domain over the national output for the years 1600, 1721, 1804, and 1846.

Source: Fukao *et al.* (2017b).

of the GDP of the national level by dividing the output from the shogunate domain l by q such that $r(=l/q)$ in Supplementary Appendix A.II.

We also fill in the linear trend of the population between estimate years, 1600, 1721, 1804, 1846, and 1874 (Table 1), displayed as series t in Supplementary Appendix A.II. Then, we obtain the per capita GDP as series $u = r/t$ in Supplementary Appendix A.II. Figure 7 draws a series of the GDP r and per capita GDP u. Our estimate results for benchmark years are presented in Table 5, whereas Figure 7 displays all years.

3.3. State Capacity

The shogunate usually only taxed the agricultural sector. The primary tax was the land tax, which was called *hon nengu* (primary tax). In addition, miscellaneous taxes were levied. The total amount of tax on farmers was roughly 1.25 times the land tax. Thus, we obtain the estimated effective taxation rate of the agricultural output based on the shogunate's output estimate as series $f(= 1.25b/d)$, the estimated effective agricultural taxation rate as series $h(= 1.25b/g)$, and the taxation rate of the total output in the shogunate domain as series $n(= 1.25b/l)$ in Supplementary Appendix A.II. Figure 8 illustrates the series.

In the 17th century, when the shogunate conducted a cadastral survey, specified a farming family for each parcel of farmland, and vested the family with property rights for the parcel, the agricultural taxation rate hit 35%; the state capacity, which is measured by the taxation rate of the total output, hit 20%. After the shogunate adopted a fixed amount of taxation in the early 18th century, it failed to raise tax in relation to productivity. The taxation rate of the total output fell to 13% in the mid-19th century.

The state capacity of other domains was not significantly different from the shogunate domain. For instance, in the Kumamoto domain, ruled by Lord Hosokawa, the state capacity is estimated to have been 14–15% from the mid-19th century onwards. The state capacity in the Choshu domain, which was ruled by Lord Mouri and which taxed the secondary and primary sectors, is estimated to have been 21.6% from the mid-19th century onwards (Imamura and Nakabayashi 2017: 38).

However, the state capacity of 13% was much higher than the 8% in China and Turkey (Deng 2012: 342; Pamuk 2012: 321). The state capacity of England rose from less than 10% in the mid-19th century to about 20% during the Napoleonic Wars, and 13% in 1819 after the wars. This enabled the British crown to support infrastructure improvements, notably for the defence of the country (O'Brien and Hunt 1993: 175; Daunton 2012: 112). In Japan, the state capacity of 13% was inherited by the imperial government after the Meiji Restoration and the tax financed modernisation efforts.

4. Quantitative Summary

4.1. Trajectory of Output per Person

For an overview of the performance of the Japanese economy after the seventh century, let us calculate the per capita GDP. Combining the estimates of the population in Table 1 and the output in Tables 3 and 4, we obtain the per capita GDP, as shown in Table 6.

As the series shows, Japan's per capita GDP grew from the eighth century to the 10th but declined in the 12th, primarily because of climate cooling (Midorikawa 2019; Supplementary Appendix A.I.2). Our substantial downward revision of the per capita GDP in 1150 from Bassino *et al.* (2019) is driven by the update of total output based on Midorikawa (2019), as discussed in section 2. It then began to recover from the late 13th century and regained its former glory in the late 15th century. It fell briefly due to population growth in the early 17th century but began to increase again in the late 17th century.

Japan's GDP surpassed China's in the 18th century for the first time in its history. It grew closer to peripheral European countries such as Poland and Portugal by the early-19th century. However, the West, led by Britain, further accelerated productivity growth from the early-19th century. The development that followed the Napoleonic wars left Japan far behind England.

In terms of improving resource allocation within each nation-state, the shogunate regime that protected property rights under the stable state was effective. However, its isolationist policy placed Japan behind the West when the West was realising the first age of globalisation from the mid-19th century, which strengthened knowledge spill-over. The labour intensive technology mix in the early modern period would not have enabled Japan to catch up with the Western advanced economies on its own (Kumon 2020). Without the Meiji Restoration of 1868 to open the country, Japan would have been unable to compete with advanced economies (Schreurs 2019; Vries 2020: 38–41; Broadberry and Fukao (Forthcoming)).

4.2. Price Responsiveness of Agricultural Output in the Early Modern Period

Our emphasis on property rights protection by the shogunate and lords since the 17th century implicitly assumes that farmers were exposed to the market and exerted residual control on how to use their parcel of farmland to maximise their utility. Property rights protection would improve resource allocation because property rights holders would exercise residual control rights to maximise the income they earn. This story envisages that sellers in markets would use their assets to maximise their profits. If this assumption held true, then the agricultural output would respond to prices in the market. Case studies have shown that early modern farmers were active market participants as the sellers of crops and, in the case of landlords, investors in rice-denominated lords' bills in the Dojima Rice Exchange (Takatsuki 2012: 26–68). We examine whether such price responsiveness was

Table 5. Our Estimate of Gross Domestic Product in Early Modern Times, 1651–1841

Year	Output and tax revenue of the shogunate domain			
	Officially estimated output	Land tax revenue	Officially estimated output adjusted for allowance	Output adjusted for oversight
	Thousand *koku*	Thousand *koku*	Thousand *koku*	Thousand *koku*
	a	*b*	*d*(=*a*/0.85)	*e*(= *d*/0.9)
1600				
1657	2,925	1,120	3,442	3,824
1662	2,734	1,100	3,217	3,574
1671	2,975	1,131	3,500	3,889
1681	3,401	1,026	4,001	4,446
1691	3,971	1,354	4,672	5,191
1701	3,849	1,115	4,529	5,032
1711	4,144	1,300	4,876	5,417
1721	4,067	1,306	4,784	5,316
1731	4,531	1,365	5,330	5,923
1741	4,586	1,570	5,396	5,995
1751	4,395	1,705	5,170	5,744
1761	4,466	1,680	5,254	5,837
1771	4,376	1,353	5,148	5,720
1781	4,348	1,466	5,116	5,684
1791	4,383	1,356	5,156	5,729
1801	4,475	1,558	5,265	5,850
1804	4,488	1,536	5,280	5,866
1811	4,479	1,533	5,269	5,855
1821	4,326	1,434	5,090	5,656
1831	4,201	1,429	4,943	5,492
1841	4,168	1,434	4,903	5,448

Effective tax rate of the agricultural sector, estimated by the shogunate	Estimated agricultural output	Effective tax rate of the agricultural sector	Subtotal of the primary sector	National output of the primary sector per person	Sectoral composition of the primary sector: (National primary sector output)/(Gross domestic product of the national level)
	Thousand *koku*		Thousand *koku*	Thousand *koku*	
f(=1.25*b*/*d*)	*g*	*h*(=1.25*b*/*g*)	*i*(=*g*/0.8436)	*j*	*k*
				1.80	0.737
41%	3,824	37%	4,533	1.69	0.686
43%	3,574	38%	4,237	1.68	0.682
40%	3,889	36%	4,609	1.66	0.674
32%	4,446	29%	5,270	1.64	0.665
36%	5,191	33%	6,154	1.62	0.656
31%	5,032	28%	5,965	1.60	0.647
33%	5,417	30%	6,422	1.59	0.638
34%	5,283	31%	6,263	1.57	0.629
32%	6,026	28%	7,143	1.60	0.629
36%	6,265	31%	7,426	1.65	0.629
41%	6,161	35%	7,303	1.69	0.629
40%	6,421	33%	7,612	1.73	0.629
33%	6,449	26%	7,645	1.78	0.630
36%	6,565	28%	7,782	1.82	0.630
33%	6,775	25%	8,031	1.86	0.630
37%	7,078	28%	8,391	1.91	0.630
36%	7,147	27%	8,472	1.92	0.630
36%	7,232	26%	8,573	1.95	0.630
35%	7,123	25%	8,443	1.98	0.629
36%	7,049	25%	8,356	2.02	0.628
37%	7,125	25%	8,445	2.06	0.627

Table 5. Continued

Year	Gross domestic product of the shogunate domain		Taxation rate (Collected tax over the gross domestic product) of the shogunate domain	(Gross domestic product of the shogunate domain)/(Gross domestic product of the national level)
		Thousands of 1990 Geary-Khamis international dollars		
	Thousand *koku*	1 *koku*=272.31 dollars		
	$l(=i/k)$	m	$n(=1.25b/l)$	q
1600				
1657	6,607	1,799,114	21%	0.13
1662	6,216	1,692,612	22%	0.13
1671	6,843	1,863,356	21%	0.13
1681	7,929	2,159,133	16%	0.13
1691	9,384	2,555,302	18%	0.13
1701	9,221	2,510,978	15%	0.13
1711	10,066	2,741,172	16%	0.13
1721	9,956	2,711,227	16%	0.13
1731	11,354	3,091,829	15%	0.13
1741	11,802	3,213,794	17%	0.13
1751	11,604	3,159,795	18%	0.13
1761	12,092	3,292,710	17%	0.14
1771	12,142	3,306,438	14%	0.14
1781	12,358	3,365,318	15%	0.14
1791	12,751	3,472,209	13%	0.14
1801	13,320	3,627,042	15%	0.14
1804	13,448	3,662,028	14%	0.14
1811	13,619	3,708,463	14%	0.14
1821	13,428	3,656,544	13%	0.14
1831	13,305	3,623,009	13%	0.13
1841	13,462	3,665,810	13%	0.13

Notes: We convert *koku* to 1990 international Geary–Khamis dollar by applying 1 *koku* = 272.31 1990 international Geary–Khamis dollars. The grossly failed harvest years 1651 and 1661 are replaced by 1657 and 1662. See Supplementary Appendix A.II. for 1651 and 1661.

Source: Supplementary Appendix A.II.

Gross domestic product of the national level		Population	Gross domestic product of the national level per capita	
	Thousands of 1990 Geary-Khamis international dollars			1990 Geary-Khamis international dollars
Thousand *koku*	1 *koku*=272.31 dollars	Thousands	*koku*	1 *koku*= 272.31 dollars
r(=*l*/*q*)	*s*	*t*	*u*=*r*/*t*	*v*=*s*/*t*
		17,000		
51,494	14,022,262	23,732	2.17	591
48,445	13,192,191	24,322	1.99	542
53,332	14,522,965	25,385	2.10	572
61,798	16,828,245	26,566	2.33	633
73,137	19,915,977	27,747	2.64	718
71,869	19,570,519	28,928	2.48	677
78,457	21,364,644	30,109	2.61	710
77,600	21,131,256	31,290	2.48	675
87,196	23,744,292	31,218	2.79	761
89,326	24,324,247	31,145	2.87	781
86,574	23,574,833	31,073	2.79	759
88,948	24,221,434	31,001	2.87	781
88,082	23,985,505	30,929	2.85	776
88,425	24,079,098	30,856	2.87	780
90,004	24,509,057	30,784	2.92	796
92,767	25,261,482	30,712	3.02	823
93,290	25,403,800	30,690	3.04	828
96,506	26,279,613	30,943	3.12	849
98,174	26,733,652	31,305	3.14	854
100,460	27,356,259	31,667	3.17	864
105,090	28,616,954	32,029	3.28	893

a nation-wide phenomenon, so that property rights protection could affect the decision-making of the farmers' class.

We use the series of the agricultural output of the shogunate domain (g in Supplementary Appendix A.II) and of the rice price at Osaka market available from 1701 (Supplementary Appendix A.II) to quantify the lead-lag relationship between the agricultural output and the price of rice in the shogunate domain. We use the first differences to remove possible trends. As the vector autoregression of the first difference of agricultural output ($\Delta\text{output}_t = \text{output}_t - \text{output}_{t-1}$) and that of the rice price for Osaka ($\Delta\text{price}_t = \text{price}_t - \text{price}_{t-1}$) shows, output changes depended on prices changes, while prices barely depended on output (Table 7). This tendency is summarised as the Granger causality only from price changes to output changes (Table 8).

In some domains, the lord designated specific crops and committed to the purchase of these crops, called the lord's monopsony and monopoly. In such cases, the residual control rights of owner-farmers over their parcels of farmland were restricted. Otherwise, registered owner-farmers assumed residual control over the parcels they cultivated, which allowed them to decide on crop choice and resource allocation. In the shogunate domain, since the shogunate did not impose a monopsony or monopoly policy, the farmers controlled decision-making. The results of the vector autoregression of the output and prices indicate that farmers were highly responsive to the prices of products when they allocated resources at their discretion.

Here, we assume the division of labour within the peasant economy as described by Saito (1983, 1998, 2000, 2009). We characterise Saito's description as follows: Farming household i has a resource endowment of farmland it owned (K_i) and the family labour it fed (L_i). We standardise family labour endowment such that $L_i = 1$. Let $l_{r,i} \leq 1$ denote labour retained at home, where subscript r refers to *retained*.

As Saito argues, each farming household retained $l_{r,i}$ to meet the demand in the busiest farming seasons. That is, each household had some slack part of $l_{r,i}$ for some days within a year. A temporary slack portion of $l_{r,i}$ would be hired by another farming household. A temporary slack portion of the workforce retained at home is used by the real agricultural wage w_a. Within the village, transfer of w_a among households is cancelled out. If the farming household was the maximiser of the household revenue and exposed to the regional labour market, the operation rate of the workforce retained at home would monotonically increase with w_a. Then, the effective labour supply to agriculture at household i is approximately $l_a^i = w_a l_{r,\,i}$.

We approximate the agricultural output of household i by $y_{a,i} = A l_{a,i}^{\beta} K_i^{1-\beta} = A w_a^{\beta} l_{r,i}^{\beta} K_i^{1-\beta}$ where $0 < \beta < 1$, that is, the returns on land and labour are marginally decreasing. A denotes labour productivity measured by the amount of agricultural output. Household i allocates labour $1 - l_{r,i}$ to the non-farm sector side jobs. Labour allocation to the non-farm sector included, for instance, hand weaving by female family members in the summer and winter and males working at a sake brewery in the winter. Let w_u denote the real wage for casual labour in the urban sector where u refers to urban, deflated by the consumption goods price. Farming households i maximised their revenue $R_i = p y_{a,i} + w_u (1 - l_{r,i})$, where p denotes the relative price of agricultural products over manufactured goods, by optimising their labour inputs to the agricultural sector, $l_{r,i}$ and the non-farm sector, $1 - l_{r,i}$.

Since $R_i = p y_{a,i} + w_u (1 - l_{r,i}) = p A w_a^{\beta} l_{r,i}^{\beta} K_i^{1-\beta} - w_u l_{r,i} + w_u$, the first-order condition for the maximisation of revenue implies that the optimal allocation of family labour to the agricultural sector is $l_{r,i}^{*} = A^{\frac{1}{1-\beta}} \beta^{\frac{1}{1-\beta}} K_i p^{\frac{1}{1-\beta}} w_a^{\frac{\beta}{1-\beta}} w_u^{-\frac{1}{1-\beta}}$.

Thus, optimal labour allocation to agriculture $l_{r,i}$ increases with the labour productivity of agriculture A, the relative price of agricultural products p, and the agricultural wage w_a, but decreases

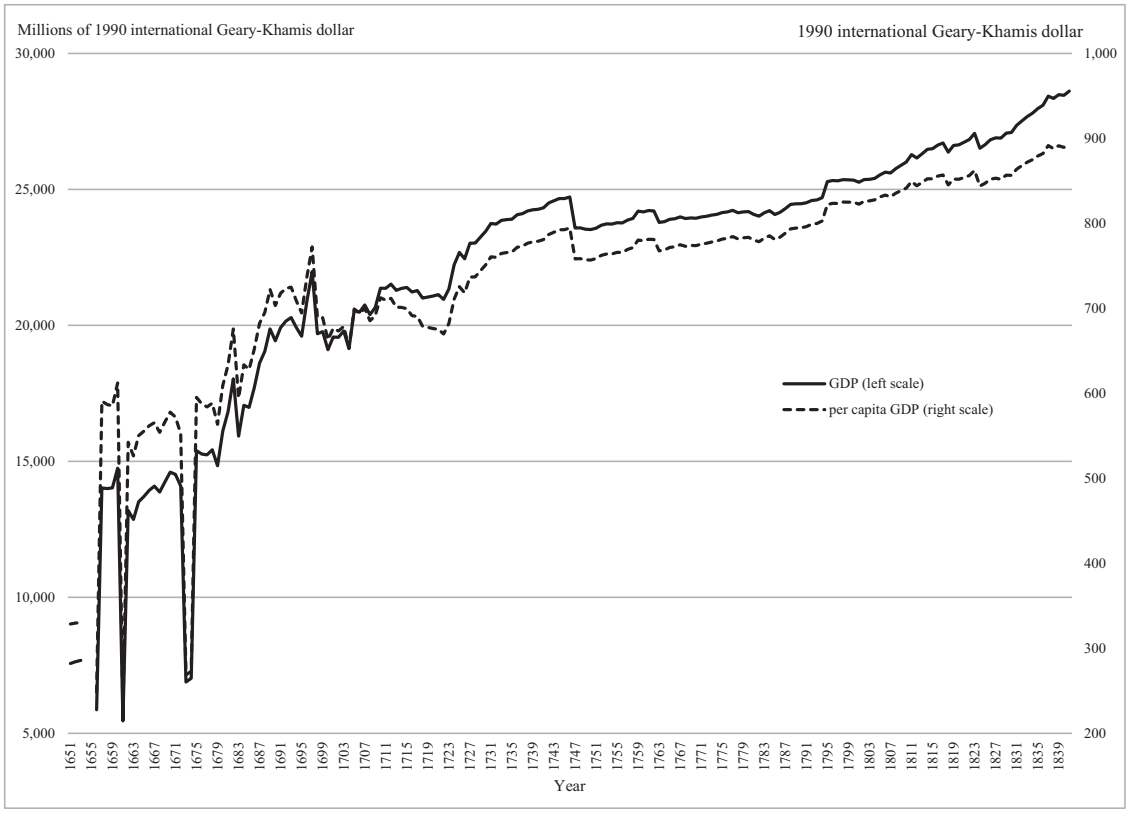

Figure 7. Gross Domestic Product, 1651–1841. *Source*: Supplementary Appendix A.II. *Notes:* We convert the output in *koku* to the output in 1990 international Geary–Khamis dollars by applying 1 *koku* = 272.31 1990 international Geary–Khamis dollars.

with the non-farm urban wage w_u. If farming households, in general, followed this strategy, then the agricultural output would increase with the labour productivity of agriculture, the price of the agricultural products, and the agricultural wage w_a, but decrease with the urban wage w_u.

Thus, to test our prediction, we perform the following ordinary least squares regressions:

$$\log y_{a,t} = \text{constant} + \alpha_1 t + \alpha_2 \log A_t K_t + \alpha_3 \log p_{r,t} + \alpha_4 \log w_{a,t} + \epsilon \quad (1)$$

$$\log y_{a,t} = \text{constant} + \alpha_1 t + \alpha_2 \log A_t K_t + \alpha_3 \log p_{c,t} + \alpha_4 \log w_{a,t} + \epsilon \quad (2)$$

$$\log y_{a,t} = \text{constant} + \alpha_1 t + \alpha_2 \log A_t K_t + \alpha_3 \log p_{r,t} + \alpha_4 \log w_{u,t} + \epsilon \quad (3)$$

$$\log y_{a,t} = \text{constant} + \alpha_1 t + \alpha_2 \log A_t K_t + \alpha_3 \log p_{c,t} + \alpha_4 \log w_{u,t} + \epsilon \quad (4)$$

where t is the time trend, $p_{r,t}$ is the relative price of rice over the average price of manufactured goods in period t, and $p_{c,t}$ is the relative price of raw cotton over that of manufactured goods.

For agricultural output y_a, we use the output of the shogunate domain, series g in Supplementary Appendix A.II. For agriculture productivity AK, we use the agricultural output per person at the national level, series j in Supplementary Appendix A.II. For the relative price of rice p_r, we divide the rice price in Osaka by the price of manufactured goods in the Osaka and Kyoto regions. For the

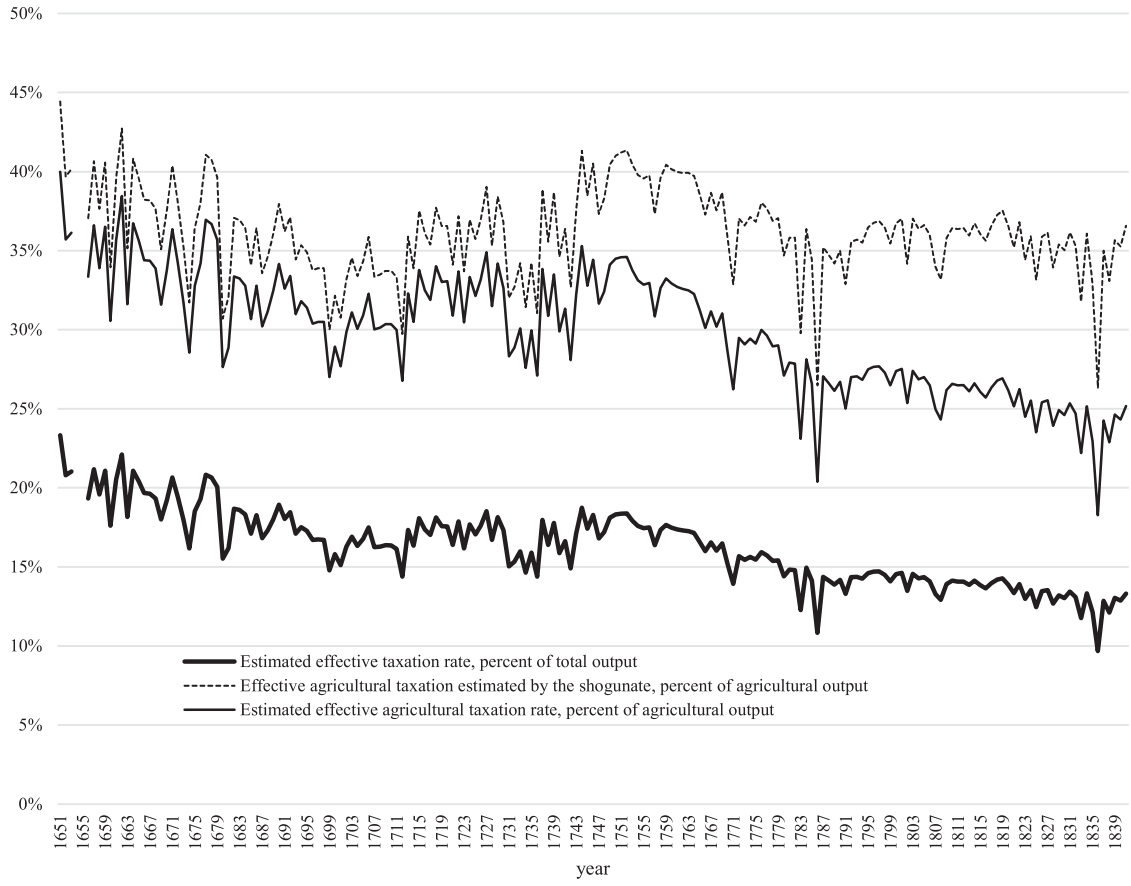

Figure 8. Taxation Rate of the Shogunate Domain, 1651–1841. *Source*: Supplementary Appendix A.II.

relative price of raw cotton, we divide the raw cotton price in the Osaka region by the price index of manufactured goods in the Osaka and Kyoto regions. For real agricultural wages w_a, we use the real daily wage of day workers in the agricultural sector in the Kinai region. For the urban wage w_u , we use the real daily wage of day workers in Kyoto. All of the above are shown in Supplementary Appendix A.II.

Equation (1) quantifies the agricultural output's response to the relative rice price $p_{r,t}$ and real wages in the agricultural sector $w_{a,t}$. Equation (2) measures the agricultural output's response to the relative raw cotton price $p_{c,t}$ and real wages in the agricultural sector $w_{a,t}$. In both equations, assuming that the farming household maximised its revenue, we predict significantly positive values for α_3 and α_4.

Equation (3) tests whether the agricultural output responded to the relative raw cotton price $p_{c,t}$ and real wages in the urban sector $w_{u,t}$. Equation (4) checks whether the agricultural output responded to the relative raw cotton price $p_{c,t}$ and real wages in the urban sector $w_{u,t}$. In both equations, the coefficients of interest are α_3 and α_4. Assuming that the farming household maximised its revenue, we predict a significantly positive α_3. If the local labour markets were tightly connected with the urban labour markets, we predict a significantly negative α_4. The results are shown in Table 9.

In specification 9–1, the relative rice price p_r and the real agricultural wage w_a have a significantly positive coefficient, as predicted. A 1% increase in the relative price of rice raised agricultural output by 2% and a 1% increase in the real agricultural wage did by 4%. In specification 9–2, the relative price of raw cotton p_c and real agricultural wage w_a have significantly positive coefficients, as predicted. A 1% rise in the relative price in raw cotton raised agricultural output by 2%. The results are consistent with our prediction that farming households optimise labour allocation, pricing in the rice market, and pricing in the labour market to maximise household revenue.

The results in specifications 9–3 and 9–4 are mixed. In specification 9–3, the real urban wage has a significantly negative coefficient, which shows that a 1% increase in the real urban wage decreased agricultural output by 4%, consistent with our prediction. However, the relative price of raw cotton does not have a significant coefficient. In specification 9–4, neither the relative price of raw cotton nor the real urban wage has a significant coefficient.

Our empirical results show that farming households keenly responded to the price changes of rice, raw cotton, local labour, and, to some extent, urban labour markets. Our agricultural output data cannot differentiate the output of rice and that of raw cotton. We thus fail to identify the effects of relative prices of rice and raw cotton on the optimisation behaviour of farming households. Still, our empirical results are consistent with Saito's argument that the peasant economy optimises internal labour allocation as a response to the goods and labour markets.

5 Institutional Changes

5.1. The Rise and Demise of the Manorial System

From the sixth century onwards, the imperial family had been actively introducing Chinese institutions and technologies to reinforce its domestic rule. The imperial court completed its Sinisation efforts by enacting the Taiho Imperial Legal Code (*Taihō Ritsu Ryō*) of 701. This legal code introduced an ideal type of centralised Chinese administration and ownership and also denied any right to private property—that is, any claim to residuals to be assumed by subordinate stakeholders. This had a devastating effect on agriculture because it discouraged local rulers from reclaiming and maintaining farmland.

Responding to the setback, the imperial court promulgated the Three Generation Usufruct Act (*San Se Isshin no Hō*) of 723, which allowed the developer of a parcel of paddy fields to use the parcel for three generations. The imperial court also promulgated the Privatisation of Reclaimed Lands in Perpetuity Act (*Konden Einen Shizai Hō*) of 743, which allowed a developer of a parcel of paddy fields to own the parcel privately without a specified duration.

The 743 Act required the registration of newly reclaimed parcels of paddy fields at the imperial court for private ownership. When the imperial court approved a request for private ownership of a newly reclaimed parcel, the imperial court delegated the administrative and judicial authority to the developer as well. The parcel, whose private ownership was warranted and whose governance was delegated, was called a *shōen* (manor or estate). This system of decentralised ownership and delegated governance was the manorial system (Nishitani, Hayashima and Nakabayashi 2017; Piggott 2018).

The 743 Act prompted large temples and shrines to reclaim paddy fields. This formed the backdrop of a rise in output from the mid-eighth century to the early ninth century (Figure 5). The growth was, however, stunted by the climate cooling from the ninth century to the early 12th century (Midorikawa 2019).

The retreat stopped in the 12th century because of the cessation of climate cooling and for institutional reasons. While large temples and shrines were the driving force of the reclamation when the Act

Table 6. Gross Domestic Product Per Head, 730–1874

	Japan				
	GDP	Population	Per Capita GDP		
			Our Estimate		Bassino *et al.* (2019)
	Million *koku*	Million	*koku*	1990 International Geary–Khamis Dollar	1990 International Geary–Khamis Dollar
	a	*b*	*a*/*b*		
730	8.693	6.100	1.425	388	376
950	10.924	5.000	2.185	595	635
980					
1020					
1050					
1086					
1120					
1150	7.262	3.900	1.862	507	583
1280	11.600	5.950	1.950	531	529
1300					
1400					
1450	20.212	10.050	2.011	548	545
1500					
1550					
1570					
1600	41.600	17.000	2.447	666	667
1650			2.170	591	
1700			2.435	663	
1720			2.483	676	
1721	77.600	31.290	2.480	675	675
1750			2.780	757	
1800			3.029	825	
1804	93.300	30.690	3.040	828	828
1820			3.129	852	
1846	106.900	32.210	3.319	904	903
1850					
1870					
1874	129.541	34.840	3.718	1,012	1,011

Notes: We convert Japan's per capita GDP in terms of *koku* into that of 1990 Geary–Khamis international dollars using 1 *koku* = 272.31 1990 international G-K dollars.

Source: For Japan: Tables 1, 3, 34, and Supplementary Appendix A.II. The value for 1650 is the estimate for 1657 in Supplementary Appendix A.II. For Great Britain and China: Bassino *et al.* (2019: 19); for Germany: Malinowski and van Zanden (2017) and Palma and Reis (2019); for Portugal, Palma and Reis (2019); and for Poland, Malinowski and van Zanden (2017).

China	Great Britain	Germany	Portugal	Poland
Per Capita GDP	Per Capita GDP	Per Capita GDP	Per Capita GDP	Per Capita GDP
1990 International Geary–Khamis Dollar	1990 International Geary–Khamis Dollar	1990 International Geary–Khamis Dollar	1990 International Geary–Khamis Dollar	1990 International Geary–Khamis Dollar
853				
1,006				
967				
878	723			
863				
	651			
	724		742	
1,032	1,045		742	562
990	1,011			
858	1,068	1,146		702
			836	
885	1,096			
865	1,077	807	790	810
	1,055		830	
1,103	1,563	939	987	569
950	1,605			
727	1,710	1,050	1,371	
614	2,080	986	916	
				634
600	2,997		923	
618	3,856	1,692		946

Table 7. Vector Autoregression of Agricultural Output of the Shogunate Domain and Rice Price at Osaka

Dependent Variable	$\Delta Output_t$		$\Delta Price\_osaka_t$	
	Coefficient	z Statistics	Coefficient	z Statistics
$\Delta output_{t-1}$	−0.07	−0.87	0.00	0.7
$\Delta output_{t-2}$	0.18	2.22**	0.00	1.88*
$\Delta price\_osaka_{t-1}$	−454.89	−1.66*	−0.31	−3.83***
$\Delta price\_osaka_{t-2}$	−787.77	−2.89***	−0.33	−4.11***
χ^2		14.29***		28.53***
R^2		0.09		0.17
Sample period		1704–1841		
Log likelihood		−2,311.18		
Number of observations		138		
Akaike Information Criterion		33.61		

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Source: Supplementary Appendix A.II.

Table 8. Granger Causality Walt Test for Agricultural Output of the Shogunate Domain and Rice Price at Osaka

Dependent Variables	Excluded	χ^2	Lags
$\Delta Output_t$	$\Delta Price\_osaka_t$	9.42***	2
$\Delta Price\_osaka_t$	$\Delta Output_t$	3.85	2

Note: *** indicates significance at the 1% level.

Source: Supplementary Appendix A.II.

of 743 came into force, local rulers then rose as developers of paddy fields. A local ruler who reclaimed a parcel of paddy fields 'donated' the parcel to a noble, a temple, or a shrine first. Then, the recipient obtained a charter to establish the parcel as a manor from the imperial court, and the manorial lord who obtained the charter 'appointed' the local ruler who reclaimed and donated the parcel as a local officer of the manor. Such local rulers were an origin of samurai. The transformation was accompanied by a further decentralisation of governance. Particularly, the Kamakura shogunate, which was the first samurai's administration, was established to protect the samurai's claims within the manorial system (Nagahara 1973: 3–53; Nagahara 1975; Friday 2010; Nishitani *et al.* 2017; Piggott 2018).

By the 14th century, uncultivated land that had been easily reclaimed under the medieval techniques dried up. This meant that the relative price of land over capital and labour rose. Accordingly, more capital- and labour-intensive techniques were adopted to intensify farming. Continuous

Table 9. Response of Agricultural Output to Rice Price and Relative Wage in the Shogunate Domain

	9–1		9–2		9–3		9–4	
Dependent Variable	$\log(y_{a,t})$		$\log(y_{a,t})$		$\log(y_{a,t})$		$\log(y_{a,t})$	
	Coefficient	*t* Statistics	Coefficient	*t* Statistics	Coefficient	*t* Statistics	Coefficient	*t* Statistics
Constant	14.92	73.83***	14.24	83.88***	14.02	99.55***	13.53	88.82***
t	0.00	−1.97*	−0.01	−7.52***	−0.01	−8.79***	−0.01	−12.50***
$\log(\text{productivity}_t)$	2.00	3.03***	4.44	8.48***	4.94	10.39***	6.50	13.61***
$\log(p_{r,t})$	0.02	1.69*			−0.01	−0.80		
$\log(p_{c,t})$			0.02	2.06**			0.01	1.12
$\log(w_{a,t})$	0.04	1.74*	0.15	10.77***				
$\log(w_{u,t})$					−0.04	−2.66***	−0.01	−0.83
Degrees of freedom	75		44		64		45	
Adjusted R^2	0.92		0.96		0.94		0.90	
F statistics	226.4***		286.7***		248.8***		113.2***	

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Source: Supplementary Appendix A.II.

cropping replaced the existing fallow method. The adoption of *indica* 'red' varieties of the rice plant, which were more resilient to the cold weather, helped enhance intensive farming with continuous cropping (Saito 2002; Saito 2015a; Nishitani 2017; Saito and Takashima 2017a).

A marginal rise in land productivity was earned by the landlord class than by manorial lords. The distribution of income towards manorial lords dropped from about 40~50% until the 12th century to about 30% in the 14th century (Nishitani and Nakabayashi 2017).

The technical transformation in the 14th and 15th centuries was also associated with institutional changes. Intensified farming meant that the manual labour and care supplied by cultivators became critical inputs. Until the 14th century, cultivators were typically subcontractors by annual contracts (Nishitani 2006: 306-351). Along with the prevalence of intensive farming, they settled into a specific place and formed a village community with landlords. Village communities were then placed in charge of handling farmland usage within the village and negotiating with feudal lords. Under such village-contractor system, village communities committed to making lump-sum payments of the stipulated land taxes of the entire village. Meanwhile, the feudal lord who ruled the village did not intervene in the internal affairs of the village if the village paid the stipulated land tax. The possibility of interference, or misdeeds, by the feudal lords was monitored by the nature of the relationship among the parties—by force, if necessary. Medieval farmers were armed with swords and guns; using arms to resolve conflicts was considered legal not only for samurai but for farmers as well (Inaba 2010; Nishitani *et al.* 2017).

While the village community served as a collective bargaining device against feudal lords, it also worked as an insurance mechanism to shield villagers from free financial markets. The medieval period, notably the 13th to 14th centuries, was Japan's first age of entirely free financial markets. Without any regulation on interest rates, the most vulnerable agents such as subcontracting cultivators were free to borrow from city financiers by paying extremely high interest rates, such as annual rates of 50–60%. Indebted cultivators sometimes rioted, demanding the shogunate to force financiers to write off debts. Prioritising social stability, the Muromachi shogunate promulgated the *Toku Sei Rei* (Shogunate Ordinance for Virtuous Governance), which forced financiers to write off debts. Using microfinance to pay the land tax within the village community warded off the violence of unregulated financial markets (Nakabayashi 2020).

Under the village-contractor system in the 15th and 16th centuries, the village community assumed residual control rights of farmland within the village, and the village community was entitled to residuals after paying the stipulated land tax. Thus, under the village-contractor system, farmers jointly assumed the property rights of the farmland they cultivated. The scheme, which provided the village community with strong incentives to improve productivity, was suitable for a transition from extensive to intensive farming. This institutional development was, along with technical improvements, a cause of productivity increases in the 15th and 16th centuries (Table 5).

In the age of provincial wars from the late 15th century onwards, the manorial system faded away. Feudal lords became the sole tax authorities and acted as the 'state' (Ferejohn and Rosenbluth 2010), and farmers became the sole claimants to residuals from farming. The decentralisation of power to local rulers and farmers and the changes in income distribution to local rulers and farmers were likely to help the productivity recover from the 13th century and further rise from the 14th century onwards.

5.2. Land Reclamation and Smallholders' Property Rights

Under the medieval village-contractor system, the property of villagers was jointly protected against possible discretionary taxation by feudal lords. However, as lords were not allowed to intervene in

the internal affairs of villages, individual farmers' rights were vulnerable to possible infringement by fellow farmers in the villages.

A proposal to address this defect was suggested by the administration of Hideyoshi Toyotomi, who reunified Japan in 1590 (Ike 2010). The Toyotomi administration decreed a thorough cadastral survey and the disarmament of farmers. The latter was enacted with peace orders to lords and samurai and to farmers and a ban restricting fisherfolk from picarooning. While all samurai, farmers, and fisherfolk had reserved the right to resolve conflicts with the use of armed force in the medieval period, the Toyotomi administration transformed the regime. The Toyotomi administration established a benefice of lords, property rights of farmers, and fishing rights; however, the protection was conditional on relinquishing the right to use arms to settle disputes, and violations led to punishment by the administration. While the physical disarmament of farmers was not common—most farmers retained their arms—it became illegal for farmers to resort to arms to resolve disagreements with other farmers of neighboring villages, for instance, on water rights. Similarly, the Toyotomi administration assumed supreme command and denied the right of belligerence to the lords. Any act of combat had to be by order of Toyotomi Hideyoshi. In that sense, lords were not independent feudal lords anymore (Hall 1961, 1981; Fujiki 2005).

The cadastral survey complemented the arms ban. The Toyotomi administration instructed lords to survey every single parcel of farmland, specify the family who cultivated the parcel, and vest the family with the property rights of the parcel (Araki 1986[1959]; Hall 1981). In practice, the costly cadastral survey was not fully conducted during the reign of Toyotomi. For the shogunate domain, a full cadastral survey was completed in the 1670s. Then, the property rights of individual farming households were protected by the state (Iwahashi 1999: 98–104). The cadastral survey vested stem peasant families with the property rights of the farmland they cultivated. This was the reason they accepted a high land taxation rate in the 17th century (Figure 8).

Under the Edo shogunate federation, the shogunate acted as a central government, assuming diplomacy and national defence as its purview. It also directly ruled its domain. Local lords operated under the shogunate command for national security, but assumed sovereignty for domestic affairs in their domain, including legislation and taxation. Thus, the shogunate and lords independently chose their own taxation policies (Ravina 1995; Ravina 1999: 16–45; Mitani 2020; Nakabayashi (Forthcoming)).

Residual claims involve a trade-off between incentive and risk. Here the risk borne by the residual claimant is volatility of harvests. On the one hand, this provided residual claimants with incentives to improve productivity. On the other hand, taking risks lowers the expected utility of risk-averse agents. Thus, the protection of the property rights of farmers came with both stronger incentives, promising increased tax revenues in the long term, and compensation for risk-taking, which in practice meant a reduction in taxes. If the former effect dominated the latter, then the protection of exclusive property rights would enhance social welfare and increase tax revenues, and vice versa. That is, whether exclusive property rights should contribute to welfare and tax revenue maximisation depended on the farmers' tolerance to weather risk—in essence, their agricultural productivity. As a result, the shogunate and lords in developed regions—where productivity was higher, and hence individual farming households were more tolerant to weather risk—adopted property rights protection for individual farming households.

However, lords in backward regions, where productivity was lower—and therefore, individual farming households were more vulnerable to weather risk—maintained joint ownership at the village level. The lord vested a village with property rights over the farmland that the villagers cultivated but did not match a specific parcel of farmland with a household as the household's property. Instead, the

village assigned parcels to households, and if necessary, reallocated parcels. Domains that sustained such joint ownership in some form to some extent amounted to about 30% of the national output officially estimated by the shogunate (*koku daka*) (Brown 1993: 39–112; Brown 2011: 58–100; Brown 2018).

During the peace of the shogunate federation, land tax revenue was reinvested in the reclamation of paddy fields. The shogunate and the lords assumed exclusive taxation authority, and, hence, had incentives and resources to reclaim uncultivated alluvial plains located in the lower reaches of big rivers (Miyamoto 1999: 41–45). The large investment in the 17th century brought about a surge in output from the 17th century to the early 18th century (Figures 6 and 7).

5.3. The Narrow Path Between Growth and Stability

After the establishment of exclusive property rights of individual stem families, the shogunate had a keen awareness of the trade-offs between growth and social stability. In particular, the shogunate strictly regulated farmland collateral loans for farmers by leaving the contracts beyond village borders, notably from merchants to farmers, outside of possible foreclosure enforcement by the shogunate court. The shogunate attempted to maintain the owner-farmer class (Mandai and Nakabayashi 2017, 2018; Nakabayashi 2020).

The effect of such regulation was substantial. Immediately after the Meiji Restoration of 1868, tenanted farmland represented 27.4% of the national average in 1873. The number was even lower in eastern Japan under the stronger influence of the shogunate. In the Kanto region and the north-eastern region of eastern Japan, the rates were 23.6% and 14.6%, respectively (Furushima 1958: 332; Kwon 2002: 72; Vries 2020: 144).

In the 1710–1720s, the shogunate made a transition from fixed-rate taxation to fixed amount taxation. Under the latter, marginal growth in the output entirely belonged to the owner-farmer, and, hence, provided stronger incentives, but also imposed greater risks. To avoid exposing owner-farmers to too many risks, the shogunate temporarily switched back to fixed-rate taxation and, in effect, reduced land taxes when the output was less than 70% of the average years (Oishi 1969[1794]: 188–191).

If the temporary tax reduction by switching to fixed-rate taxation was insufficient, it could result in the organised protests of farmers. The shogunate and lords usually accommodated demands from farmers while they suppressed organisers (White 1995: 1–24).

After the Meiji Restoration, the imperial government enacted the Land Tax Reform Act (*Chiso Kaisei Jōrei*) of 1873, under which the land tax was a fixed amount, regardless of the yield of the harvest. The imperial government also executed the Ordinance for Pledging Land for Loan and Securing Loan by Land (*Jisho Shichiire Kakiire Kisoku*) of 1873, which equally protected land-collateral loans either within or beyond village borders. Furthermore, the government did not reduce the land tax in poor harvest years. The outcome was straightforward. The national average ratio of tenanted farmland rose from 27.4% in 1873 to 45.4% in 1908. In particular, those in the Kanto and the north-eastern regions of eastern Japan rose from 23.6% and 14.6% to 46% and 41.6%, respectively (Furushima 1958: 332; Kwon 2002: 115; Francks 2006: 137; Vries 2020: 144).

Under the modern tenancy contract in Japan, consolidation of farmland ownership did not imply a rise in the scale of farming. Typically, ex-owner peasants continued to cultivate the parcels they had owned. Thus, the expansion of landlordism did not accompany changes in agricultural techniques. Instead, it was an institutional change in risk-sharing. When the government ceased to share the risk with farmers, and owner peasants could not bear the weather, financial market, and rice market risks,

they transferred their property rights to landlords and continued to cultivate their ex-properties, relying on risk-bearing by landlords (Arimoto 2005; Arimoto, Okazaki and Nakabayashi 2010; Sakane 2014, 2019; Sakane and Arimoto 2017).

The protection of property rights for individual households strengthened incentives for productivity improvements, which led to productivity growth in the 18th century. At the same time, the regulation on farmland-collateral loans was intended to hinder agricultural financial markets from expanding geographically. The regulation, along with flexible taxation, stabilised the peasant economy. This was the backdrop of higher social stability in the early modern period compared with the medieval and modern periods. The effort to balance growth and stability enabled modest, but long-term, growth under the Edo shogunate regime (Saito 2015b; Mandai and Nakabayashi 2018; Schreurs 2019).

6. Conclusion

Fukao *et al.* (2017a), Fukao *et al.* (2017b), Takashima (2017), and Bassino *et al.* (2019) substantially updated Japan's per capita GDP estimates before the mid-18th century based on historical documents. Here, we have revised the output estimates for the year 1150 based on Midorikawa (2019) and extended the output estimate by incorporating the estimate by Midorikawa (2019). Further, we revised the population estimate for 1150 by Farris (2009) downwards based on Midorikawa (2019).

We have also extended the output estimates for additional points over the centuries by consistently linking the agricultural estimates for the ancient and medieval periods presented by Midorikawa (2019) and records of output in the Edo shogunate domain in the early modern period presented by Ono (1996), Nakabayashi (2012), and Imamura and Nakabayashi (2017) to the estimates by Fukao *et al.* (2017a), Fukao *et al.* (2017b), Takashima (2017), and Bassino *et al.* (2019).

Based on the estimates, we have revised long-term trend of output per person. Notably, we found that medieval Japan reached a low-growth equilibrium in the 12th century under the manorial system, and saw a spike with the emergence of feudal lords from the 13th century onwards, and that further acceleration in the early modern period began in the late 17th century.

Our results also confirm that the new geopolitics and international economy after the Napoleonic Wars had a significant influence. The gap between the leading Western nations and Japan widened again from the early 19th century when the first age of globalisation was integrating Western nations, increasing the division of labour globally, and accelerating knowledge transfer among Western nations (Schreurs 2019; Broadberry and Fukao (Forthcoming)). This widening gap between Japan and a resurging West was seen as a threat by the shogunate in the 19th century, whose crucial moment was the US navy's visit in 1853. The immediate response of the shogunate was the building of a modern navy, followed by the Meiji Restoration of 1868, which fully opened Japan up to Western knowledge and was essential for sustainable growth.

The productivity growth trajectory drawn by Fukao *et al.* (2017a), Fukao *et al.* (2017b), Takashima (2017), and Bassino *et al.* (2019) shows a rapid rise in the 15th century. Our downward revision for the 12th century and the extension of estimate points indicate that the rise began earlier—from the 13th century—after a sharp fall. This revision is, however, qualitatively consistent with the view suggested by Saito and Takashima (2017a)—that the decentralisation of governance, along with the emergence of the samurai class, led to productivity growth. In the late 13th century the Kamakura shogunate mobilised national resources to defend Japan against the Mongolian invasion, and thus its authority was strengthened over manorial lords such as the imperial family, nobles, temples, and

shrines. Backed by the Kamakura shogunate, the samurai gradually established exclusive rule over the benefice territory, eroding the power of the manorial lords. The process accelerated in the 14th and 15th centuries under the Muromachi shogunate (Takahashi 2008: 215–310; Nishitani *et al.* 2017). The decentralisation of governance, by which we mean the decline of manorial lords and the rise of local samurai rulers, contributed to productivity improvement.

Our finding that the early modern acceleration began in the late 17th century, which was earlier than previously estimated, is also consistent with recent works on Japan's modernisation after the Meiji Restoration. While the Tokyo Stock Exchange and Osaka Stock Exchange emerged as centres of corporate finance from the 1880s (Nakabayashi 2019a), and the Bank of Japan bolstered the Tokyo and Osaka markets in the 1890s (Nakabayashi 2017a), case studies on growth in regional economies from the 1880s to the 1910s have found that relational corporate finance from local financiers and banks to local entrepreneurs was also one of the driving forces of industrialisation, as well as major organised exchanges and arms-length lending in Tokyo and Osaka. Long-standing resource allocation mechanisms in regional economies bequeathed from a decentralised early modern Japan continued to be an engine of growth until the early 20th century (Nakamura 2000, 2010, 2014, 2015). Also, the key role of the stem family for resource allocation and risk-sharing in the early modern period was formalised after the Meiji Restoration by adopting a continental civil law system (Nakabayashi 2019b). The traditional law affected choice and building of the modern law system as seen in many other industrialised economies (Gutmann and Voigt 2020).

In the manufacturing sector, the highly competitive silk-reeling industry had a long tradition in the early modern period and quickly modernised after the Meiji Restoration (Nakabayashi 2006, 2014, 2017b). In other traditional branches such as weaving, synthetic dyers and power looms introduced from the West after the Meiji Restoration revitalised traditional weaving industry to produce figured fabrics (Hashino and Otsuka 2013b, 2013a; Nakabayashi 2017c).

In the aggregate, the productivity gap of the secondary and tertiary sectors among prefectures rose in the 1890s, but fell in the 1900s. Modern techniques rapidly spread to rural prefectures and improved the productivity of both the traditional and new industries (Fukao *et al.* 2015: 37–66; Fukao and Settsu 2017).

Such a buoyant economy of rural prefectures would not have been possible without regionally balanced growth under the decentralised regime before the Meiji Restoration. At the same time, as Ma (2004) and Dong, Gong, Peng and Zhao (2015) demonstrate, Japan's ascendancy in its leading manufacturing industries of silk and cotton was heavily indebted to the transfer of technology from the West. Qing China had been competitive in the traditional silk and cotton industries. However, Japan's slightly earlier adoption of modern technologies in the late 19th century after the Meiji Restoration drastically enlarged the divergence between Japan and China. Fukao and Settsu (2017) attribute 1.47% of the 1.75% annual growth in labour productivity between 1885 and 1899 to the rise in total factor productivity. The contribution of an increase in capital intensity is estimated at 0.29% of 1.75%. Factors other than capital intensity, such as technology transfer, human capital investment by compulsory schooling, and factor markets liberalisation after the Meiji Restoration, dominated labour productivity improvement in the early phase of Japan's industrialisation. This achievement, in turn, indicates the cost imposed by the shogunate regime on early modern Japan's potential. Our upward revision of early modern performance does not reduce the significance of structural reforms after the Meiji Restoration.

Supplementary Material

Supplementary material is available at *Social Science Japan Journal* online.

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