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The Role of Information in the Rice Exchange:

YAMAGATA Bantō's *Great Knowledge* (1806)

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ABSTRACT

The nineteenth-century French economist Jules Regnault has been reassessed as a pioneer of financial economics by Jovanovic and others. Although not as elaborate as Regnault's model for the random nature of stock prices, there was a Japanese philosopher in the same century whose ideas resembled Fama's (1970) hypothesis that all available information is reflected in market prices. His name was YAMAGATA Bantō. This paper clarifies his contribution to the early concept of the Efficient Market Hypothesis by analysing his discussion on information presented in his 1806 *Great Knowledge*.

Keywords: YAMAGATA Bantō, Dōjima Rice Exchange, Efficient Market Hypothesis, information, speculation

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1. Introduction

In the 1960s, the modern financial doctrine regarding the role of information making efficient markets developed in economics (Jovanovic 2008, 216–17; 2018, 292; Delcey and Sergi 2022, 3). One of the main contributors was Eugene Fama. Initially, Fama formulated his famous definition of the Efficient Market Hypothesis (EMH) as a “market in which prices always ‘fully reflect’ available information” (1970, 383). Fama and his opponents engaged in considerable debate over this original definition (Jovanovic 2018, 292–95, reviewing the qualitative history of the EMH; also see Delcey and Sergi 2022, 4–5). Throughout the controversy, Fama altered his definition of EMH multiple times (see, for example, Fama 1991; 1998). However, his contribution to empirical analyses of the EMH was reevaluated and gained prominence in the twenty-first century, earning Fama the 2013 Sveriges Riksbank Prize in Economics Sciences in Memory of Alfred Nobel. The role of information in the stock market is now well acknowledged by most present-day economists of the financial market.¹

Centered on the question of random fluctuations in stock prices, the origins of financial economics can be traced back to the mid-nineteenth century in France (Jovanovic 2008, 215; 2018, 292). During the period “when short-term speculation was denounced as immoral,” a French assistant broker, Jules Regnault, “approached this issue ‘scientifically’” on “the basis of modern stochastic models of price behaviour” in his 1863 book *Calcul des Chances et Philosophie de la Bourse* (For the biography of Regnault, see Jovanovic 2006).

¹ For the quantitative history of the EMH, see the elaborated study by Jovanovic (2018: 295–302). Jovanovic (2012) also introduced the work of Louis Bachelier who is believed to be the first to formulate the Brownian motion required to test that hypothesis.

In Japan early in the nineteenth century, when many of the Chu Hsi Confucian scholars in the country believed that short-term speculation in the rice market was immoral, the merchant and scholar YAMAGATA Bantō (1748–1821; hereafter we shall refer to him as Bantō²) proposed that the Osaka-Dōjima rice market gathered information from various regions and that information was reflected in its prices. This proposition can be found in his main 1821 work, *Material of Dreams* (*Yume no Shiro*), a treatise that included discussions of astronomy, geography, theology, history, and political economy.³

Suenaka (1971), Sakasai (1990; 1993), and Arisaka (1993; 2005) has considered the economic ideas in Bantō's *Dreams* without reference to financial economics. Their accounts, however, were published in Japanese. It was Craig (1965), Najita (1987) and Fujii (2018) that introduced the *Dreams* to English-speaking readers. Craig and Fujii did not focus on Bantō's economic ideas, while Najita (1987, 269–71) mentioned Bantō's doctrine that price in the Dōjima rice market was fixed at a “natural” level. However, Najita did not trace back to Bantō's explanation of how this level was realised. Hence, none of the authors emphasised Bantō's contribution to financial economics theory.⁴

² Bantō is a pseudonym; his autonym is Yoshihede. Japanese scholars' names in the Tokugawa period are given in the customary Japanese order, that is, SURNAME first, except in the Reference section. Their names, when shortened, are often expressed as first names rather than surnames, and this paper follows this practice.

³ The title of Bantō's book has been variously translated into English, as *Instead of Dreams* (Gramlich-Oka and Smits eds. 2010, 267), “*Daydreams*” (Craig 1965, 135), and others. We chose to use *Material of Dreams*, referencing Arisaka's (2005, 110) interpretation of the Japanese title.

⁴ Nishioka's (2020, 27) brief footnote mentions Bantō's doctrine of “great knowledge” that “represented the market mechanism” but does not discuss it any further in relation to modern financial economics.

Craig (1965, 136) asserted that Bantō's *whole* system of thought was based *entirely* on the Chu Hsi Confucian tradition. On the other hand, Arisaka (1993, 29–99; 2005, 97–128), Suenaka (1971, 354–488; 1976, 1–248), and Minamoto (1971, 37) has argued that Bantō partially had the rationalist spirit in contrast to Chu Hsi Confucianism. There were other rationalist minds, such as KUSAMA Naokata (1753–1831; hereafter Naokata) and KAIHO Seiryō (1755–1817; hereafter Seiryō) in Tokugawa Japan, but they did not attempt to integrate these rationalist ideas into price theory.⁵ ISHIDA Baigan (1685–1744; hereafter Baigan) partially discussed the price mechanism, but ultimately, in the framework of Confucian thought, he asserted that prices were regulated by Heaven ([1739] 1956, 81). Bantō directly turned to the issue of price determination, pioneering the ground-breaking idea of the role of information in the market.

This paper aims to reveal Bantō's contribution to the early concept of the EMH, by analysing his perspective on the role of information in the Dōjima Rice Exchange (DRE), which was first expounded in his *Great Knowledge (Taichi-ben)* and, later, repeated in his *Dreams*. It neither asserts that Bantō was the first to propose the concept of random fluctuations in stock prices nor that he was the first and only proponent of the efficient market theory. It merely shows that he was one of the early nineteenth-century authors

⁵ Metzler and Smits (2010, 1–21) and Kawaguchi (2022, Chapter 7) demonstrated that Naokata criticised market intervention with his own rationalist spirit, and Seiryō supported the rationalistic aspect of Bantō's qua businessman. Morris-Suzuki (1989, 34) stated that “in Seiryō's writings the language and imagery of Confucian thought is transformed into the rationality of market exchange.” However, Seiryō ultimately identified “market exchange as the principle (*ri*) which, in Confucian thought, imparts order and harmony to human society.” Thus, Seiryō still only grasped the market mechanism within the framework of Confucian thought.

who proposed a very similar notion to Fama's (1970) EMH.

The paper is structured as follows. Section 2 describes the structure and system of the DRE. The complex and unique system is largely unknown outside Japan and is highly relevant to Bantō's political economy doctrines. Section 3 presents a biography of Bantō. It shows that his background influenced the formation of his economic thought. This section also provides an opportunity to introduce this Japanese author who remains little known outside of Japan. Section 4 examines his price-related assertions in the *Great Knowledge*. Section 5 discusses Bantō's contribution to financial economics and concludes with some additional observations.

2. Dōjima Rice Exchange

During the period in which Bantō lived, the Tokugawa shogunate (1603–1867) reigned as the authority over all of Japan, while a local lord ruled each region. Hundreds of local lords had the authority to rule specific domains, and the shogunate had its own domains in various regions, which included most developed cities, such as Tokyo (then known as *Edo*), Osaka, Kyoto, and Nagasaki. Each lord, as well as the shogunate, received tax payments in the form of rice. The taxed rice was sold on the market to cover the administrative costs (see Takatsuki 2022, Chap.1). The lords necessarily had their eyes on the market where they expected to create a large demand for rice.

It was in the Nagasaki market that, at the beginning of the shogunate hegemony, the local lords actively sold their tax-rice to foreign merchants. In the second half of the seventeenth century, rice exports through Nagasaki declined because of the ban in 1639 by the shogunate, and the local lords shifted sales of tax-rice to Osaka. This change was a result of the improvement in transport and storage infrastructure, such as canals, bridges,

and warehouses, in Osaka (Miyamoto 1988, Chapter 1). The volume of rice shipped to Osaka by Hosokawa, the great local lord, reached 12,000 tons in 1703, which shows a doubling in half a century. Thus, Osaka established itself as a central market between the late seventeenth and eighteenth centuries (see Takatsuki 2022, Chap.1).

[Insert Figure 1 near here.]

The process and system of trading at the Osaka-Dōjima Rice Market are illustrated in Figure 1. Local lords ship tax-rice to Osaka and store it in warehouses (Figure 1, Phase 1). They then sell the rice to brokers at auction. Successfully bidding brokers are asked to pay within ten days of accepted bid submission. This income is allocated to the repayment of debt and remitted to the local lords' domains and to Tokyo by financial merchants (Figure 1, Phase 2). Once a rice broker's payment for a given bid is complete, a rice certificate is issued by the local lord's warehouse. Rice certificates are securities exchangeable for 10 units (*koku*) of rice (approximately 1.5 tons of rice) per certificate. The face value of rice certificates is unified to 10 units of rice per certificate, regardless of which local lord issues the certificate. This makes calculations easy when rice brokers resell to or purchase from third parties. In principle, rice brokers are allowed to submit their rice certificates to the warehouses in exchange for bags of rice—although, in practice, they primarily sold the rice certificates on the secondary market, that is, the DRE (Figure 1, Phase 2). The spot market in Dōjima is a market for the transaction of *certificates* and not of the physical commodity. Rice stocks are contracted when a rice certificate is presented to a local lord's warehouse for delivery to consumers (Figure 1, Phase 3).

In this system, rice brokers preferred to trade in certificates rather than trade in bulky rice-bags made of straw. The storage fee was not charged for a certain period—generally, a year or a year and a half in major warehouses. As long as in this period, the stored rice was remunerated without any additional fee, even if its quality was decreased or it was damaged by rats. If the time limits are expired, the merchants must burden costs.

[Insert Table 1 near here.]

The DRE included a spot and futures market. Both markets were separated into *spring*, *summer*, and *winter* market seasons each year, as presented in Table 1.

The spot market remains open one day longer than the futures market, as futures trades will be cleared. The spot trading takes place between 10:00 and 12:00. The futures trading commences two hours before the spot trading. After a “temporary stop” at noon, futures trading resumes and finishes at 14:00. Certificates for about thirty different brands of rice are traded in the spot market where the trading ultimately requires to be settled by exchanging cash for certificates. In principle, the settlement must be completed within four days. Meanwhile, all the futures contracts must be settled by selling (buying) back without any delivery of the rice-bags or rice certificates.

The objective of futures trading was a kind of index. For each trading season, one rice brand was chosen by a vote of the rice brokers. The chosen brand was called “representative rice” for trading purposes.⁶

⁶ Once the rice is chosen as representative rice, it generally remains the same for the winter market and the spring market of the following year. However, the Fukuoka rice was frequently chosen for winter and spring markets, whereas the Kanazawa rice was selected

According to *The Story of Rice (Hachiboku no Hanashi)* written in the Tokugawa period, a “representative rice” must be, at first, a certain quantity of the branded rice shipped to Osaka and, next, a good quality of it contained in straw bags. Only rice brands with demonstrable liquid market are qualified to serve as an underlying asset for futures trading. Suppose that a merchant bought 1 unit in futures. In this case, the futures trade is usually recorded as: ‘the merchant bought 100 *koku* (approximately 15 tons) of a proxy-rice—which are derived from a representative rice—in futures’. This trading, however, does not mean that he can obtain 15 tons of the rice on the date of maturity. Instead, he must place a reversing (selling) order for 15 tons to offset the purchase till the maturity date. All the futures contracts in the DRE must be cancelled out until the maturity date of each period, thus preventing the rolling over to the next period. As the futures trading follows the rule of net settlement, representative rice is neither exchanged for rice certificates nor physical rice. That is, the Osaka-Dōjima futures market was *not* a situation where *commodity* trade took place. Rather, it was kind of an *index-futures* market.⁷

Both spot and futures prices were all open to the public, both within and outside the market. In the Tokugawa period, prices in the DRE were immediately transmitted from Osaka to every region of Japan and information that influence prices was, in turn, gathered from every direction transmitted to the Dōjima market by means of mail, hand signals and so on.

The system of the DRE, explained above, is highly relevant to Bantō’s ideas of political economy. Figure 2 depicts the futures market in Dōjima at the end of the

as the single representative rice for futures trading for the summer market (see Table 1).

⁷ The futures trade in Dōjima was called “Chōaimai”, meaning “rice trades settled on book”. From the name, it is evident that any exchange of rice did not take place.

eighteenth century when Bantō lived.

[Insert Figure 2 near here.]

3. A Biography of Bantō

3.1 Business background

Bantō was born in *Harima* (now Hyōgo) in 1748 as the second son of a farmer. At thirteen, he was adopted by his uncle, the merchant of the Masuya at Kajikimachi (near Dōjima) in Osaka, and a few years later, Bantō succeeded to his uncle's position (Suenaka 1971, 1–2).

Established in 1694, the Masuya merchant house successfully grew as a rice dealer. In the mid-eighteenth century, the Masuya extensively extended large loans to local lords and provided financial advice with Bantō at the helm of these activities. His most prominent contribution was the restoration of the Sendai clan's finances (Minamoto 1971, 20–22). Following Bantō's suggestions, the Sendai clan purchased extra rice from farmers that were unnecessary for annual tribute payments and sold it in the cities, such as Tokyo, where the demand for provisions was large (Seiryō [1813] 1976, 427–446). This system enabled Sendai to acquire considerable wealth and, the Masuya, the creditor of the Sendai clan, earned extensive profits. In proportion to these gains, the employees in the merchant house quadrupled between 1792 and 1805.

The success of Bantō as a financial advisor to local lords is comparatively well known, but his influence as a rice trading specialist is less known. The servants of the Mitsui family, the greatest business group, called the Masuya “a master of the rice-trader” (Takatsuki 2022, Chapter 9). It is Bantō who led the Masuya at this time. The Mitsui's

statement shows Bantō's substantial talent as a rice merchant.

His work and experience at the DRE enabled him to link rice prices with information. Based on his daily experience of spot and derivatives trading, he wrote the *Great Knowledge*. A major difference between Bantō and other philosophers of his time, such as Baigan, Seiryō, and Naokata, is that they lacked the actual experience of trading at the rice market, although their contributions referred to the operation of this market. Instead, Bantō's practical experience probably led him to become an economic rationalist philosopher.

3.2. Academic background

The DRE had frequently been the subject of criticisms since its establishment in 1730. The shogunate, however, supported the role of futures trading. A series of bad harvests in the mid-1780s raised the price of rice, which eventually caused riots in Osaka and Tokyo in May 1787. In response to the riots, in January 1788, the Tokugawa shogunate summoned the merchants to discuss the usefulness of trading in futures. For the rice merchants, futures trading was necessary both for hedging losses from price fluctuations and for speculation.

In opposition to this move was the influential Confucian scholar Nakai Chikuzan (1730–1804; hereafter Chikuzan) who denounced this kind of trading as empty in his 1789 work, *An Alarm from an Anonymous Outsider (Sōbō Kigen)*, which was originally submitted in November 1788 to the executive government official, MATSUDAIRA Sadanobu (1759–1829; hereafter Sadanobu). Chikuzan stated:

According to those who are engaged in the futures trades, the price of rice is

maintained and market price fluctuations are properly stabilised by the futures trade. This explanation, however, is a “misleading façade” intended to deceive the government and cheat the people [...]. In futures trade, even in normal years (neither poor harvest nor good harvest), while the spot price of rice is gradually falling, they set a different futures price and speculate on its fluctuation. Therefore, it has nothing to do with the real rice market. Rice is used only in name, and wheat, beans, oil or indigo could actually play the same role. The name “rice” is used only because rice is the commodity most widely traded. The futures trade is the “mere gambling chartered by the shogunate.” Without this “empty trade,” there would be no change in the spot rice market ([1789] 1942, 1–2; our translation).

Although Chikuzan never denied the usefulness of rice certificate trading, he claimed that futures trading should be abolished as the spot rice market could function without it. However, his opinion was not accepted by the shogunate. On the contrary, the government’s policy was directed to the protection of the futures trading in the DRE as if it follows the advice of Bantō, a pupil of Chikuzan at the Kaitokudō school.

Established in 1724, the Kaitokudō was a highly successful institution as “a semi-official school” to educate the sons of Osaka merchants (see Craig 1965, 134; Suenaka 1971, 6). Bantō took time out from his work to be educated there. The teachers, including Chikuzan highly praised his eager studiousness. The knowledge that Bantō gained there perhaps aided him when writing the *Great Knowledge*.

The Kaitokudō had the perspective that everyone could understand the natural principles of things (*Mono-no-Kotowari*) through empirical contemplation. GOI Ranshū (1697–1762; hereafter Ranshū), a teacher of the Kaitokudō, believed in a universal law of

nature in this world (Sakasai 1990, 119). According to Ranshū, if someone feels as if something is not subject to the natural law, it is because of a personal lack of knowledge. From this spirit of Kaitokudō, Bantō adopted rationalistic thought and he came to develop negative views of Chu Hsi Confucianism. Using the example of the natural phenomena of lightning strikes may happen to good as well as to bad people in Bantō's *Dreams* ([1820] 1971, 557), he dismissed the Confucian assertion of a "correlation between Heaven and man," in which human action and natural phenomena are inseparably linked (Minamoto 1971, 37). This rationalist approach to Bantō's thought is said to have led him to view the price mechanism as a system (Sakasai 1990, 119).

Chikuzan's reputation as an advisor to the government helped to elevate Bantō's and his scholarship throughout the country. In 1812, Bantō had an opportunity to submit the *Great Knowledge* to the shogunate executive, Sadanobu, through Chikuzan.

The *Great Knowledge* (*Taichi-ben*) first appeared in 1806 under the title *Ko-Taichi-ben* ([1806] 1976). The submission of it to Sadanobu shows that it was written to influence policy. The text was later reproduced, with some trifling alterations, in Book VI on "Political economy (*Keizai-roku*)" of the *Dream*. The *Dreams* was circulated in the form of handwritten copies and then Bantō's ideas were widely popularised during the remainder of the Tokugawa shogunate's governance (Suenaka 1971, 321, 354–370). In the following section, we shall examine Bantō's original idea regarding the role of information in the Osaka-Dōjima rice market which was presented in the 1812 version of the *Great Knowledge*.

4. Bantō on *Great Knowledge*

Japanese intellectuals and politicians of the Tokugawa period were heavily influenced by

Chinese Confucianism. In the *Great Knowledge* (Figure 3), Bantō began by citing Shun, one of the Confucian symbols of Chinese myth:⁸

[Insert Figure 3 near here.]

Among thousands of saints, only Shun was considered to have Great Knowledge (*Tai Chi*). He would not stick obstinately to his own knowledge, but be willing to accept the knowledge of other people. One person's ability to have knowledge should be limited, but tens of thousands of people would possess an unlimited amount of knowledge. We could not understand all the things of the world with one person's knowledge [, how could we?] ([1806] 1976, 719; our translation).

The Osaka rice market took in a vast amount of information (Great Knowledge) from many people, as Shun does in the myth. The knowledge accumulated was then factored into rice price. Bantō stated that “it is the rice price of the Osaka market that gathers the knowledge of the world (*tenka*) and [...] incorporates it into itself. The great Shun would accumulate the knowledge of the world on his own accord, while the knowledge naturally gathered is factored into price at the Osaka market” (*ibid.*, 722; our translation).

The process by which Great Knowledge or information is reflected in the price, at first glance, “looks like a divine oracle, or even an order by the commander, but it is not” (*ibid.*, 723; our translation). He continued, “Buy or sell. Therefore, it gets more expensive,

⁸ The title of this work seems to reference Shun's famous maxim, “Those who are truly wise do not flatter themselves with their great knowledge, which makes them seem foolish at first glance” (*Taichi ha Gu no Gotoshi*).

or it becomes cheaper. This is all. Heaven or God does not regulate this [the price]” (*ibid.*; our translation). Thus, Bantō’s discussion about price was *not* really in line with the Confucian framework, in which all things in the world were believed to be predetermined by Heaven. This differs from Craig’s (1965) argument that “*all* of [the] heterogeneity of his [Bantō’s] thought was effectively encased within the framework of the Chu Hsi teachings” (136; our emphasis). Bantō appears to assert that people’s aggregate knowledge (Great Knowledge) was reflected in rice prices through active trading at the Osaka market. In highlighting the advantages of rice certificates for reducing transaction costs, Bantō wrote:

Why is Great Knowledge gathered in the Osaka rice market? Because the market enables participants to take advantage of both rice certificates and rice index futures trade. If we purchase and hoard rice certificates [instead of actual rice], we do not need any transportation costs, any worries about being eaten by rats, and any thermal degradations. In case of a fire, we could escape with our rice certificates in our pocket. They are thus extremely convenient. However, it should be noted that we can only sell rice if we have it on our hands. It is easy to buy rice certificates, but it is difficult to sell them. On the other hand, if we take advantage of the rice index, we can sell rice even if we do not have it on our hands. Rice index futures trade thus is the driving force behind the flow of blood to the world. ([1806] 1976, 724; our translation)

Bantō pointed out that market participants cannot start a new selling position if rice transactions are only initiated through certificates. Some modern readers familiar with

speculation can consider that, if participants sell a certificate that they do not have, they must sell a certificate that they have borrowed in advance under the condition that they will buy it back later. Such short selling, however, was forbidden by the Tokugawa shogunate (Takatsuki 2022, Chapter 5). Conversely, derivatives trading *can* begin with selling. A derivatives trader can initiate a position with a sale under the condition that the trade will be closed out by buying back the position prior to maturity. The same types of transactions were made in the Osaka market, where the rice index futures trading system was established.

Bantō obviously understood the essence of the index futures trade and argued that information was first factored into index futures market prices. This argument underlies Bantō's criticism of his teacher Chikuzan's view, discussed earlier, that trading should be confirmed to the spot market of rice certificates. Unlike Chikuzan, Bantō emphasised the significance of the simultaneity of the two types of trade.

The relationship between rice certificate trading and rice index futures trading is like day and night, and both should take place at the same time. Even if there is a difference between the futures price and the rice certificate price during the trading period, these prices will be the same on each maturity date, namely, at the end of each of the months of April, October, and December. Hence, the blood flows between these two markets. ([1806] 1976, 724; our translation)

When he wrote the *Great Knowledge*, in the early nineteenth, Bantō found that rice certificates and rice index futures converged on the same price at the maturity date of each trading period. This is shown by Figure 4.

[Insert Figure 4 near here.]

As the price index at the rice futures trade ultimately coincides with the price at the rice certificate (spot) trade,⁹ it follows that “Great Knowledge” is factored into both prices. Therefore, the price index futures trading, as Bantō argued, must not be a gamble. The Tokugawa shogunate only accepted the futures trading as a necessary evil to mitigate price fluctuation. However, Bantō never considered any speculations to be evil. On the contrary, he found all the speculative trading in the DRE to be indispensable device for gathering information.

In addition, Bantō argued that the desired allocation of resources results from accurately collecting information. The impacts of insect damage, good harvests, typhoons, volcanic eruptions, earthquakes, and tsunamis are all reflected in the rice index futures price (*ibid.*, 723). This information is then reflected in rice certificate prices. Consequently, rice is transported from areas with a rice surplus to areas where rice is scarce (*ibid.*, 722). Thus, Bantō advocated the free trade of rice in the Osaka market on the grounds that whether in the form of rice certificate trading or rice index futures trading, it should be expected to realise the efficient allocation of resources as comprehensive information could be fully factored into the market’s rice price.

5. Concluding Remarks

⁹ However, the two prices might not converge on the maturity date if a famine or severe natural disaster were to occur (Takatsuki 2022, Chapter 5 introducing the transactions in the DRE).

In the *Great Knowledge*, Bantō endeavoured to explain the economic meaning of speculative trading in terms of information and clearly stated that knowledge or information is factored into prices in the Osaka-Dōjima rice market. He also endeavoured to apply the idea of market efficiency respecting information to the problem of resource allocation and discussed the economic implications of the role of information in the market. For these reasons, the *Great Knowledge* can be considered to be the pioneering contribution to political economy.

On “economic thought in Tokugawa Japan,” Morris-Suzuki has argued that “[t]he newly emerging ideas on the economy [...] cannot be understood without some knowledge of their philosophical roots, particularly Confucianism, which constituted the most important of these roots” (1989, 11). This also applies to relevant in understanding economic thought, as Bantō’s contribution. However, Bantō’s discussion on market efficiency by reference to role of information was *never* in congruence with the Confucian framework. Our view differs from Craig’s (1965) interpretation that all Bantō’s ideas originated from the Chu Hsi tradition. In this respect, Bantō differs from other Japanese philosophers of his time as he clearly broke away from the Confucian perspective that Heaven (*Ten*), the controller of all things in the whole universe, determined the price of rice. Bantō had advantage of the first and most well-organized futures market in the world to study as an active rice trader involved in probably observed the processes of information being reflected in prices when conducting daily business at the DRE.¹⁰ This

¹⁰ From the beginning of the eighteenth century to the beginning of the twentieth century, in Japan, information was transmitted by flag-waving communication (*Hata-furi Tsūshin*). The mountains between the Osaka-Dōjima market and any given area were used as relay points, and a person with flags was stationed on each mountain. Using flag waving as a

enabled his thinking to move beyond Chu Hsi Confucianism and recognise the efficient market as a device for information gathering.¹¹

The results of a series of excellent studies on Regnault by Jovanovic and others, and the discussions on Bantō in this paper, allow us to compare these two authors' ideas and the matters relevant to them concerning financial economics in nineteenth-century France and Japan.¹²

signal, price information from the Osaka-Dōjima market was transmitted to the destination. This way of communicating was banned by the shogunate but is considered to have been (secretly) used in practice. Transmission speed is estimated to have been more than 720 km/h (see Takatsuki 2022, Chapter 10 on the Tokugawa-period revolution in communications).

¹¹ Fujii (1976, 59) also noted that Bantō drew on his own commercial experiences to articulate a rational theory of price in the *Dreams*. However, he overlooked the importance and role of information (great knowledge), which is the backbone of Bantō's theory.

¹² James Maitland (the eighth Earl of Lauderdale; 1759–1839), a British economist, was regarded by Turner (2011) as “a precursor of the modern efficient market theory economist in that he believed that the stock market is one of the best revealers of information” (222). *Thoughts on the Alarming State of the Circulation*, a pamphlet written by Lauderdale (1805), attempts to expose the illegal manipulation of stock prices by the directors of the Bank of Ireland (BOI). According to Turner, by presenting monthly stock price data from the BOI from 1798 to 1804, Lauderdale (1805) attempted to demonstrate that the overissue of bank notes during that period resulted in the depreciation of the Irish pound and that the efficient transmission of information about the overissue to the market was immediately reflected in prices (106–107, 115–17; Yamakura (2019, 29–30) supports Turner's claim). However, Lauderdale does not appear to describe how information is incorporated into stock prices, and Turner never provides conclusive evidence to support his claim. Therefore, Lauderdale's perspective as a precursor of efficient market theorists is dubious.

In France at “a time when short-term speculation was denounced as immoral, Regnault followed Adolphe Quételet’s (1796–1874) social physics program and “approached ‘scientifically’ the issue of speculation by developing his short-term speculation model, which “took the form of a random walk model” (Jovanovic and Le Gall, 2001, 333–34). Bantō, despite being influenced by Confucianists such as Chikuzan, understood the role of information in determining market prices and directly opposed the Chu Hsi Confucian authors’ view of speculation as immoral. It is noteworthy that these two economic writers, of Japan and of France, had similar backgrounds that helped them establish their theory. As a broker on the Paris Stock Exchange close to his home, Regnault could directly observe the (random) fluctuations in stock prices (Jovanovic 2006, 212). Meanwhile, Bantō, a significant trader in the Osaka-Dōjima rice market, had ready access to the information that influenced prices. However, the influence of the two authors on later generations was not identical. Regnault’s theory of random fluctuations in stock prices was utilised by Bachelier in 1900 to develop the mathematical model of Brownian motion (Jovanovic 2006, 213; 2018, 292), whereas Bantō’s idea on the role of information in the market has lost all influence since the transition to a new political system in Japan.

The Tokugawa government did not adopt Chikuzan’s opinion to abolish the DRE system, including futures trading, but continued to protect it until 1868 when the Tokugawa shogunate was replaced by a new Meiji government. In the following year, the DRE was suspended as it was contributing to confusion rather than stabilising prices.¹³ The new government heeded the pleas of rice merchants to revive the DRE in 1871.

¹³ The DRE experienced the large fluctuations in price at the end of the Tokugawa period due to political instability. Hence, spot and futures prices ceased to match on their maturity dates.

However, they were forced to trade in so-called *commodity futures*, where delivery of physical rice was guaranteed on the maturity date. Designing the system so that futures prices did not diverge from spot prices on the maturity date was a requirement of the DRE's re-emergence. Consequently, an index futures market without physical delivery on the maturity date was neglected in Japan until the 1988 launch of Nikkei 225 futures and TOPIX futures markets. After the collapse of the Tokugawa Shogunate, the Japanese not only abandoned the old DRE market but also forgot Bantō's thought of *Great Knowledge*.

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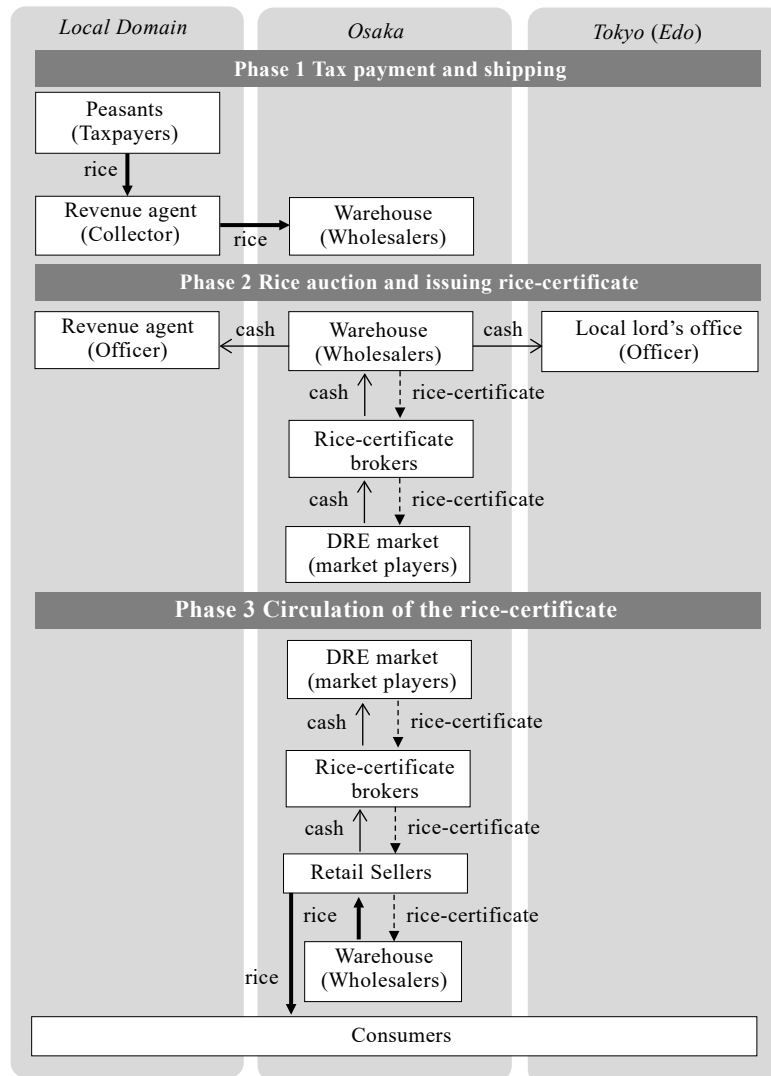
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Table 1. The DRE trading seasons

	Futures	Spot	Brands often chosen for representative rice
First Season: Spring Market	From 8 January to 27 April	From 8 January to 28 April	Fukuoka rice, Kumamoto rice, Chugoku rice, Hiroshima rice.
Second Season: Summer Market	From 7 May to 8 October	From 7 May to 9 October	Kanazawa rice, Yonago rice.
Third Season: Winter Market	From 17 October to 23 December	From 17 October to 24 December	Fukuoka rice, Kumamoto rice, Chugoku rice, Hiroshima rice.

Source: Based on Takatsuki (2012a). Also see Takatsuki (2022, 80, Table 3).



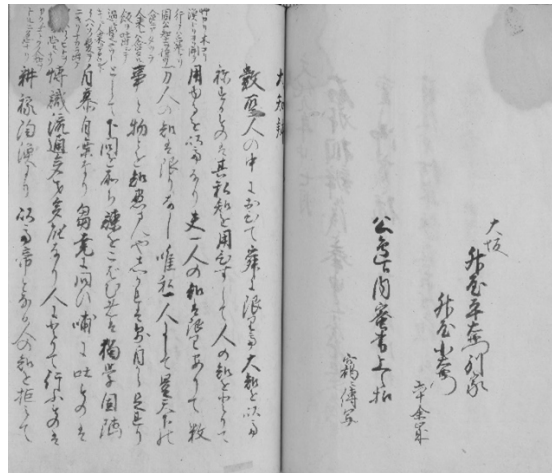
Source: Takatsuki (2022, Chapter 4).

Figure 1. The flow of trade at the Osaka-Dōjima rice market

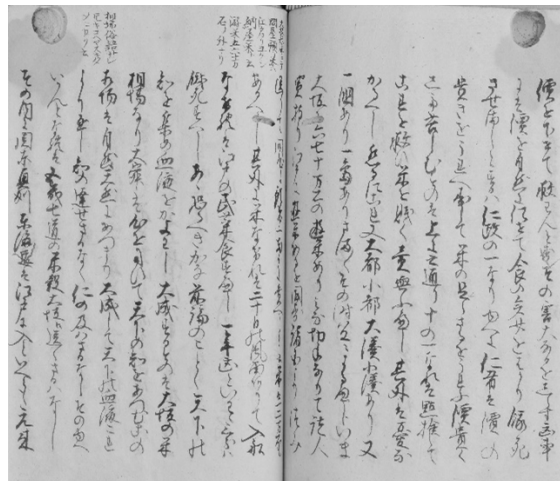


Source: Settsu Meisho Zue Series: *Dōjima Kome Akinai* (Series of Settsu's Famous Landscape: Rice Trading in *Dōjima*), published in Osaka at the end of the eighteenth century. Credit: The picture is reproduced with the kind permission of Osaka Exchange, Inc.

Figure 2. The trading scene at the DRE



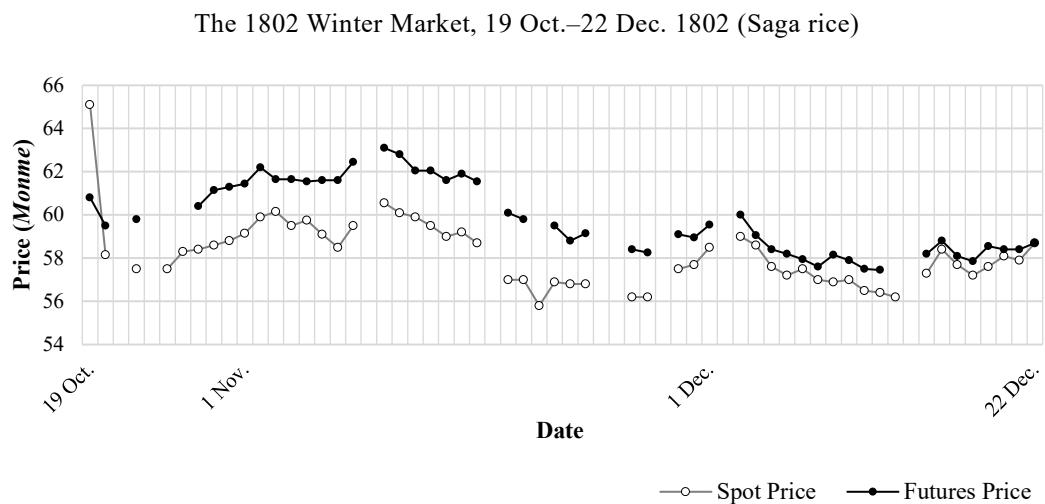
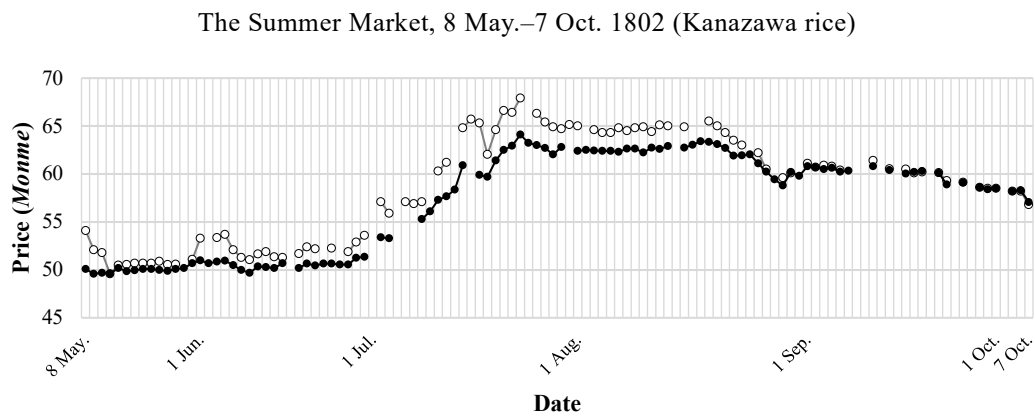
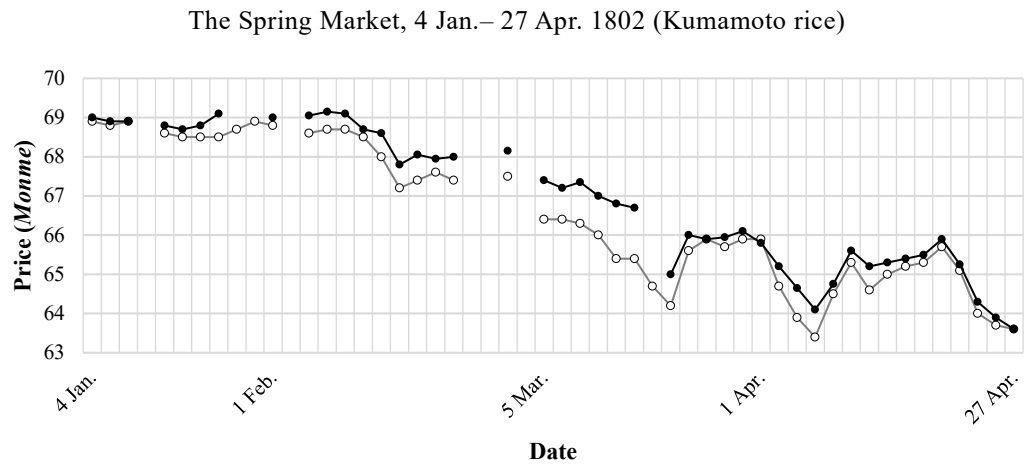
(The beginning section: YAMAGATA [1806] 1976, 718–19)



(The section explaining how Great Knowledge is factored into price in the market: *ibid.*, 722)

Source: Mitsui Bunko (Mitsui Archives), No. 1063–64. This copy was originally handed down to the Matsudaira family of the Kuwana domain and it is now the possession of Mitsui Museum of Art. Credit: These pictures are published with the kind permission of Mitsui Bunko.

Figure 3. *The Great Knowledge* (1806)



Source: “Diary on Many Markets (*Yorozu Souba Nikki*)” included in the *Tamao’s Archives (Tamao-ke Monjo)* in the collection of the National Institute of Japanese Literature.

Note: The money unit “*monme*” had been used in Osaka for the Tokugawa period.

Figure 4. Daily price movements in the market