Agrarian land tenancy in prewar Japan:

Contract choice and implications on productivity*

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March 12, 2008

Abstract

This paper studies the determinants of agrarian tenancy contract choice and its implication on productivity in prewar Japan. Rapid agricultural growth under extensive tenancy relationships in prewar Japan was achieved with the prevalence of a unique rent reduction contract, which was more efficient than a share tenancy or a pure fixed-rent contract in terms of provision of incentives and risk-sharing. Despite its potential efficiency, a rent reduction contract incurred substantial transaction costs, which may have inhibited its adoption outside Japan. The prevalence of this contract in prewar Japan was likely due to the presence of villages that reduced such costs through informal governance of the private tenancy relationships.

We found quantitatively at the village level that the choice of tenancy contract in prewar Iwate prefecture was affected by risk and possibly transaction costs. Furthermore, a sign of Marshallian inefficiency was found at the prefecture level, where the prevalence of tenancy and productivity is negatively correlated and such inefficiency was worse in prefectures with a greater proportion of share tenancy.

Keywords: tenancy contract; rent reduction; risk-sharing; moral hazard; transaction costs; Japan.

JEL Classification: D23; D82; O12; Q15

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* We thank Takeharu Bokura, Alain de Janvry, Takashi Kurosaki, Keijiro Otsuka, Elisabeth Sadoulet, Yoshihiro Sakane, Yasuyuki Sawada, and Futoshi Yamauchi for their valuable comments. This paper has benefited from the suggestions of seminar participants at the University of Tokyo, IFPRI, the 2004 Annual Meeting of the Japanese Socio-Economic History Society in Osaka, the Japanese Economic Association in Okayama, and NEUDC2006. Arimoto would like to thank Masayoshi Honma, Katsuhiro Saito, and Kazunari Tsukada for their advice and encouragement. Arimoto acknowledges a Grant-in-Aid for JSPS Fellows from the JSPS and MEXT of the Japanese Government.

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1. Introduction

Agricultural development supports industrialization and economic growth by providing food and a labor force to the industrial sector. To play these roles, the agricultural sector must increase or at least sustain productivity without falling into the Malthusian trap. Indeed, most developed countries experienced agricultural development with productivity growth during economic development (Hayami and Ruttan 1973). With respect to Japan, Hayami (1973) and Hayami and Yamada (1991) made clear the high growth of agricultural production and productivity in the late nineteenth and early twentieth centuries. Nakamura (1971) characterized this pattern of agricultural growth combined with rapid growth of the industrial sector before the World War I as "balanced growth."

Japanese agricultural development is particular in that the production and productivity growth since the late nineteenth century was accompanied by the development of extensive land tenancy relations. As we see in the next section, nearly half of the arable land was tenanted and 70% of the farm households leased-in land. It is notable that rapid production and productivity growth occurred under the expansion of tenancy relations, because depending upon the contractual form adopted, tenancy can potentially undermine productivity by hurting the incentives of the tenants. In particular, the disincentive of a share tenancy---the Marshallian inefficiency---has been widely acknowledged. A distinguishing feature of the Japanese tenancy is the prevalence of a unique contractual form, the rent reduction contract, which is a fixed-rent contract with state-contingent rent reduction when crop failure occurs. A rent reduction contract is more efficient than a share tenancy or a pure fixed-rent contract when risk is low, because it provides decent incentives (because it is basically a fixed-rent contract) and reduces the risk borne by the tenant (because it reduces rent in bad years) at the same time (Arimoto 2005). Therefore, the prevalence of this contractual form could have mitigated the problem of incentives and sustained productivity growth even under extensive tenancy relations.

The prevalence of this efficient rent reduction contract in Japan raises the question of contract choice: if it is more efficient than a share tenancy or a pure fixed-rent contract, why is it uncommon in other countries? Economic historians and development economists have so far asked why a share tenancy, which appears to be less efficient than a fixed-rent contract in terms of provision of incentives, prevailed in some regions in some time periods. For example, the prevalence of share tenancy contracts in pre-modern France and Italy has attracted the attention of economic historians (Hoffman 1982, 1984; Ackerberg and Botticini 2000, 2002). The standard argument resolves the

puzzle by noting the benefit of risk-sharing held by a share tenancy (e.g., Stiglitz 1974 and Holmstrom 1987. For a survey of the literature, see Singh 1989, Otsuka et al 1992, Huffman and Just 2004, and Otsuka 2007). However, they assume linear contracts and therefore rule out the possibility of adopting alternative nonlinear contracts, such as a rent reduction contract. Instead of asking why a seemingly inefficient share tenancy arrangement prevailed in some time and places, we reverse the question: Why is a seemingly efficient rent reduction contract uncommon in most countries and why did it prevail in prewar Japan? What are the implications of the prevalence of rent reduction contracts on productivity and agricultural development in Japan?

To answer the first question, this paper focuses on transaction costs following the argument by Ohno (1989) that implementing a rent reduction generates prohibitively high transaction costs, so that such contracts have rarely been observed outside Japan. Various historical documents show that the transaction costs incurred in a rent reduction contract included inspecting yield and negotiating on whether rent should be reduced and, if so, at what rate. These costs could discourage the adoption of the rent reduction contract despite its potential efficiency in terms of incentives and risk-sharing. However, in prewar Japan, local communities played a role in reducing such transaction costs through governing and institutionalizing the process of rent reduction. We then investigate the correlation between the potential determinants of contract choice and adoption of share tenancy using village-level data on the tenancy contract distribution in Iwate prefecture. We found that share tenancies prevailed in villages with higher risk and severe crop failures, consistent with the standard risk-sharing thesis. It also appeared that rent reduction contracts were more likely to be adopted in villages with stronger communal ties. Together with the qualitative historical evidences, it is likely that transaction costs and the presence of community that reduces such costs was critical in the adoption of rent reduction contracts in Japan.

To answer the second question concerning productivity, we conducted fixed-effect estimations using prefecture-level panel data to investigate whether rice yield was lower in prefectures where more paddies were cultivated under tenancy. We found a negative correlation between the prevalence of tenancy and rice yield and that such inefficiency was worse in prefectures with a higher proportion of share tenancy. Therefore, the Marshallian inefficiency seems to be present in prewar Japan at the prefecture level but it was less severe where rent reduction contracts were dominant. Combining these two results suggests that the prevalence of rent reduction contracts was sustained

by the informal community institutions and that this helped prevent a serious decline in agricultural productivity, which is a premise of industrialization and economic development.

The rest of the paper is organized as follows. Section 2 presents a brief overview of the agricultural sector and tenancy relationships in prewar Japan. Section 3 summarizes the framework for tenancy contract choice and presents the results of quantitative investigation of contract choice using village-level data from Iwate prefecture. In Section 4, we provide the results of prefecture-level fixed-effect estimation on the correlation between contract choice and productivity. Section 5 concludes the paper. The Appendix presents alternative estimation results of contract choice on productivity using village-level data.

2. Agriculture and land tenancy in prewar Japan[1]

2.1. Agricultural production and growth

In the late nineteenth and early twentieth centuries, agricultural production grew fairly rapidly in Japan (**Table 1**). The annual growth rates of agricultural output were 1.6% and 2.0% in 1880-1900 and 1900-1920, respectively. They are lower than the growth rates of the production of the mining and manufacturing in the same periods, but much higher than those of the agriculture in the U.S. Agricultural growth in Japan slowed down in the 1920s but the growth rate was still positive.

[**Table 1:** Growth of agricultural production and productivity]

According to the decomposition of the growth of agricultural output into those of inputs and productivity by Hayami (1973) (**Table 1**), the production growth is mostly accounted for by the growth of labor productivity. Indeed, the labor input measured by the number of agricultural workers gradually declined in this period reflecting the fact that the agricultural sector supplied labor force to the industrial sector. To put it differently, the labor productivity growth enabled the agricultural sector to increase production while simultaneously functioning as a labor pool for the industrial sector. Meanwhile, the labor productivity growth is mainly accounted for by the growth of TFP. The basic cause for the especially high TFP growth before World War I was the creation and dissemination of a newly coordinated agricultural technology, which is called the “Meiji Agricultural

[1] For background of Japanese agricultural history written in English, see Dore (1959), Hayami and Yamada (1991), Francks (2006), Kawagoe (1999), and Waswo (1977).

Method." This Method was composed of several complementary technologies, such as intensive use of fertilizer, introduction of new rice varieties with higher response to fertilizer, use of animal power for cultivation, and conversion to dry paddy fields. The Method systematized these technologies, which had been developed since the late Tokugawa Era (Yagi 1990).

2.2. Development of land tenancy

Land tenancy was pervasive in the prewar Japanese agriculture. There were more than five million farm households and this number remained essentially unchanged throughout the prewar period. They were mainly small farms; the average arable land size per farm household was close to 1 ha. At the same time, a large proportion of those farms were tenanted land. **Table 2** displays the number and distribution of tenancy in terms of number of farm households and area of arable land. Nearly 70% of the farm households cultivated some plots under tenancy, either as owner-cum tenants or pure tenants. In terms of area of arable land, the proportion of tenanted land was around 45% from the early twentieth century to 1940.

[**Table 2:** Extent of tenancy relations]

The historical origin of the prewar Japanese land tenancy occurred during the Tokugawa Era when land tenancy was already *de facto* prevalent through transfer of land by mortgage or pledge in credit transactions. It was the 1873 Land Tax Reform Act and the 1873 Land Collateral Rule that provided the modern legal foundation by conferring the right to own and sell property. By the land tax reform, the Meiji Government recognized the ownership of the *de facto* landlords in the Tokugawa Era, which implied that the tenancy relationship was recognized as well. The government issued the land certificates (*chiken*) to the recognized owners, and they were then able to sell their land by selling the certificates. At the same time, the government determined the official land price of each plot basically according to its fertility and imposed the land tax amounting 3% of the land price. The land tax was collected in cash. Rents from tenants, on the other hand, were usually paid in kind, which implies that the landlords sold crops to obtain cash to pay the land tax.

Land tenancy expanded after the land tax reform until the early twentieth century. The estimated proportion of arable land under tenancy just after the land tax reform was 27.4%, excluding Hokkaido, which became 35.9% in 1883-1884 and 43.2% in 1903, when the proportion

including Hokkaido was 43.6% (Furushima ed. 1958; Miwa and Hara eds. 2007, p.19). The trigger of this expansion was the severe deflation of the early 1880s caused by the tightening macro-economic policy led by the Financial Minister, Masayoshi Matsukata. The rice price sharply declined under the deflation, while the land tax based on the official land price was fixed. Due to the substantial increase of real burden of the land tax, many landed farmers were obliged to sell their lands and become tenants. It is notable that this was the period when the agricultural production and productivity rapidly grew, as described above. In other words, the early phase of agricultural growth was accompanied by the expansion of tenancy relations.

One of the characteristics of the tenancy system in prewar Japan was that the landlords were usually small and not so different from the tenant. **Table 3** shows the distribution of farm households by the size class of land owned. More than 70% of the farm households owned less than 1 ha and only 4% owned large holdings of more than 5 ha.

[**Table 3:** Distribution of household by size of land ownership]

2.3. Tenancy contracts

Tenancy agreements were verbal and contracts were rarely written down. According to the *Taisho 10 Survey of Tenancy Customs* (MAF, 1926), the most comprehensive survey of farm tenancy customs in prewar Japan conducted in 1921, more than 70% of the farm tenancy was arranged verbally. Similarly, only 80 out of 439 landlords (18%) studied in *The Survey on the Custom of Tenancy Rent Reduction and Exemption* (Teikoku Nokai, 1927), who were sampled from each county across Japan, had written down the contract. Even a written contract seemed to lack legal formality and binding force; the Survey reports that “The contents of these contracts are incomplete from the viewpoint of the concept of a lease contract (p. 34).”

Most tenancy arrangements had no explicit contract duration. An arrangement was expected to last until either the landlord or the tenant asked for cancellation. For those that had a specific contract term, the duration was usually 3 to 5 years or longer for paddies and farms, and 5 to 10 years for fruit orchards, mulberry farms, and tea fields[2]. Sakane (1999) indicated that the

[2] Bandiera (2007) studies tenancy contract duration in Italy, 1870-1880, and finds that the choice of contract length was driven by the need to provide incentives for non-observable investment, taking into account transaction costs and imperfections in the credit markets that made incentive provision costly. The fact that the contract durations were longer for fruits and mulberries relative to annual crops in prewar Japan seems to be consistent with this argument.

Japanese landlord-tenant relationships were usually stable and the contract durations relatively long, which was supported by regional mutual trust among villagers.

Unlike in most Asian countries where the average proportion of share tenancies in tenanted land exceeded 50% in 1990 (Otsuka 2007), the predominant form of paddy tenancy in prewar Japan was a fixed-rent tenancy-in-kind paid after the harvest. Share tenancy was rarely observed in shadowy fields in the mountainous areas, paddy fields with cold water, mountainous farms, newly cultivated areas or poor fields where the yield is unstable due to flood or drought (MAF, 1934, p. 341), covering only 1.6% and 2.1% of the area of paddy and field under tenancy in 1941 (**Table 4**). At the prefectural level, Aomori, Iwate, Akita, Nagano, Gifu, and Okinawa prefecture had more than 5% of their tenanted paddy under share tenancy, where the coefficients of variation of rice productivity for 1931-40 are relatively high.

[**Table 4:** Rice productivity and areas of share tenancy by prefecture (1941)]

The unique characteristic of the Japanese fixed-rent contract is that landlords were expected to reduce the rent temporarily in times of crop failure[3]. Of the 449 landlords studied in the above mentioned *Survey*, 445 reduced the rent in case of inevitable crop failure, and 2 out of the remaining 5 had adopted a share tenancy. The majority of landlords (279 out of 439, or 64%) had explicit reduction schedules. The actual rent, r, to be paid under a fixed-rent contract with rent reduction can be written as:

$$r(y)=\begin{cases} R & if \quad y \geq \hat{y} \\ R-\phi(y) & if \quad y < \hat{y} \end{cases}$$

where R is the predetermined fixed base rent, y is output and $\hat{y}$ is the cut-off value of output---usually 70%--80% of average output over recent years---used as the criteria for "crop failure". The function $\phi(\cdot)$ specifies the amount of the reduction. For example, $\phi(y)=\hat{y}-y$ implies that the rent reduction is proportional to the decline of output. We shall henceforth refer to this contract as a rent reduction contract. The ex post adjustment of rents only took place in bad crops, and there were generally no increase of rent in good years. Thus, ex-post state-contingent rent adjustment was upwardly rigid. Moreover, since it was uncommon to raise the fixed-rent except after the landlord invested in land improvement or irrigation, the tenant came to have more crops to their

[3] See Waswo (1977), ch. 2 for an English description of rent reduction and landlord--tenancy relations in prewar Japan.

hand as land productivity rose, leading into changing output distribution between a landlord and a tenant (**Figure 1**).

[**Figure 1:** Distribution of output in tenancy relations]

Since formal tenancy contracts were rarely written down, reduction of rent was determined by negotiations between landlords and tenants. Typically, rent reduction was initiated by a request from the tenant. The landlord and the tenants then conducted an yield sampling, known as *kemi* or *tsubogari* (literally meaning to harvest a plot of one *tsubo*, approximately 3.3 m^2) by harvesting the output on a unit sample plot within a paddy. They then used the result of sampling to estimate the total output. In many cases, rent reduction was granted only when there was at least a certain amount (20%-30%) of damage to the crops.

There are at least three rationales behind rent reduction: limited liability, *de facto* fixed-wage contracts, and risk-sharing. Because most rents in prewar Japan had to be paid in kind, the upper bound of rent cannot exceed the output. Rent reduction can be interpreted as a custom of meeting this ex post restriction of limited liability (see Shetty (1988), Basu (1992), and Ray and Singh (2001) for a discussion of the relationship between rent reduction, share tenancy, and limited liability). On the other hand, Japanese historians conventionally interpret rent reduction as a device for exploiting the surplus from tenants. In some cases, the fixed base rent was set at such a high level that it was almost impossible for tenants to pay. Under these circumstances, the landlord grants a rent reduction to secure the tenant's fixed subsistence output and extracts the remainder. Thus in this case, it is essentially a fixed-wage contract. Finally, rent reduction can be considered as a device to reduce the tenant’s burden of risk, which we will discuss in detail below.

Input-sharing, often observed in South and Southeast Asia, was uncommon. Landlords rarely provided inputs or services other than the land and land tax, both under a share tenancy or a rent reduction contract. In some cases, the tenants who cultivated the plot under a share tenancy had to provide labor for harvesting and for carrying the rent to the landlord's house. Moreover, in some parts of Iwate prefecture where the patron-client *Nago* relationships remained, tenants had to work for the landlord for several days per year for either a reduced wage or none.

3. Choice and distribution of tenancy contracts

3.1. Incentives and risk-sharing

As the standard argument on tenancy contracts address, landlords who adopted a share tenancy in prewar Japan did seem to suffer from the tenant's moral hazard. A report commissioned by the *Teikoku Nokai* (Imperial Agricultural Association) found that share tenancy reduced the tenant's incentives and lowered their effort. The following statement conveys Marshallian inefficiency:

> "Under a share tenancy, output is allocated by fixed rate regardless of the yield. So even if the tenant exerts more effort and as a result increases the output, half of the increment will be taken by the landlord. Therefore, it reduces the tenant's effort to improve his output, resulting in dominance of low productivity and low rent revenue caused by primitive and extensive farming. (Teikoku Nokai, 1942. p. 49.)"

While the inefficiency in terms of incentives associated with share tenancy is not straightforward because the landlord might be able to monitor and enforce the tenant's effort (Cheung 1969) or can mitigate the moral hazard by providing dynamic incentives of refusing contract renewal of unsatisfactory tenant (Otsuka 2007), the standard argument indicates the benefit of risk-sharing in justifying the adoption of share tenancy. Thus, it is predicted that share tenancies should prevail in villages with high risks and adopted among tenants who are more risk averse (for a recent study, see Allen (1999), Ackerberg and Botticini (2002), and Chiappori and Salanie (2003)).

Rent reduction can be considered as an alternative and possibly superior means of balancing risk-sharing and provision of incentives. Arimoto (2005) shows that a landlord can benefit from incorporating a rent reduction into a pure fixed-rent contract if the tenant is risk-averse because it reduces the tenant's risk. Moreover, because it is basically a fixed-rent contract, a rent reduction contract provides more incentives to a tenant and is therefore more efficient than a share tenancy if production risk is not too severe and when a tenant is not too risk-averse. Given that landlords insure against risk in bad years by reducing rents, risk-sharing becomes less important when choosing between contracts.

3.2. Transaction costs

Despite its superiority in terms of incentives and risk-sharing, a rent reduction contract is not necessarily better than a share tenancy because of the associated transaction costs[4]. According to the

[4] Another reason mentioned in the report is that the landlord adopted a share tenancy to obtain straw for horse breeding (which was common in the Iwate prefecture: the region enjoyed suitable natural

report *Special Tenancy Customs* (Iwate Prefecture, 1932), the main reason for the adoption of a share tenancy was instability in crop output, which increased the transaction costs of levying a fixed rent. The main concern was that, because of output fluctuations, it was impossible for a tenant to pay a fixed rent every year, and hence the landlord and the tenant were obliged to negotiate rent reductions frequently. The same reason is reported in the *Taisho 10 Survey of Tenancy Custom* (Ministry of Agriculture and Commerce 1926) as well (p. 192). At the same time, the survey reports a special tenancy custom of fixed rent tenancy in the narrow sense. This was the fixed rent contract without rent reduction. According to the *Survey*, this contractual form was observed in those areas where disasters were frequent and therefore negotiations for rent reduction were troublesome. It was reported that the rent of this contract was lower than that of the ordinary fixed rent contract with rent reduction by 10%-20% (*ibid*, p.209). The difference in the rent can be interpreted to reflect the transaction costs.

In the context of prewar Japan, two transaction costs associated with the implementation of rent reduction were observed: costs of inspecting crop yields (inspection costs) and costs of negotiating rent reductions (negotiation costs). Note that these transaction costs are of contract enforcement and are different from those of previous studies that focused on the costs of enforcement, supervision, monitoring, and management of inputs and outputs (see, for example, Cheung (1969), Alston et al (1984), Eswaran and Kotwal (1985), Shaban (1987), Allen and Lueck (1995), and Chew (1998)).

Inspection costs were necessary because rent reduction is granted only when the output y was below the threshold, $\hat{y}$. To confirm that this condition holds, the landlord and the tenant had to inspect the output, which required substantial effort and time in sampling the crop and achieving an agreement of the inspection. This could be costly since the landlord has no incentive to reduce the rent ex post and tends to overestimate the actual output, whereas the tenants are motivated to understate the output to get a greater rent reduction. In practice, determining the "standard" output $\bar{y}$ ---average output over recent years---was essential for implementing rent reduction. This is because the threshold level of output $\hat{y}$ to start granting the rent reduction was based on $\bar{y}$, which was typically set at the 70%-80% of $\bar{y}$. However, reaching agreement on $\bar{y}$ was not easy because

conditions and mountainous topology (Mori, 2003). It was common to share output in sheaves under a share tenancy, while under a fixed-rent contract, the tenant paid with threshed rice. The reason for this is unclear, because it was possible for the landlord to ask the tenant to provide straw under a fixed-rent tenancy. One possibility is that a tenancy arrangement was made solely for rough rice and not sheaves, and the landlord needed a special arrangement to request the delivery of straw under a fixed-rent tenancy, whereas under a share tenancy incorporating the *taba-wake* custom, the output was shared in sheaves.

output tended to vary with the fertility of the plots and the technology used (Teikoku Nokai, 1927, p. 22). Note that share tenancy does not require precise measure of output and inspection cost was unnecessary, since the essence of share tenancy is to *share* the output; the absolute amount of output did not matter as long as the parties can split the output with the agreed ration. In practice, the parties to a share contract divided output on the basis of *taba-wake*---"sharing sheaves"---, which involved setting out the harvested sheaves in the paddy, after which each party took its turn in taking every other sheaf. By letting a tenant stack up the sheaves in a way what he believes is equal and allowing a landlord to choose the sheaves he takes satisfies both parties and leaves no room for conflict.

Negotiation costs under a rent reduction contract were relevant because, in many cases, tenancy contracts were verbal arrangements lacking legal formality. The process of rent reduction was dominated by moral codes, social norms and customs. There were initially no explicit agreements between landlords and tenants on definitions of production shock or how to measure it. Rent reduction rates were also indeterminate.

We note that, just like a rent reduction contract, share tenancy was not free of transaction costs. The cost of attending and monitoring the harvesting, which was necessary every year, was perceived to be one of the costs of share tenancy along with tenant's shirking. Rents for paddies under a share tenancy were shared either in standing crops before harvesting (so the landlord had to harvest by herself), in sheaves immediately after harvesting, or in grain after threshing and drying; the latter was customary. In any case, it was common for the landlord under share tenancy to attend the harvesting after agreeing with the tenant on which day to harvest, in order to avoid underreporting of output and to make certain of collecting the rent[5]. To reduce this cost, absentee landlords and large landlords were more likely to adopt rent reduction contracts than resident landlords (MAF, 1934, p. 402). Rent reduction contracts have the advantage of saving this cost but they incurred inspection and negotiation costs that might have outweighed such benefit.

In summary, while rent reduction contracts can save the attendance cost that is necessary under share tenancy every year, it incurred investigation and negotiation costs in bad years. Therefore, a rent reduction contract mitigate the trade-off between incentives and risk-sharing but generate a new trade-off between incentives and transaction costs.

These transaction costs, that can potentially inhibit the adoption of rent reduction contracts, were in fact relevant and large. Some landlords switched back to share tenancies to avoid frequent

[5] Otsuka (2007) also notes the same point.

late payment and rent reduction. Requests for rent reductions and determination of the rate of reduction were two of the main causes of the tenancy disputes that arose in the 1920s and 1930s. Disputes arose over where and how to sample the harvest. For example, in Gunma prefecture, in 1927, a dispute arose when tenants requested a rent reduction by claiming a 15% decrease in the yield, while the landlords asserted that the yield was above average (Sato, 1987, p. 54). In Yamanashi prefecture, the landlords and the ward mayor, a witness to the sampling, accepted a request to resample made by the tenants, who claimed that a primary sampling paddy did not fairly evaluate the crop of that year (Sato, 1987, p. 210). After agreeing on the estimation of output, the parties then had to negotiate the rent reduction, which was another source of dispute.

The transaction costs were sometimes reduced by the community or the village, which informally governed the individual tenancy arrangements in the village. The quasi-legal–based tenancy relationships referred to as the "collective landlord-tenant relationships"' were based on either a "cooperative association"' or a "collective tenancy contract" (Sakane, 1990). A cooperative association was a village organization with a committee to coordinate tenancy relationships. It maintained collective relationships between the landlords and the tenants in the village under the yield inspection (*kemi*) committee and collectively determined the criteria for rent reductions in the community (Shoji, 1991)[6]. A collective tenancy contract is a formal contract written after the tenancy conciliation based on the Tenancy Conciliation Law of 1924. It had clauses on late payment and procedure of yield inspection and was agreed upon collectively between the group of landlords and tenants in the village. In case of the collective tenancy contract of 1931 in Kawarajiri village in Kyoto, the contract prescribed the procedure used for yield sampling when crops were bad: a request for yield sampling had to be made at least ten days before the harvest; the first yield sampling had to be performed by representatives of the landlords and tenants with agricultural committee staff in attendance; and if agreement could not be reached after the first sampling, the parties had to delegate the sampling to the agricultural committee staff, whose decision the parties had to accept (Sakane, 1990).

[6] An example is the *Showa-kai* formed in 1927 in Umaji village of Kyoto Prefecture after the tenancy dispute over bad crops in 1926 (Sakane, 1990). The dispute was settled by a rent reduction of 23% and an understanding that all future issues between landlords and tenants should be dealt with the cooperative association---the *Showa-kai*. The *Showa-kai* comprised ten board members: five each representing the tenants and the landlords. It was given an exclusive authority to sample and inspect output in bad years and to decide the rates of rent reduction. The rent-reduction system institutionalized by the *Showa-kai* was successful in preventing tenancy disputes after that.

These cases suggest that the transaction costs associated with rent reductions were reduced by the communal governance of tenancy relationships incorporating explicit and transparent institutions for rent reduction. The process of rent reduction was executed collectively and objectively and hence, arbitrariness and uncertainty was reduced. The main characteristic of prewar Japanese tenancy relationships, relative to those of other Asian countries, was that they were embedded in the communal society. It was common for communities to intervene in private tenancy relationships relating to yield sampling, collection of rents, rice inspections, and rent reductions. These communal interventions possibly originated from the *Murauke* system in the Tokugawa period, the village taxation system under which village member households were jointly responsible for paying the land tax imposed to a village. Under this joint liability, a village held various social activities including the management of irrigation systems and community forests, politics, and ceremonial functions, which likely enhanced social capital.

3.3. Determinants of tenancy contract choice: the case of Iwate prefecture

Iwate prefecture, located in northeastern Japan, was one of the few prefectures that had a high prevalence of share tenancy (**Table 4**). The availability of village-level tenancy contract data in Iwate prefecture allows us to quantitatively examine the determinants of contract choice. We utilize the data on the proportion of the area cultivated under share tenancy as a percentage of the total tenanted area (hereafter, the percentage of share tenancy) in February 1930 for 100 of the 236 villages in Iwate prefecture (reported in Iwate Prefecture (1932)). Missing observations are complemented with the percentage of share tenancy at the county level in 1935 reported in Iwate Prefecture (1954). Because the contract data reflects the contractual status after the 1929 crop season, we match them with other village-level data that represents potential determinants of contract choice, mainly constructed from the Annual Statistics of Iwate Prefecture (*Iwate Ken Tokei Sho*) for 1929.

Our empirical specification is the following:

$$\%Share_i = \beta_0 + \beta_1 Risk_i + \beta_2 Wealth_i + \beta_3 Community_i + \varepsilon_i .$$

The dependent variable *%Share* is the percentage of share tenancy in tenanted paddies in village *i* in 1929. $Risk_i$ is the measure of risk of rice production, $Wealth_i$ is the vector of variables that capture the average wealth level of tenant farmers that affect their attitude and tolerance toward risk, $Community_i$ represents communal ties in village *i*, and ε_i is the error term.

The indicator of risk of rice production is the village-level coefficient of variation of the rice yield over 15 years from 1920 to 1934[7]. This represents the risks associated with rice production, possibly because of bad weather, floods, droughts, or damage caused by insects and disease. The period 1920-1934 covers 10 years (1920-1929) before the year under consideration 1929, and 5 years after (1930-1934). The latter 5 years is included to capture the disastrous crop failure in 1934. This is to take into account that Iwate is periodically attacked by severe crop failures that halve the output approximately every 10 years, but the 1920s was exceptionally stable (**Figure 2**). We wish to include at least one severe crop failure and 1934 is the nearest from 1929.

[**Figure 2:** Rice yield in Iwate prefecture, 1900-50.]

Figure 3 shows a map the geographic distribution of share tenancy, measures of risk, and the terrain of Iwate prefecture. One can observe that share tenancy was concentrated in the coastal areas, where the rice production was relatively risky compared to inland. One cause of frequent and severe crop failures in the coastal areas was the seasonal wind known as *Yamase*, a cool moist air current originating in the Okhotsk Sea that blasts from the Pacific Ocean side of the Tohoku region in early summer (Bokura, 1998). A remarkable feature of cool summers in the Tohoku region is that there is a stark difference between the damage caused to the Pacific side of the region and that caused to the Sea of Japan side. This is because the *Yamase* is only 1,000 to 1,500 meters above the ocean and the wind from the Pacific side is blocked and weakened by the Ohu Mountains before reaching the Sea of Japan side. In the Iwate prefecture, the wind is blocked by the Kitakami Highlands. This topographical condition leads to substantial rice yield variability in the areas along the Pacific Ocean.

[**Figure 3:** Distribution of tenancy contracts, terrain, and risk in Iwate]

[7] Rice yield could be endogenous to contract choice. We construct our risk variables based on rice yield because, to our knowledge, there is no theoretical reasoning to believe that the choice of contract affects yield *variability* but *mean*. However, it might be reasonable to imagine that tenants cultivating under rent reduction contracts may try to reduce yield variability compared to those cultivating under share tenancy, because the former burden involves more risk. In this case, risk measured by rice yield under rent reduction contract would be smaller and therefore the coefficient will be overestimated. Nonetheless, it is unlikely that the farmers were able to control risk given the technology of the period of our study.

Table 5 reports the village-level cross-section two-limit Tobit estimates of the determinants of tenancy contract choice. A positive coefficient indicates that an increase in the independent variable is positively correlated with the percentage of share tenancy in tenanted paddies. In any specification, all of the risk variables have positive and highly statistically significant coefficients, implying that share tenancy was likely to be adopted in the villages with greater risk.

[**Table 5:** Tobit estimates of tenancy contract choice in Iwate prefecture, 1929]

In column (2), we include variables that proxy the tenant's wealth and income, since wealthier tenants may able to accept a rent reduction contract that is riskier than share tenancy. The variables used are the average landholdings (paddies and fields) per farm household and gross average total output per household (including non-farm households)[8]. The proportion of tenant farmers is included to control for the fact that tenant's landholdings are typically smaller than that of the owner-cultivators. The results indicate that relatively wealthy villages tended to adopt a rent reduction contract rather than a share tenancy, but the estimates are not significant in several specifications.

In column (3), two variables of village-wide risk-coping institutions---dummy variables indicating the existence of at least one credit cooperative and a rice bank in each village in 1929[9]---are included since these would enable the tenants to adopt riskier contracts. Only one of the coefficients for the risk-coping institutions is significant and have the expected negative sign.

Column (4) includes community variables to see whether community ties affected contract choice. However, since direct data on the distribution of cooperative associations or collective tenancy contracts are not available, we use several indirect proxies that would arguably represent communal ties. The paddy-to-field ratio is intended to capture communal ties since paddies require collective action to operate and manage irrigation and commons (Tamaki, 1983:19-20). The sign is

[8] These variables were computed by dividing the total landholdings, or gross total output, aggregated at the village-level by the number of resident households in the village.

[9] The credit cooperative variable is based on the complete list of industrial cooperatives in Japan in 1924 (Sangyo kumiai chuo kai, 1925). The rice bank variable comes from the individual rice bank (*goso*) data collected around 1936 by the *Sekisetsu chiho noson keizai chosa sho* (Research Institute of Rural Economy in Snowy Region) of the Ministry of Agriculture and Forestry. The results of this survey are summarized in the report *Tohoku chiho ni okeru biko goso ni kansuru chosa* (Survey of the precautionary rice banks in Tohoku region) in 1936. Rice banks established after 1929 are excluded, most of which were established following the famine of 1934 by the relief fund provided by the Emperor and the government.

consistent with our transaction cost story. But alternatively, we can also interpret it as a wealth effect since paddies are generally more productive than fields. The proportion of households engaged in agriculture represents occupational homogeneity, dependence on agriculture, and also reflects the idea that communal ties are generally stronger in agriculture-oriented villages due to the need for collective action over the use and management of irrigation and common land. All of the coefficients are positive and insignificant.

We also construct variables that represent collective action in the village in 1960. These variables indicate the ratio of relevant agricultural communities to total agricultural communities within the village that conducted voluntary collective activities on pest control, shipping of agricultural products, and community ownership of agricultural machines[10]. We find that collective actions of pest control and shipping in 1960 are correlated with the adoption of rent reduction contracts in 1930. Again, several interpretations are possible. Primarily, if the intensity of voluntary collective action in 1960 reflects strong communal ties in the 1920s, we may interpret this to mean communities were able to lower transaction costs through communal governance of landlord-tenancy relationships. However, the actual causality may be the reverse; villages might have been able to conduct collective actions in 1960 because they built up social capital by governing the process of rent reduction in prewar period. Another possible interpretation could be that such communities might also have been effective in mitigating moderate risk and encouraged the adoption of rent reduction contracts through informal mutual insurance.

For interpretation of the magnitudes of coefficients, marginal effects of changes of independent variables given the censoring of dependent variable is reported in column (5). OLS estimates are also presented in column (6) for comparison. A one standard deviation increase in the coefficient of variation of rice yield raises the percentage of share tenancy for 10.6% (derived from 1.315×8.06), whereas a 1% increase in the proportion of agricultural communities within a villages that conduct pest control or shipping collectively in 1960 is associated with a 22.2% and 11.9% lower percentage of share tenancy, respectively.

In sum, the estimation results suggest that contract choice in prewar Iwate prefecture was affected by risk; share tenancy contracts were more likely to be adopted in the villages with highly fluctuating yields and severe damage in years of serious crop failure. Also, the positive correlation between our community tie variables and adoption of rent reduction contract is consistent with the

[10] This data is derived from the Agricultural Community Survey conducted as part of Census of Agriculture and Forestry every 10 years.

idea that strong community ties ease the adoption of rent reduction contracts, either by reducing the transaction costs of rent reduction or by mitigating risk through mutual insurance. However, the result should be interpreted with caution since there are several alternative possible interpretations which we cannot completely identify due to data limitations.

4. Contract choice and productivity

What is the historical implication of agrarian tenancy in Japanese economic development? Theory predicts that if monitoring and enforcement of tenant's effort or provision of dynamic incentives is not possible, the land productivity diminishes in the order of owner-cultivation and pure fixed-rent contract, rent reduction contract, and share tenancy because the marginal profit of the tenants becomes smaller (Arimoto, 2005). Thus, the prevalence of rent reduction contracts might have prevented the fall in productivity despite the widespread tenancy relationships.

4.1. Previous results

In studies reported to date, no difference in land productivity between owner-cultivation and tenancy in Japan has been found. By comparing rice yield per unit plot of paddy and rice yield per working hour reported in several agricultural household surveys, Kajii (1986) concluded that paddies under owner-cultivation were more productive than those under tenancy around 1900 but the difference became less clear thereafter. Owner-cultivation was no more productive than tenancy in the 1930s, once the farming area is controlled for. Kawagoe (1995) reached the same conclusion using different household surveys. The differences in productivity seem to be come from differences in the cultivation area where farmers with larger farms tended to be more productive. Moreover, Kawagoe confirms no productivity difference at the prefectural level by comparing the growth rate of rice yield before and after the drastic land reform implemented after World War II. The land reform transformed the majority of the tenanted land to owner-cultivation, so prefectures with a high tenancy rate before the reform should have higher productivity growth if there were any productivity difference between owner-cultivation and tenancy. He finds *negative* but insignificant correlation between tenancy rate before the land reform and productivity growth, implying that the reform had no impact on productivity and that productivities were similar regardless of the prevalence of tenancy. To summarize, no productivity difference is found either at the household level or the prefecture level. However, they do not take into account the choice of contracts. Since the majority

of the contracts were rent reduction contracts in prewar Japan and that this contract provides fairly good incentives to the tenant, it is not so surprising to see no productivity difference between owner-cultivation and tenancy.

On the other hand, the descriptive evidences of low productivity under share tenancy compared to "ordinary" tenancy (i.e., rent reduction contract) are mixed. The report *Share Tenancy in Japan* (MAF, 1934) indicates that, while there were regions where share tenancy was equally productive as that under rent reduction contract, the land productivity under share tenancy was only 2/3 to 1/2 in many cases. This Marshallian inefficiency is identified as "the cost of share tenancy" in other official documents of the time as well (MAF, 1926, 1934; Iwate Prefecture, 1932). Thus, Marshallian inefficiency was widely recognized by the contemporary government officials. However, the causality of inefficiency is not so clear. The report suggests two reasons: the paddies rented out for share tenancy were less fertile to begin with (so the causality is reversed in this case), and the tenants take charge of cultivating their own paddies, applying less fertilizer and weeding than the paddies under share tenancy (a typical Marshallian inefficiency) (MAF, 1934, p. 375).

4.2. Prefecture-level fixed-effect analysis on productivity

To investigate the effect of contract choice on productivity, we conducted prefecture-level fixed-effect estimations, regressing rice yield on percentage of area of tenanted paddies to all paddies and its interaction term with the measures of the extent of share tenancy. If the rice yields in share tenanted paddies were lower than those under rent reduction contracts, then prefectures with a higher proportion of share tenancy within tenanted paddies would see the mean rice yield decline as the percentage of tenanted paddies increased. The dataset is constructed from Kayo (1983) and consists of all 47 prefectures in Japan for 20 years from 1915 to 1934 resulting in a total of 940 observations.

Rice yield per unit plot of paddy in a prefecture can be written as $y = p^O y^O + p^T y^T$, where p^O, p^T is the percentage of area of paddy under owner-cultivation and tenancy, respectively, and y^O, y^T is the corresponding yield. Since $p^O = 1 - p^T$, we estimate the following:

$$y_{it} = \beta_0 + \beta_1 p_{it}^T + \beta_2 p_{it}^T * share + \delta_i + \delta_t + \varepsilon_{it},$$

where y_{it} represents rice yield in prefecture i in year t and δ_i , δ_t are prefecture and year fixed effects. Given prefecture fixed effects, β_1 mearsures the effect of a 1% increase in the share

of area under tenancy on overall rice yield. The term $p_{it}^{T} * share$ represents the interaction of the percentage of tenanted paddies and the prevalence of share tenancy within tenanted paddies. Since the measure of prevalence of share tenancy is only available for one period in 1941, we are forced to assume that this has not changed throughout the period of consideration until 1941.

Table 6 presents the results of prefectural-level fixed-effect estimates of rice yield per unit plot of paddy. Prefecture fixed-effects and year dummies are included in all specifications. Column (1) shows that rice productivity is lower when a higher percentage of paddies was cultivated under tenancy, suggesting the realization of Marshallian inefficiency. Column (2) uses the percentage of tenant farmers (separated into owner-cum-tenant and tenant farmers) to all farmers instead of tenanted paddies and gives a similar result. In column (3), we interact the percentage of tenanted paddies with a dummy variable of 'share tenancy prefecture', which equals 1 if a prefecture had more than 5%[11] of paddies cultivated under share tenancy, and 0 otherwise. The magnitude of the coefficient of interaction term is twice as large as the coefficient of percentage of tenanted paddies. This implies that an increase of tenancy had a greater negative impact on rice yield in prefectures with higher prevalence of share tenancy, again suggesting the Marshallian inefficiency.

[**Table 6:** Tenancy and productivity: Prefecture-level fixed-effect estimates, 1915-1934.]

The result in column (1) indicates that a 1% increase in the percentage of tenanted paddy decreases the overall rice yield by 0.012 koku/tan. The mean rice yield is 1.9201 koku/tan so this implies a 0.62% decline resulting in 1.9081 koku/tan. Evaluating at the mean, we obtain the following system of equations:

$$1.9201 = 0.5107 y^{T} + 0.4893 y^{O}$$
$$1.9081 = 0.5207 y^{T} + 0.4793 y^{O},$$

where 0.5107 and 0.4893 is the share of area of tenanted paddies and owner-cultivated paddies respectively, at the mean. Solving this yields 1.3329 koku/tan for tenanted paddies and 2.5329 for owner-cultivated paddies, where the ratio of the former to the latter is 0.5262, i.e. productivity of the tenanted paddies were only half of the owner-cultivated paddies. This seems to be too small and it is

[11] Five percent criterion is chosen to include enough prefectures as 'share tenancy prefectures'. See Table 4.

likely to be skewed by observations in extremely bad years. In columns (4) and (5), we drop 19 observations of extremely bad years when the rice yield was less than 70% of the mean intertemporal rice yield of a given prefecture. The coefficient of the percentage of tenanted paddy is now -0.005 in column (4), which is equivalent to a 0.26% decrease, evaluating at the mean. The calculated rice yield for tenanted paddies is 1.6755 koku/tan and 2.1755 koku/tan for owner-cultivated paddies, where the ratio is 0.7702; tenanted paddies are 23% less productive than those under owner cultivation. The coefficient of the interaction of percentage of tenanted paddies and the dummy variable 'share tenancy prefecture' in column (5) is smaller than that of the percentage of tenanted paddies but is insignificant. This is because 9 out of the 19 observations dropped were those of 'share tenancy prefecture'.

These results indicate that the productivity of tenanted paddies was lower than owner-cultivated paddies and suggests the presence of Marshallian inefficiency in prewar Japan at the prefecture level. Moreover, some evidence suggests that productivity loss due to tenancy was likely to be larger in prefectures with a greater proportion of share tenancy. Taking these together, we conclude that, while landlords in prewar Japan were not able to resolve the productive inefficiency of tenancy completely, they were at least able to mitigate such a loss by providing more incentives to the tenants with the adoption of a rent reduction contract.

Why is our result different to the previous studies? There are two major differences between our analysis and the prefecture-level investigation by Kawagoe (1995). First, we limited our analysis to the prewar period (1915-1934) while Kawagoe (1995) used a longer period from 1923 and 1959 (averaged over 5 years centering on 1923 and 1959). Second, we used annual data, whereas Kawagoe used only two time points. Since we used a shorter interval and looked at the period before World War II, our results are less likely to be biased by omitted variables that affect productivity growth other than the potential inefficiency caused by tenancy. In particular, several policies enacted after World War II seem to have enhanced productivity. The government procurement food price was raised after 1952 to stimulate food production. Public investment in land increased after the establishment of the Land Improvement Act in 1949 also fostered productivity growth.

5. Concluding comments

Agricultural productivity growth is essential to avoid leaping into the Malthusian trap and to stimulate modern economic growth. In the earlier stage of Japan's economic development, the

prevalence of the rent reduction contract seems to have sustained agricultural productivity despite the prevalence of landlord-tenancy relations by providing incentives and mitigating risk from the tenant better than other types of contracts. However, historical evidence suggests that rent reduction contracts incurred transaction costs on inspecting the output and negotiating the size of the rent reduction, which could be the main reason for its unpopularity outside Japan. Our quantitative evidence at the village-level suggests that share tenancy was more likely to be adopted in villages with higher risk, supporting the standard theory of risk-sharing and incentives in the choice of tenancy contracts. Moreover, rent reduction contracts were more likely to be found in villages with stronger communal ties. This result, along with the historical anecdotal evidence, suggests that transaction costs and the presence of informal community institutions that mediate and enforce the rent reductions could have been one of the critical determinants of contract choice.

In consideration for contract choice and productivity, a negative correlation between the prevalence of tenancy and productivity is found at the prefectural level and such inefficiency was likely to be worse in prefectures with a greater proportion of share tenancy. Therefore, the result suggests at the macro-level that Marshallian inefficiencies were common in prewar Japan, but that it was at least partly mitigated by the adoption of rent reduction contracts.

In short, the agriculture in prewar Japan may have benefitted from the prevalence of rent reduction contracts that prevented the dramatic decline of productivity due to widespread tenancy. Such a unique contract was probably sustained by the informal communal institutions that mitigated the transaction costs of rent reduction. Therefore, the experience of prewar Japan suggests the importance of informal institutions on agricultural development and industrialization through the enforcement of complex contracts. However, further quantitative studies are required to reach a concrete and confident conclusion on the relationship between tenancy contract and productivity.

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Figures

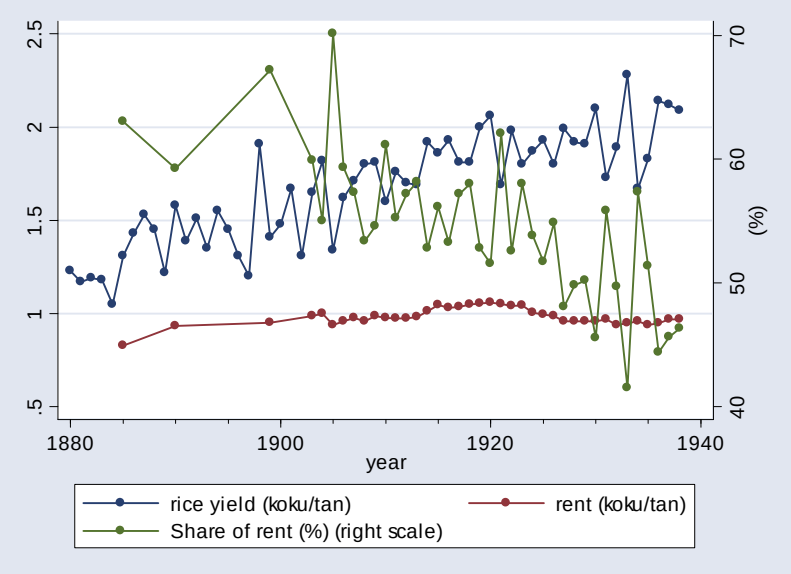


Figure 1: Distribution of output in tenancy relations

Source: Umemura et al (1966); Bureau of Food, Ministry of Agriculture and Commerce of Japan (1922); Bureau of Food Administration of Japan(1948); Bureau of Agriculture, Ministry of Agriculture and Commerce of Japan, *Kokumotsu Yoran* (*Handbook of Grain*), various issues.

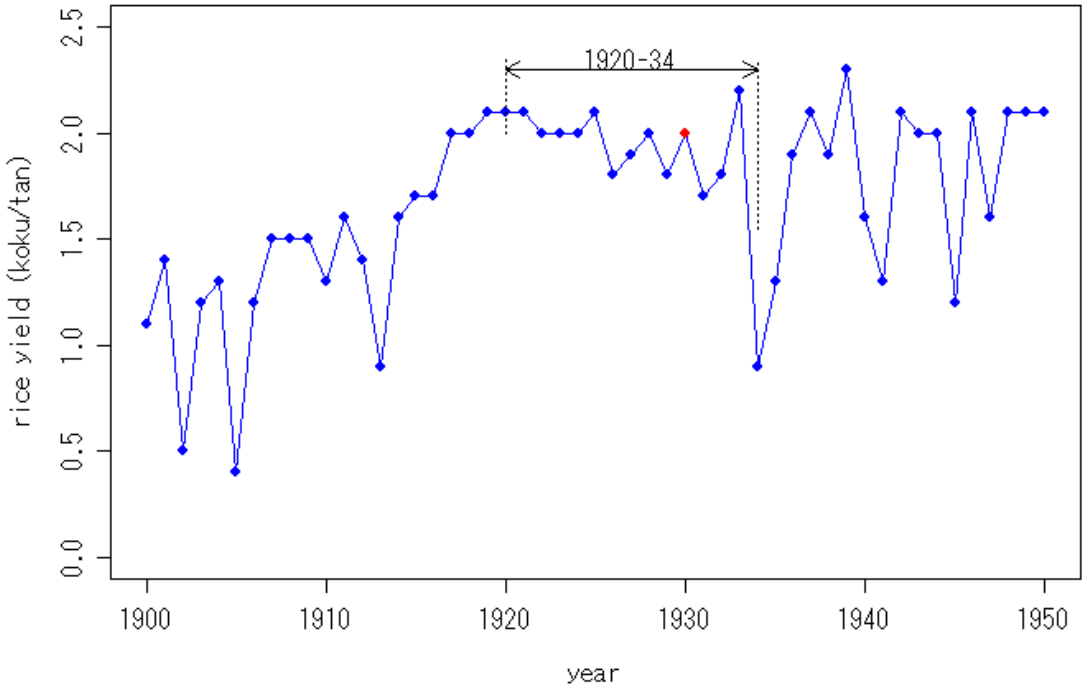
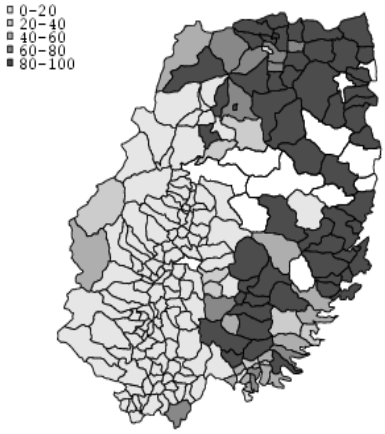
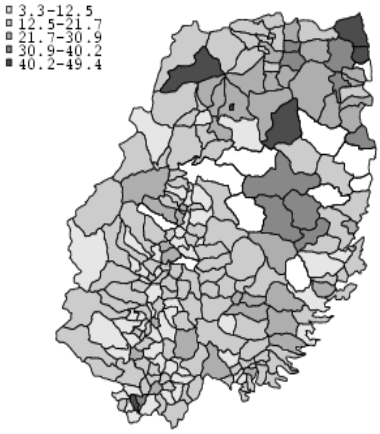


Figure 2: Rice yield in Iwate prefecture, 1900-50.

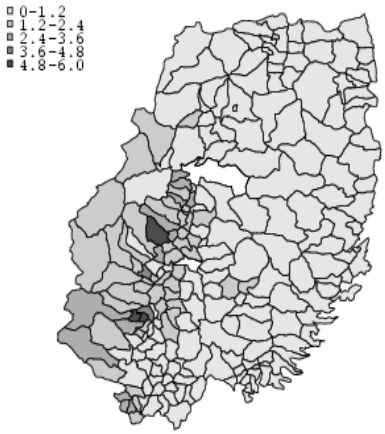
Source: Kayo (1987).



(a) % of share tenancy (1930)



(b) c.v. of rice yield (1922-31)



(c) paddy-field ratio (1929)

(d) terrain

Figure 3: Distribution of tenancy contracts, terrain, and risk in Iwate

Tables

Table 1: Growth of agricultural production and productivity

Period	Agri-cultural output	Input				Labor productivity	TFP
		Labor	Arable land	Capital stock	Total input		
1880-1900	1.6	0.0	0.5	0.9	0.4	1.6	1.2
1900-1920	2.0	-0.6	0.7	1.3	0.5	2.6	1.5
1920-1935	0.9	-0.2	0.1	0.9	0.5	1.1	0.4

Note: Annual rate of change (%).

Source: Hayami (1973), pp.32-41.

Table 2: Extent of tenancy relations

	Number of farmers				Area of arable land		
	Total	owner farmers	owner-cum-tenant farmers	tenant farmers	Total	owned	tenanted
	(1,000 households)				(1,000 ha)		
1908	5,408	1,800	2,117	1,492	5,504	3,005	2,499
1913	5,444	1,745	2,178	1,521	5,794	3,159	2,635
1918	5,477	1,697	2,229	1,550	6,027	3,250	2,777
1923	5,440	1,665	2,240	1,536	6,039	3,231	2,808
1928	5,576	1,748	2,345	1,483	6,035	3,270	2,765
1933	5,622	1,746	2,376	1,500	5,979	3,159	2,819
1938	5,520	1,696	2,361	1,462	6,028	3,221	2,806
	(Percentage)						
1908	*100.0*	*33.3*	*39.1*	*27.6*	*100.0*	*54.6*	*45.4*
1913	*100.0*	*31.7*	*40.4*	*27.9*	*100.0*	*54.5*	*45.5*
1918	*100.0*	*31.0*	*40.7*	*28.3*	*100.0*	*53.9*	*46.1*
1923	*100.0*	*30.6*	*41.2*	*28.2*	*100.0*	*53.5*	*46.5*
1928	*100.0*	*31.3*	*42.1*	*26.6*	*100.0*	*54.2*	*45.8*
1933	*100.0*	*31.1*	*42.3*	*26.7*	*100.0*	*52.8*	*47.1*
1938	*100.0*	*30.7*	*42.8*	*26.5*	*100.0*	*53.4*	*46.5*

Source: Toyo Keizai Shinposha (1927), p.507; Toyo Keizai Shinposha (1991), p.167, p.173.

Table 3: Distribution of household by size of land ownership

	Total	-0.5 ha	0.5-1 ha	1-3 ha	3-5 ha	5-10 ha	10-50 ha	50 ha-
	(1,000 households)							
1908	4,937	2,278	1,288	926	279	123	40	2.6
1913	4,899	2,355	1,231	882	264	123	40	3.0
1918	4,863	2,376	1,172	890	254	123	44	3.6
1923	4,879	2,416	1,181	883	228	118	49	5.1
1928	5,045	2,504	1,240	910	229	113	45	4.1
1933	5,120	2,550	1,284	900	223	113	46	3.6
1938	5,089	2,475	1,308	928	222	110	44	3.2
	(Percentage)							
1908	*100.0*	*46.1*	*26.1*	*18.8*	*5.7*	*2.5*	*0.8*	*0.05*
1913	*100.0*	*48.1*	*25.1*	*18.0*	*5.4*	*2.5*	*0.8*	*0.06*
1918	*100.0*	*48.9*	*24.1*	*18.3*	*5.2*	*2.5*	*0.9*	*0.07*
1923	*100.0*	*49.5*	*24.2*	*18.1*	*4.7*	*2.4*	*1.0*	*0.10*
1928	*100.0*	*49.6*	*24.6*	*18.0*	*4.5*	*2.2*	*0.9*	*0.08*
1933	*100.0*	*49.8*	*25.1*	*17.6*	*4.4*	*2.2*	*0.9*	*0.07*
1938	*100.0*	*48.6*	*25.7*	*18.2*	*4.4*	*2.2*	*0.9*	*0.06*

Source: Toyo Keizai Shinposha (1927), p.507; Toyo Keizai Shinposha (1991), p.167, p.173.

Table 4: Rice productivity and areas of share tenancy by prefecture (1941)

	rice productivity 1931-40 (koku/tan)			area under tenancy 1941 (cho)		area under share tenancy 1941 (cho)		(%)	
prefecture	Mean	S.D.	C.V.	paddy	field	paddy	field	paddy	field
Hokkaido	1.345	0.44	32.58	115,227	302,040	150		0.1%	
Aomori	1.68	0.4	23.93	44,044	19,804	5,379	3,155	12.2%	15.9%
Iwate	1.87	0.32	17.01	28,018	17,731	3,750	10,350	13.4%	58.4%
Miyagi	1.945	0.27	14.1	67,294	17,808	1,250	20	1.9%	0.1%
Akita	1.895	0.21	11.03	69,707	8,406	4,000	20	5.7%	0.2%
Yamagata	2.17	0.26	11.88	62,985	15,760				
Fukushima	1.795	0.28	15.49	51,830	24,625	53		0.1%	
Ibaraki	1.81	0.21	11.6	58,662	67,976	120		0.2%	
Tochigi	1.74	0.19	10.94	41,946	31,192	8	1	0.0%	0.0%
Gunma	2.105	0.34	16.27	19,111	32,656	256		1.3%	
Saitama	1.83	0.24	13.28	40,740	41,673				
Chiba	1.87	0.18	9.52	58,890	43,098	550	200	0.9%	0.5%
Tokyo	1.885	0.22	11.58	5,295	15,132				
Kanagawa	2.05	0.28	13.75	9,777	18,344	3		0.0%	
Niigata	1.96	0.27	13.69	109,069	23,042				
Toyama	2.045	0.2	9.58	49,183	2,616				
Ishikawa	2.135	0.18	8.5	26,379	4,216				
Fukui	2.075	0.16	7.64	23,681	2,687	15		0.1%	
Yamanashi	2.315	0.26	11.41	10,722	14,492	200		1.9%	
Nagano	2.14	0.23	10.55	36,484	31,047	2,300	700	6.3%	2.3%
Gifu	2.04	0.22	10.83	33,417	9,832	4,670		14.0%	
Shizuoka	2.07	0.25	11.84	32,000	26,239	5	10	0.0%	0.0%
Aichi	2.08	0.27	12.92	46,354	18,990	100	5	0.2%	0.0%
Mie	1.925	0.23	12.02	30,252	8,160	12		0.0%	
Shiga	2.305	0.16	6.82	31,575	2,537				
Kyoto	2.025	0.3	14.93	19,070	3,463				
Osaka	2.42	0.22	8.95	24,194	3,758				
Hyogo	2.16	0.18	8.14	51,211	5,120				
Nara	2.42	0.23	9.63	15,258	2,432				

Wakayama	2.075	0.24	11.37	14,093	4,144				
Tottori	2.095	0.2	9.61	19,593	6,551				
Shimane	1.865	0.16	8.75	28,835	6,516	190		0.7%	
Okayama	2.04	0.21	10.23	42,608	8,683	400	50	0.9%	0.6%
Hiroshima	1.795	0.17	9.65	30,887	7,280	7		0.0%	
Yamaguchi	1.845	0.18	9.71	31,984	4,215				
Tokushima	1.89	0.22	11.76	13,750	5,619	32	15	0.2%	0.3%
Kagawa	2.275	0.3	13.06	25,241	5,378				
Ehime	2.09	0.21	10.05	25,821	12,659	95	20	0.4%	0.2%
Kochi	1.68	0.19	11.03	15,692	7,158	300	2,500	1.9%	34.9%
Fukuoka	2.145	0.17	8.07	53,048	8,909				
Saga	2.365	0.23	9.53	26,988	4,005	363	163	1.3%	4.1%
Nagasaki	1.685	0.24	14.19	15,506	12,046	60	50	0.4%	0.4%
Kumamoto	2.095	0.2	9.61	47,577	25,192	200	60	0.4%	0.2%
Oita	2.02	0.26	13.11	27,777	8,335	150		0.5%	
Miyazaki	1.81	0.17	9.12	23,137	15,768	416	602	1.8%	3.8%
Kagoshima	1.695	0.14	8.23	30,243	39,067	915	2,576	3.0%	6.6%
Okinawa	1.15	0.3	25.78	1,224	7,089	600	300	49.0%	4.2%
All Japan				1,686,379	1,003,490	26,549	20,797	1.6%	2.1%

Source: “Rice productivity (1931-40)” and “area under tenancy”: Kayo (1983); other data: Sakane (2005), Table 1-1, 1-2, 1-6.

Table 5: Tobit estimates of tenancy contract choice in Iwate prefecture, 1929

dependent variable: percentage of share tenancies in tenanted paddies (in area)

	(1)	(2)	(3)	(4)	(5)	(6)
	Tobit	Tobit	Tobit	Tobit	dy/dx	OLS
c.v. of rice yield	4.646	4.268	4.159	2.900	1.315	1.944
	(0.461)***	(0.464)***	(0.462)***	(0.471)***		(0.358)***
landholdings per household		-16.189	-16.133	-4.065	-1.844	-0.919
		(6.749)**	(6.708)**	(6.543)		(5.606)
total output per household		-0.004	-0.005	-0.012	-0.005	-0.007
		(0.007)	(0.007)	(0.008)		(0.006)
% tenant farmers		-25.985	-24.797	-9.534	-4.324	-10.336
		(18.255)	(18.094)	(17.416)		(13.957)
credit association			-7.105	-4.440	-2.016	-4.227
			(6.100)	(5.699)		(4.565)
rice bank			-17.262	-2.177	-0.984	-5.178
			(13.324)	(12.659)		(7.692)
paddy-field ratio				-13.764	-6.243	-12.276
				(3.414)***		(2.588)***
% farming household				3.776	1.712	-0.534
				(16.863)		(12.916)
pestcontrol (%), 1960				-49.024	-22.235	-33.900
				(11.857)***		(10.026)***
shipping (%), 1960				-26.216	-11.890	-21.656
				(15.349)*		(10.592)**
machine (%), 1960				-8.554	-3.880	-1.890
				(9.925)		(7.479)
Constant	-81.522	-30.758	-23.185	60.677		59.817
	(12.125)***	(20.519)	(20.725)	(26.251)**		(22.542)***
Observations	224	224	224	209	209	209
log likelihood	-894.39	-888.90	-887.22	-801.01		

Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6: Tenancy and productivity: Prefecture-level fixed-effect estimates, 1915-1934.

dependent variable: rice yield (koku/cho)

	(1)	(2)	(3)	(4)	(5)
				dropped	dropped
	full obs.	full obs.	full obs.	bad years	bad years
% paddy tenanted	-0.012		-0.010	-0.005	-0.004
	(0.003)***		(0.003)***	(0.002)**	(0.002)*
% paddy tenanted * dummy share			-0.021		-0.006
			(0.008)**		(0.008)
% owner-cum-tenant farmer		-0.008			
		(0.006)			
% tenant farmer		-0.017			
		(0.005)***			
Constant	2.449	2.664	2.463	2.123	2.130
	(0.133)***	(0.326)***	(0.133)***	(0.117)***	(0.117)***
Observations	940	939	940	921	921
Number of group(pref)	47	47	47	47	47
R-squared	0.45	0.44	0.45	0.49	0.49

Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Note: "dummy share" is a dummy variable which takes 1 if a prefecture's percentage of share tenancy in paddy was more than 5% in 1941. Prefectures with dummy share=1 are Aomori, Iwate, Akita, Nagano, Gifu, and Okinawa.