

Research Article

# Bottom-up design of a gas futures market in East Asia: Lessons from the Dojima rice exchange

Shi Xunpeng<sup>a</sup>, Li Yanfei<sup>b,\*</sup>, Reshetova Elena<sup>a</sup>

<sup>a</sup> Energy Studies Institute, National University of Singapore, Singapore

<sup>b</sup> Economic Research Institute for ASEAN and East Asia, Indonesia

Received 6 June 2016; accepted 7 December 2016

Available online 1 March 2017

## Abstract

The natural gas market in East Asia remains fragmented without a functioning benchmark price to duly reflect the dynamics of demand and supply forces in the region. A functional regional gas futures market, which is highly dependent on the presence of well-developed physical spot trading, is yet to be established. Since the intra-regional pipeline connection is largely non-existent in East Asia, it is the LNG spot cargo trading that is likely to become the basis for the regional gas futures market. This paper offers a novel approach to understanding the development of such a market by analyzing the experience of a different commodity market – the Dojima Rice Exchange (DRE) – and identifying potentially transferrable lessons in the market design and the role of government regulations. Based on the case study analysis, implications for the development of natural gas trading hubs in East Asia are offered and an LNG futures exchange design is put forward.

© 2016 Sichuan Petroleum Administration. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

**Keywords:** LNG; Spot market; Futures market; Trading hub; East Asia; Dojima rice exchange

## 1. Introduction

It is in the interest of East Asian countries to develop their own regional gas trading hubs. Given the absence of a global gas market and existing differences between demand–supply dynamics within regional markets, region-specific natural gas trading hubs would potentially provide better benchmarks for market-based LNG prices. They would also generate spot and futures prices based on gas-to-gas competition reflecting the region's supply and demand fundamentals and the relationship between natural gas and other competing fuels [37].

The establishment of gas trading hubs in Asia could enhance flexibility and transparency of the LNG market. Additionally,

the IEA has recommended the development of Asian natural gas trading hubs to steer Asia's transition towards “green growth” [15]. All of these potential benefits suggest the possible appearance of hub pricing in Asia before 2020 [35]. Singapore, China and Japan are leading the way in establishing regional trading hubs and furthering region-specific pricing mechanisms through both spot and futures markets.

This paper argues that the Asian gas trading hub will have to be different from the existing North American and European ones, especially due to the lack of an interconnected network of gas pipelines as well as expected heavy reliance on LNG in the future in this region. Therefore, a bottom-up approach to designing an Asian gas market while paying attention to its unique characteristics becomes necessary. This paper will discuss the key institutions, components, and players of a futures market in Asia. It will also analyze the experience of the Dojima Rice Exchange (DRE) as the first futures market for commodities in Asia.

A comparison with the DRE as a commodity market that had been located in the same region and had had similar

\* Corresponding author. Economic Research Institute for ASEAN and East Asia, Sentral Senayan II, 5th & 6th Floor, Jalan Asia Afrika No. 8, Gelora Bung Karno-Senayan, Jakarta Pusat, 10270, Indonesia. Fax: +62 21 5797 4464/65.

E-mail address: [yanfei.li@eria.org](mailto:yanfei.li@eria.org) (Li Y.F.).

Peer review under responsibility of Sichuan Petroleum Administration.

challenges would be a useful reference point. To be more specific on the unique characteristics of the Asian gas market, two points should be elaborated here. First, unlike crude oil or pipeline gas, LNG differs in quality and quantity at the point of production and the point of delivery. The difference depends on the size of a transporting vehicle, its design and technical characteristics, as well as management practices of the parties involved. These factors give rise to standardization issues, complicate contract design, and make it difficult to use the current oil market and gas trading hubs as reference points for the development of an LNG trading hub. Second, all the existing regional gas futures markets are based on natural gas spot markets and are hardly applicable to an LNG futures market, which is unprecedented. In contrast, successes and failures of the DRE futures trading offer valuable insights due to similarities in the nature of rice and LNG as traded commodities.

The structure of the paper is as follows. The following section justifies the choice of a single case study method for the purposes of this study. The third section outlines the basics and the value of the futures markets, as well as the role of government regulations and market mechanisms ensuring their successful performance. The fourth section introduces the DRE case study and provides a critical assessment of the factors that contributed to its successes and failures. The fifth section discusses the implications for the gas futures market development and proposes an LNG futures exchange design. The sixth and concluding section summarizes the findings and briefly outlines the opportunities for further research.

## 2. Methodology

The objective of this paper is to identify major institutions, components, and players of a functioning LNG futures market, and the single case study method is chosen in accordance with this objective. Since the design of a market that is yet to be created cannot be tested in any way, the key lessons learned from the historical experience of the world's first futures market [27,45] provide the best available rationale for the proposed design. The DRE case fits the definition of a typical case, which “exemplifies what is considered to be a typical set of values, given some general understanding of a phenomenon” ([12], p. 91).

This single case also serves as a “building block” study ([11], p. 76) on LNG futures markets development. It draws implications from the experience of the DRE and analyzes their application to LNG futures markets development. There are plenty of studies seeking lessons from other fossil fuels commodity markets like crude oil and pipeline gas [4,10,24,39], while analyses of historical cases and agricultural commodities as potential learning opportunities for LNG futures markets are scarce.

Moreover, a case study method is advantageous for at least two reasons. First, it recognizes the uniqueness of a historical event. Unlike statistical research, the case study puts variables into context and helps examine relationships between them in detail permitting observation of a large number of intervening

variables ([11], pp. 19–22). Second, it allows for a search for causal mechanisms and construction of causal inference, which, in their turn, lead to establishing causality. Understanding the factors resulting in successful market performance is essential for designing effective LNG futures markets.

Nevertheless, the limitations of a single case study such as its external validity are well understood, and qualifying statements on the applicability of the DRE's experience in today's conditions are included where necessary.

## 3. The basics of the futures markets

### 3.1. Futures markets in energy commodity trading

An over-the-counter (OTC) market and an exchange market are the two basic types of financial market organization. The differences between the two consist of *where* and *how* the commodity or asset is traded. An exchange comes with standardized contracts that specify delivery or settlement terms. Public reporting and settlement of trades through a clearinghouse ensure transparency and lower counterparty risk. An OTC market is bilateral, and all contract terms are negotiable between the trading parties. Prices are not publically reported, nor is the counterparty risk controlled. An OTC market is usually not as liquid as an exchange market.

Fig. 1 presents the basic types of energy commodity markets. In the case of natural gas market in East Asia, a non-organized market dominated by long-term contracts dictates the physical spot trading. Since contracts are negotiated on a bilateral basis and their terms are confidential, such a market is not capable of delivering transparent and neutral benchmark prices. The limitations of the current market structure coupled with the relatively high spot gas prices paid by consumers in the region, growth of spot LNG trading, and expectations of higher demand for the commodity in the future constitute a set of strong incentives for the development of an organized gas futures market and eventually gas trading hubs in East Asia.

### 3.2. Key players

A variety of players make a modern futures market operational. Their roles extend well beyond those of buyers and sellers to include liquidity providers, guarantors, insurers and objective trade mediators. Futures markets are designed to benefit two core groups of its participants — hedgers and speculators — by providing information on future prices. Hedgers generally have a stake in the business directly related to the traded commodity (i.e., storers, processors, and producers). They rely on the futures markets' ability to discover prices in order to make realistic business plans and secure access to affordable financing. Speculators specialize in risk taking and typically have no stake in the physical commodity markets [31]. Their financial positions are usually spread between several commodity markets simultaneously to help them achieve economies of scale and, thus, offset some of the risks. Therefore, while hedgers provide a link with the physical commodity market, speculators enhance the hedgers'

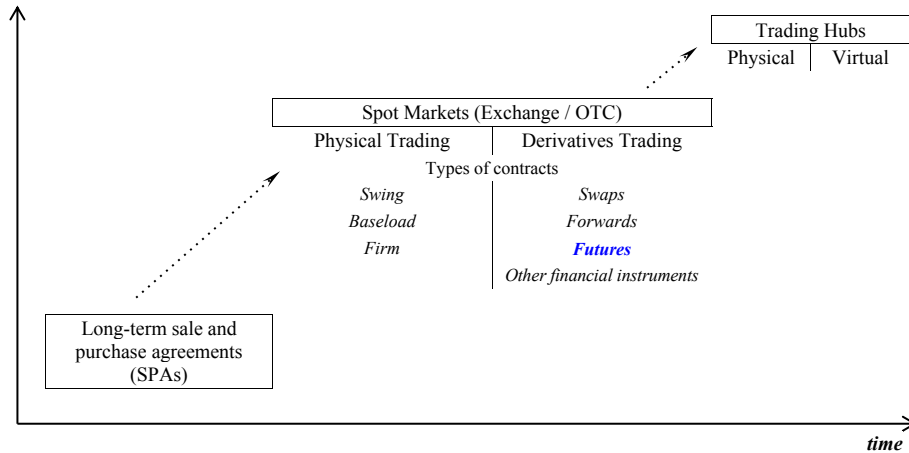


Fig. 1. The evolution of energy commodity trading.  
Source: Authors

ability to plan for the future. This makes both hedgers and speculators indispensable to a well-performing futures market.

### 3.3. Contract design

Although a futures exchange “is a nonprofit institution,” its major objective is to “maximize the collective interest of its members” ([38], p. 124; [3], p. 719). Hence, futures contracts – as the main instrument of communication between market participants – seek a delicate balance between the interests of hedgers and speculators.

First and foremost, a futures contract is supposed to carefully define the “basis” variety ([30], p. 45). This concept refers to a basket of variable commodity qualities, such as the characteristics of the commodity itself as well as locations of its production, assembling, distribution, export, and consumption. The recommended “basis” should take into account major varieties of the above, but, at the same time, should not be so broad as to maintain commodity standardization.

In addition to the “basis” variety, the literature on the futures contract design considers the following elements essential: (a) the deliverable commodity grade [38]; (b) the delivery location(s) [38]; (c) the mode of delivery (physical or cash settlement) [3,22,32]; (d) the pricing, trading, and delivery unit(s) [3,38]; (e) the tick size, or minimum price increment [3,34]; (f) the commencement of trading timing; and (g) the delivery month(s) [38].

### 3.4. The value of a futures market

A futures market accommodates participants with various attitudes to risk. Depending on their roles and objectives, they might choose one of the following strategies – hedging, speculation, or arbitrage – in an attempt to profit from a reduced, increased, or risk-free asset sale or purchase. A well functioning futures market is able to meet a wide range of expectations from these different market participants by facilitating communication, transportation, financing, storage,

price formation, and uncertainty bearing. By doing so a market significantly reduces transaction costs, improves resource allocation efficiency, and provides transparency.

Also, in comparison with the conventional physical and forwards trading, the exchange-based futures market offers several additional benefits. First, a high-liquidity centralized exchange easily matches buyers and sellers, thus, maximizing the market efficiency. Second, a futures contract is standardized because it specifies the future delivery dates and fixes their limited number, thus, focusing the attention and interest from various parties and, at the same time, promoting liquidity. Third, a futures exchange makes use of a diversity of its players by enabling a risk transfer to specialized speculators who are willing and able to take the risk. Lastly, since transactions are centralized and information on all trades is publically available, the process of price formation becomes transparent.

### 3.5. Government regulations and market characteristics

Viable futures markets cannot take off without the support of respective governments. Today, many financial markets are international in scope, which implies reliance on multiple levels of regulations and influence of a larger institutional environment.

A mature legal and financial system is a must for a thriving futures market. Such a system creates a framework of checks and balances for the markets. They contribute significantly to meaningful regulations and vibrant policies, and help prevent or eradicate corruption.

The government is a facilitator responsible for co-creating and integrating both tangible and intangible resources, which would contribute to a setting conducive to successful development of a futures market. Tangible resources include physical infrastructure, reliable communication channels, and incentives for private market players. Intangible resources include trust, reputation, and values that require political will, time, and finances ([18], p. 23; [21], p. 424).

Nevertheless, market characteristics are as, if not more, important as government regulations in curbing negative externalities such as speculation and cheating. As the case of the DRE will demonstrate, government regulations are unlikely to achieve their objective if the market is suffering from (a) unregulated activity of anonymous traders, (b) unenforceable contracts, (c) non-neutral brokers, (d) low trade volumes, or (e) thinness.

The licensing regime introduced by the government had to be enforced by the market participants in order to remain effective [20,42]. It was the abolition of the licensing regime that led to the loss of DRE efficiency. Moreover, contract enforceability was provided by the clearinghouses, which conducted background checks on the merchants and monitored their financial performance [27,36]. Broker neutrality was one more rule enforced by the rice exchange. In particular, clearinghouses represented interests of their clients, but were not allowed to conduct independent trade in their own interest. Finally, the experience of the DRE, which eventually lost its leading position to the Tokyo Rice Exchange (TRE), demonstrates the dangers of low trade volumes and market thinness [17].

Therefore, the success of a futures market depends on the market's internal mechanisms as well as the legal, tax, and regulatory regimes which the market is set within. Historical experience of commodity markets in various parts of the world offers lessons on the nascent natural gas market development in East Asia. The DRE is the world's first futures market and, thus, presents a learning opportunity to study the development of nascent commodities markets in the region. Over two hundred years of futures trading in the 18th–20th centuries, and its rebirth in the 21st century provide valuable lessons for challenges to tackle, practices to replicate, and failures to prevent.

#### 4. A case study of the Dojima rice exchange

As the first futures market in Asia, the DRE demonstrates how a futures market could be developed, regulated and destroyed and thus could be a useful reference in development LNG futures market, which is unprecedented.

##### 4.1. Descriptive analysis: history of the Dojima rice exchange

The DRE outlasted three politically, economically, and socially distinct periods of Japanese history. The exchange emerged during the Tokugawa shogunate (1603–1868), persevered through the turbulent years of the Meiji era (1868–1912), outlived the Taisho period (1912–1926), and crumbled only under the totalitarian regime of prewar Showa period (1926–1945).<sup>1</sup> Despite the fact that it first materialized

in the feudal samurai-dominated Tokugawa government, the DRE was able to evolve together with the Japanese national economy.

##### 4.1.1. Emergence of the exchange (1650s–1730s)

The consensus among scholars is that the DRE emerged in response to sellers and buyers' demand for a common commercial space [36,40,44,45]. Initially, the government played no role in the development of the marketplace, except trying to prevent its expansion, especially futures trading, until it finally approved the exchange in 1730.

Curbing the inflation of rice prices was the major policy objective behind extensive government efforts to prevent the emergence of the rice exchange in the 1650s–1720s [36]. provides a detailed account of these efforts. Despite restrictive regulations, physical and futures trading flourished in Dojima. By 1730, prices were so depressed due to increased rice production that it made sense for the government to reverse its policy and provide the DRE with the official status of the only rice exchange in Japan [13,36].

##### 4.1.2. Period of stability (1740s–1830s)

Two lines of argument regarding the regulation of the DRE during this period exist. One stresses the self-regulatory function of the merchant coalition holding the license to operate on the exchange, or *kabu-nakama* (株仲間) [45], while the other emphasizes the role of the Tokugawa Government in protecting property rights through judicial services [42].

In the DRE, the government strictly controlled the number of issued licenses, or *kabu* (株). A limited number of market participants – 50 clearinghouses, 500 rice traders, and 800 rice brokers – who held the license to operate, maintained order in the market via self-regulation during the Tokugawa period (1730<sup>2</sup>–1868). In the absence of well-developed statutory commercial law and strong administrative capacities of the government, market participants were encouraged to settle commercial disagreements between themselves, and the resolution of disputes over contract enforcement relied heavily on customary rules developed within the *kabu-nakama*.

Contract enforcement and market order mechanisms employed by the *kabu-nakama* relied on trust and reputation within the merchant coalition and formal internal rules and institutions of the market [45]. In order to maintain the importance of reputation, the *kabu-nakama* employed a multilateral punishment strategy to prevent cheating. It effectively deterred merchants from cheating since a cheater would lose the chance of future transactions not only with the cheated merchant, but also with all other members of the *kabu-nakama*. At the same time [45], argues that merchants relied more heavily on formal internal rules such as a requirement for cash settlement or the firebox system.

<sup>1</sup> Showa period is usually divided into two parts. The first period (1926–1945) is associated with imperial Japan. The second (1945–1989) refers to the State of Japan, abolition of the absolute monarchy, and Japanese economic miracle.

<sup>2</sup> Tokugawa period commenced in 1603, but the DRE was officially established only in 1730.

Contrary to [42,45] contends that the government played a significant role in maintaining the trade order in the DRE by protecting the property rights of the rice bills. The government initially denied the legal enforceability of the un-backed rice bills in the 1730 edict, but once this policy was reversed and un-backed and backed rice bills were traded interchangeably in the market, a certain rice bill was revealed to be an un-backed rice bill only when it was dishonored. Therefore, this policy reversal was a de facto prohibition of dishonor. Takatsuki argues that, at the same time, it meant that the government was now willing to protect the property rights of the rice bills and hear disputes in the court.

The government further strengthened the protection over rice bills to the extent that Takatsuki refers to it as social policy rather than mere protection of property rights. An edict issued in 1773 required the government to purchase dishonored rice bills. However, this policy did not prevent warehouses from issuing un-backed rice bills, and since 1783, the government required that every rice bill received a stamp from a government official upon issuance. This later policy was reverted in 1787 as it met severe opposition, especially from the feudal lords who managed their budgets through issuance of un-backed rice bills.

#### 4.1.3. Period of turbulence and shut down of the exchange (1840s–1939)

The period of instability for the DRE started with the dissolution of *kabu-nakama* in 1841, which allowed anyone to participate in transactions [20]. The consensus among scholars of the DRE is that the efficiency of the exchange decreased significantly by the end of the Tokugawa period [13,26,41].

Changes in Japan's political and macroeconomic orientation following the Tokugawa period brought new challenges for the DRE. By the late 1870s, Osaka faced strong competition from Tokyo, the new capital and fast growing economic center of the country. By the 1910s, external trade and substantial imports were testing flexibility of the DRE, which was initially designed only for domestic trade. Nonetheless, by mid-1920s, the exchange was able to compete with the Tokyo Rice Exchange (TRE) and adapt to the demands of a more globalized Japanese economy.

Both the DRE and TRE ceased to exist in April 1939 with the enactment of the Rice Distribution Control Law. This was the culmination of the government pressure on the rice trade intensifying since 1921<sup>3</sup>; it established Japan Rice Company, a quasi-governmental organization that controlled prices and rationed consumption of the “most important agricultural product in Japan” ([23], p. 149). Thus, the abolition of the free market, inclusive of rice trading, was in line with the “totalitarian character” ([8], p. 87) and military aspirations of the Japanese state. The DRE fell victim to the new policy course, and its elimination had little to do with the market's internal characteristics or its performance.

<sup>3</sup> In April 1921, the government enacted the Law of Rice, the first attempt to indirectly control rice prices and distribution. In May 1933, government role was expanded further with the passing of the Rice Control Law, which set the floor and the ceiling for rice prices ([19], p. 186).

#### 4.1.4. Rebirth of the DRE: rice futures on the Osaka Dojima commodity exchange (2011–present)

The rice market analogous to the original exchange did not begin to recover until 1995, and rice futures trading did not make a comeback until July 2011. Futures trading of domestically grown rice resumed on the Tokyo Grain Exchange (TGE) and the Kansai Commodities Exchange (KCE) [43]. In less than two years, TGE was forced out of business, and its contracts were transferred to KCE, now known as the Osaka Dojima Commodity Exchange (ODCE) [43].

With its symbolic name, the ODCE is being developed to take advantage of exactly the same futures trading benefits the DRE last delivered over 70 years ago. Rice futures trading is expected to revitalize struggling Japanese commodity exchanges, provide price transparency, and hedge exposure of the market participants [6,46].

The ODCE's biggest challenge is a much more complex environment. For instance, the exchange faces a very strong opposition from major agricultural groups like the National Federation of Agricultural Cooperative Associations (Zen-Noh). The Federation opposes the ODCE on the basis of negative effects of speculative trading. However, the Federation's participation in the exchange is crucial because it controls 60 percent of rice in circulation [2,43].

At the same time, the ODCE has to navigate through the web of interconnected issues of the globalized world. These include, but are not limited to, the effect of rice futures prices on China's Zhengzhou Commodity Exchange, and progress on the Trans-Pacific Partnership (TPP) negotiations [2]. Hence, it is hard to say whether the ODCE will endure. The trial period of the exchange expired in August 2015, and although Japan's Ministry of Agriculture, Forestry and Fisheries (MAFF) was supposed to make a decision on the formal listing of rice futures before the expiration date, there have been no updates on their status. Nevertheless, as of November 2016, rice is still listed under the ODCE's traded commodities, and the exchange claims to be “the only rice futures market in Japan” [28].

#### 4.2. Critical assessment: drivers and inhibitors of the DRE's success

A combination of internal and external dynamics contributed to successes and failures of the DRE performance at different times. **Internal dynamics** refer to self-regulating mechanisms originating in the market. They help maintain<sup>4</sup> healthy competition, effective incentives for participants to abide by the rules, and vigorous physical (warehouses, transportation, etc.) and virtual (i.e., information-sharing and communication channels) infrastructure ([18], p. 23; [21], p. 424).

**External dynamics** reflect the government's role in the market as well as other factors outside the control of the DRE

<sup>4</sup> Note that although listed conditions are *maintained* by the market, they can originate from and be (co-)created by the market and/or government regulations.

and the government. Among such external factors, wider macroeconomic features applicable to the wider Japanese economy, as opposed to specific commodity markets like the DRE, are the most prominent. These include money supply, commodity-to-currency exchange, competition from other markets trading the same commodity, emergence of substitutes, and changing composition of national imports and exports. Additionally, natural disasters and adverse weather conditions, particularly relevant to agricultural commodity trading, also fall into the external factors category. Finally, geopolitical events are external forces that have the potential to undermine a strategically important market location, thus, negatively affecting spot and futures markets, or impeding trade flows in general.

#### 4.2.1. Internal dynamics

Basic instruments originating from within the market included warehouses, clearinghouses, credit houses, and merchant coalitions [27]. While the positive influence of **merchant coalitions** on contract enforcement as well as trust- and reputation-building was discussed in the previous section, the other three instruments are detailed below.

“The exchange was an autonomous, voluntary, non-profit association,” and its members were expected to bear the costs of organization and operations. But warehouses emerged as the most mature and influential institutions of the exchange, and “payment was soon taken over by [them]” ([36], p. 496). In addition to warehouses, credit houses and clearinghouses gradually acquired leading roles in the exchange as well. All three institutions – warehouses, clearinghouses and credit houses – as well as individual merchants licensed to participate in the DRE had financial obligations towards the exchange, and had to pay for various services the exchange provided.

Although feudal lords owned **warehouses**, merchants, assigned as superintendents, and financial agents were in charge of their daily management. Financial agents had access to the revenues from the warehouse's sales and could “invest the funds that were normally entrusted to them interest-free” ([27], p. 8). Consequently, as the agents' wealth grew, they often became creditors to their lords, and the balance of power between the employer and employee shifted in favor of the latter. Warehouses were responsible for issuing rice bills and silver bills (receipts for ‘good-faith’ deposits), organizing auctions, and keeping records of all transactions.

**Clearinghouses** used to be simple money changers at the early stages of exchange development. However, as the number of transactions on the exchange grew, and it became hard for warehouses and traders to keep track of them, clearinghouses assumed the function of objective record keepers. They were not allowed to trade on their own; instead, clearinghouses were an intermediary between exchange participants, and “kept a record of the traders' transactions, monitored their trading partners, and facilitated payments” ([27], p. 9). Traders were charged a margin and a small commission for the services of a clearinghouse. The amount of commission payable, however, was regulated by the exchange, not by clearinghouses themselves ([36], p. 498).

**Credit houses** gradually grew in significance as well. These were merchants extending credit to other exchange participants. Rice bills, silver bills, physical commodity and other assets could be accepted as collateral for such credit. Not only did credit houses charge interest, they “earned profits by trading the bills they had accepted as collateral” ([36], p. 501). Thus, credit houses helped inject liquidity into the exchange and were full-fledged members of the marketplace.

Regardless of its impressive adaptability, the DRE was held back by one of its foundational characteristics – a **small market with limited number of participants and high barriers to entry**. Born in the Tokugawa era, the DRE was built around a relatively small Osaka-based domestic rice market. Despite regulatory changes in the late 1700s–early 1800s, this foundation remained untouched. Once Meiji era restructuring took off, the DRE experienced its first major difficulties, which continued to mount as Japan was nearing the turn of the 19th century.

#### 4.2.2. External dynamics

Regulatory practices pushed forward by the government at different times consisted of the license regime, stamp requirement, commitment to purchase dishonored rice bills, and dissolution of merchant coalitions [20,42]. As [45] and [42] demonstrate, a number of policies on dispute resolution (1730–1773; 1773–1784; 1785–?),<sup>5</sup> dishonored bills (1773–1782), and stamps (1783–1787) were short-lived. One of a few more durable government initiatives was the licensing regime. Established at the same time as the exchange, it provided the license holders with the exclusive right to enter and participate in the rice market.

The decline of the DRE is closely linked to the struggle for political and economic influence between the two major cities of Osaka and Tokyo. The subsequent loss of Osaka's economic status also undermined the status of the DRE, as compared with the TRE. The final closure in early 1930s was due to government decision to close rice exchanges.

First, Osaka, and hence, the DRE, was losing its position as a dominant trading hub, which weakened its role as the sole price setting platform for rice in Japan. The relocation of the Emperor's home from Kyoto to Tokyo in 1868 undermined the significance of Western Japan and boosted political and economic status of Tokyo. As a result, by the late 1870s, Japan had two well-established futures markets based in Osaka and Tokyo. Over time, with the expansion of regional railroads and port facilities, the Tokyo exchange became more influential, and so did its position in relation to the DRE. By the mid-1900s, the TRE was dictating the futures prices on the DRE ([17], p. 11).

Second, the growing significance of external trade and non-standardized imports undermined the price discovery function of the DRE. Meiji reforms led to population growth and improved living standards, which, in turn, caused a surge in

<sup>5</sup> Policy on dispute resolution was reversed several times; there is no definite answer as to when the latest policy (initiated in 1785) was terminated, if at all.

rice consumption followed by the rice shortage and swelling imports. Rice imports from Korea and Taiwan, two Japanese colonies at that time, were supposed to offset domestic scarcity of the commodity. But they did not, because a principle vital for the smooth operation of futures markets was ignored, namely, the traded commodity was not standardized. Traditionally, the DRE and later the TRE dealt only with japonica rice, whereas imports were of a different – indica – breed. Even though the price of the latter was lower, it was not accepted “as a staple” by Japanese consumers ([17], p. 3). Most importantly, while “only domestic rice was listed in [the DRE and the TRE] futures market[s]” ([17], p. 9), imported and domestic rice was traded interchangeably on the spot market. Imported rice contributed to the overall volume of commodity traded on the spot basis, but not in the futures market. As a result, “the futures price failed to be a fine index of the expected price of rice” ([17], p. 9).

Nevertheless, by the 1910s, Japanese government policy promoting the production of japonica rice in the colonies triggered standardization of imported and domestic rice. Consequently, even though imports constituted over 50 percent of consumed rice, they “hardly affected pricing in rice futures market[s]” ([17], p. 10). But by the 1910s, the DRE lost its dominant position settling for number two, and the two markets even embarked on separate paths. While the TRE continued to deal domestic rice, the DRE traded exclusively imported rice, which was lower-quality, cheaper and further diminished the DRE's efficiency in futures pricing. ([17], p. 11).

Finally, by the mid-1920s, in the closing years of Taisho period, both the DRE and the TRE were able to fully recover and successfully perform their functions of price discovery and price hedging once again. This is mainly due to the standardization of the traded commodity, and the DRE reclaiming a share of domestic rice trade.

Thus, the struggle for political and economic influence between the two major cities of Osaka and Tokyo, as well as factors like population growth, the role of rice, and positioning of the Japanese economy in regional and world markets did have an effect on the DRE's performance. Undoubtedly, all of these factors condensed into two main points analyzed above illustrate the incompatibility between the intended purpose of the DRE and the changing demands of different time periods. But they do not reveal the mechanisms behind the DRE's failure and success in coping with the challenges. These mechanisms are shaped by internal as well as government-imposed regulations.

#### 4.2.3. Summary

Overall, the DRE was more dependent on the internal system of checks and balances, rather than government induced permissions and restrictions, with the exception of barrier to entry arrangements. Comparison of the two groups of institutions reveals that internal mechanisms, first and foremost, formed a structural foundation of the market. At the same time, government-imposed measures established the rules of conduct. This is not to say, however, that the market did not have its own means of governing operational aspects of spot and futures trade. On the contrary, the formal and

informal market practices of trust- and reputation-building were so powerful that they often overshadowed the rules imposed by the government.

As Meiji and Taisho governments, which were busy with the overhaul of national economic and political systems, weakened their grip over the DRE, internal market mechanisms governing the exchange continued to evolve. Market participants were the drivers of this evolution because rice remained a prime commodity, and they benefited from the well-performing rice market. Ultimately, internal market institutions ensured the DRE's adaptability and secured its survival until 1939 when the DRE was shut down by the government.

The DRE case demonstrates that market fundamentals are the cornerstone of market development, and government regulations, although useful, could not create markets without the fundamental need for a market. However, on the contrary, the government can easily destroy even a mature market through anti-market measures.

## 5. Discussion

### 5.1. Implications for the gas futures market development

Although LNG and rice are completely different commodities, a number of fundamental principles of market organization and government regulation can be inferred from the DRE case to serve as guidelines for designing a successful regional gas futures market in East Asia.

First, market fundamentals are essential for the development of successful spot and associated futures markets. A well-developed spot market is a prerequisite for a successful futures market. The rice exchange was and is dependent on physical trade, and the commodity being traded remains of high value to the Japanese economy. While a standardized gas futures market in East Asia is likely to take quite a long time to develop, OTC-based derivatives trading, including swaps and forwards contracts, can become a precursor of a futures exchange. At this stage, a balanced approach is needed from the national governments in the region, which would foster an innovative regulatory regime and, at the same time, let the region-wide spot market flourish through industry incentives (i.e., tax breaks) and human capital development (i.e., local traders training initiatives).

Second, government regulations should be oriented towards the structure of the market, whereas process rules (rules of conduct) should be left to the internal market mechanisms. This is because structural characteristics of the market have to fit into the broader legal and financial framework, whereas market processes are dependent on the qualities of a specific commodity.

Third, creditors such as banks and finance companies are vitally important participants of developing futures markets. Commitment from credible financial institutions builds strong credit relationships and creates trade volume, thus contributing to higher market liquidity. However, as skillful speculators, financial institutions have the potential to overstep their bounds. Thus, they require government regulation to prevent them from manipulating the market to their advantage.

Fourth, commodity standardization is a must, as significant discrepancies between spot and futures market products negatively affect the price discovery ability of the latter. This insight implies that a regional gas futures market in East Asia would have to reflect unique LNG transportation challenges and qualitative differences in the commodity at the points of production and delivery.

Fifth, government predictability is far more important than regulation or deregulation. Predictability in government actions leads to market stability. In contrast, sudden leaps in either direction tend to result in market disruption.

However, the DRE experience which exhibited low levels of government intervention may not be applicable in the modern world. Self-regulating market mechanisms were efficient in the DRE mainly because it was a relatively small and closed community of traders. Each market participant remained visible to others at all times, and punishment for dishonesty and default was severe – a loss of trading privileges (i.e., the license to trade) which signified an outright exclusion from the merchant community. The context of today's globalized markets is very different. Large numbers of market participants who originate from various countries make it economically irrational to guarantee their credibility with certain merchant organizations.

Moreover, in the DRE, it might have been the case that the use of trust and reputation within the merchant coalition was the second best option to judicial actions because statutory commercial law was underdeveloped, and the government lacked judicial capacity to hear all the claims [42].

Finally, the risks of exposing LNG prices to broader financial markets must be recognized and dealt with by policymakers. When commodities like rice or LNG turn into

financial assets, their “prices become more exposed to broader global financial market trends” ([5], p. 189). On a micro-level, futures contracts are instruments for hedging against price volatility and are supposed to protect market participants from external risks. On a macro-level of global financial markets, possible risks multiply. Thus, these risks are much harder to manage when a commodity market is also a financial market. While there is no evidence that the DRE made spot prices more volatile, the experience of gas markets suggests that spot prices are more volatile than oil-indexed prices [1,14].

### 5.2. Proposing an LNG futures exchange design

Based on the above discussion of the DRE case study, the factors that influenced its performance, and implications drawn from its experience, we propose the following general design of an LNG futures exchange. It aims to address the issue of commodity standardization, which is a challenge in the case of LNG trading. Given current storage and infrastructure constraints, physical LNG cargos cannot be standardized. This is because the spoil-off during the transportation process is significant, at about 0.15% per day [16]. Further, this number is not universal and varies depending on the vessel type, in-transport conditions, and the overall shipping management system [25].

The proposed design of an LNG futures exchange (Fig. 2) offers commodity standardization based on the terms of the futures contract via either physical or cash settlement. It provides a loose link between physical non-standardized cargos and virtual trading of a standardized futures contract. In such a market, buyers, sellers, and the clearinghouse would play a key role in designing a contract and arranging for a delivery if

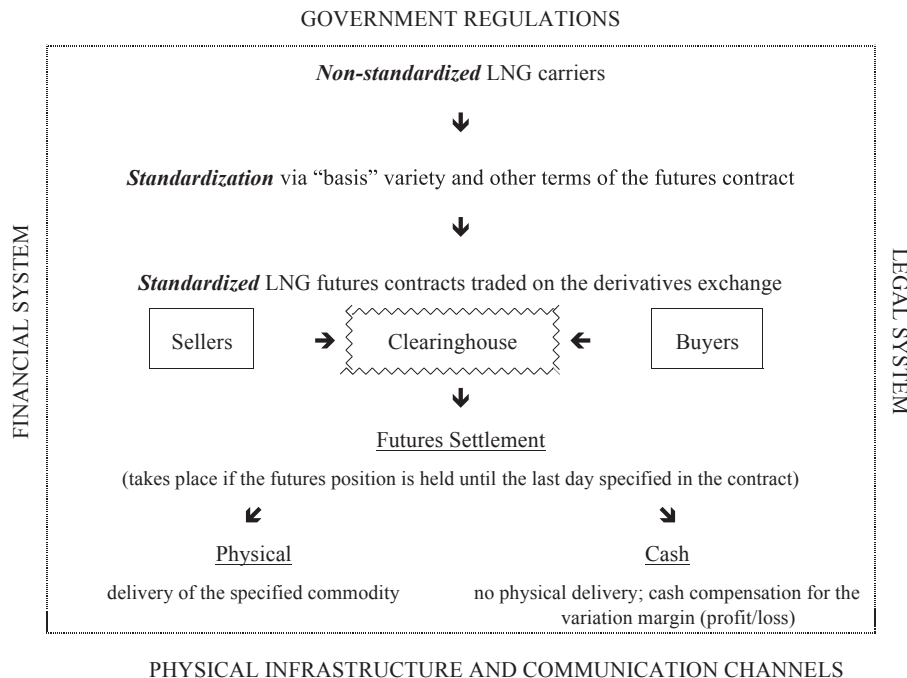


Fig. 2. Proposed design of the LNG futures exchange. Source: Authors



necessary. Physical delivery may take place very rarely in a very liquid market. Hence, parties to the contract have an option of cash settlement. Market participants are expected to work out the contract design details, and the algorithm for adjustment and estimation of reference spot prices and cost of physical delivery. Market institutions should be able to ensure the reliability of contract enforcement and price transparency.

Last but not the least, as Fig. 2 demonstrates, successful operation of the futures exchange is also conditioned upon corresponding legal and financial systems, an appropriate regulatory framework, as well as hard and soft infrastructure for coordinating, monitoring and, if a market failure occurs, correcting the market. In this regard, it is important to foster skilled brokerage companies and facilitate the establishment of reliable region-specific price reporting agencies.

## 6. Conclusion

Natural gas market in East Asia is currently a non-organized market dominated by long-term contracts. As a form of a futures market, a gas exchange, which comes with standardized contracts specifying delivery and settlement terms, would contribute to delivering currently non-existent transparent and neutral benchmark LNG prices. Another important feature of an exchange would include equally important roles of hedgers and speculators supported by a multitude of players such as liquidity providers, guarantors, insurers and trade mediators. The varying interests of market players are balanced by one more important element of a futures exchange, namely the contract. A well-designed contract attracts sellers and buyers thus increasing the market liquidity. A well functioning futures market, in its turn, is able to meet a wide range of expectations from the market participants by facilitating communication, transportation, financing, storage, price formation, and uncertainty bearing. Its ultimate objective is to reduce transaction costs, improve resource allocation efficiency, and provide transparency. The experience of the DRE is valuable for the ongoing development of gas futures markets in East Asia. It is located in the same region, has had similar challenges of product standardization, is well researched and represents a typical case that better illustrates the development of commodities markets from scratch, and serves as a “building block” study contributing to the comparative research on the LNG futures markets. The DRE is the world's first futures market with a long history. In various stages of its existence, the exchange managed to overcome a range of market problems, and was able to make commodity futures trading efficient. In other stages, it failed to cope with the challenges, which led to significant discrepancies between futures and spot prices, and increased the vulnerability of market participants. The shift of economic power from Osaka to Tokyo significantly weakened the DRE but its closure was caused by the government decision.

However, the success of a futures market also depends on the legal, tax, and regulatory regimes which the market is set within. Viable futures markets cannot take off without the

support of respective governments, while mature legal and financial systems create a framework of checks and balances for the markets. Also, along with the market, the government is the co-creator and integrator of tangible and intangible resources. The experience of the DRE demonstrates that the combination of market-specific dynamics, government imposed regulations, macroeconomic context, geopolitical events, and external factors like weather conditions contributed to successes and failures of the exchange at different times. Overall, however, the DRE was more dependent on the internal system of checks and balances, rather than government induced permissions and restrictions. Government-imposed measures formed a structural foundation of the market, while internal mechanisms established the rules of conduct. In other words, market fundamentals are the cornerstone of market development, and government regulations, although useful, could not create markets without the fundamental need for a market. At the same time, the government can easily shut down even a mature market through anti-market measures.

The DRE case study provides a number of implications for the LNG futures market development. These include the importance of strong market fundamentals, the different roles of the market and the government in designing structural and process rules, the crucial role of strong credit relationships and commitment from credible financial institutions, the significance of commodity standardization, government predictability for market stability, and the ability of policy-makers to anticipate and prepare for the volatility of spot and futures trading.

Finally, based on the case study analysis and the lessons it offers, this study suggests an LNG futures exchange design that addresses the issue of commodity standardization – a key challenge in the case of LNG trading. The proposed exchange design is very general and represents the first step towards development of a more nuanced market design. As such, it requires further research into the mechanisms of product standardization, contract design, and the roles of sellers, traders, brokers and the clearinghouse among others.

Additionally, as demonstrated in Fig. 1, physical and financial spot markets are the intermediate stage in the evolution of energy commodity trading and can lead to the development of physical and virtual trading hubs. As LNG spot markets in East Asia become more vibrant and mature, further research is necessary into the prerequisites for the establishment of successful gas trading hubs in the region. As the experience of gas hubs located across continental Europe demonstrates, they contribute to flourishing trade, but are preconditioned by the comprehensive process of gas market liberalization, and no single best model of gas hub development exists.

## Acknowledgement

The authors are grateful for research support from the Singapore Ministry of Trade and Industry and extend special thanks to Kohei Wada for research assistance. Any errors remain the sole responsibility of the authors.

## References

- [1] Alterman S. Natural gas price volatility in the UK and North America. The Oxford Institute for Energy Studies; 2012.
- [2] Azyro. Japanese rice futures should be formally listed before August 2015 to benefit out of TPP. 2014, July 22. Retrieved September 16, 2015, from, [www.azyro.com](http://www.azyro.com). <http://www.azyro.com/news/rice-news/japanese-rice-futures-should-be-formally-listed-august-2015-benefit-out-tpp>.
- [3] Bollen N, Smith T, Whaley R. Optimal contract design: for whom? *J Futur Mark* 2003;23(8):719–50.
- [4] Brown S, Yücel M. Market arbitrage: European and North American natural gas prices. *Energy J* 2009;30:167–85.
- [5] Clapp J, Helleiner E. Troubled futures? The global food crisis and the politics of agricultural derivatives regulation. *Rev Int Political Econ* 2012;19(2):181–207.
- [6] Cleveland T. Rice feeds hope for Tokyo commodities trading. 2011, July 21. Retrieved September 2, 2015, from, [agrimoney.com](http://bit.ly/1JzIYMa). <http://bit.ly/1JzIYMa>.
- [8] Cwiertka KJ. Cuisine, colonialism and cold war. London: Reaktion Books; 2012.
- [10] Fattouh B. An anatomy of the crude oil pricing system. the Oxford Institute for Energy Studies; 2011. WPM 40, January 2011.
- [11] George A, Bennett A. Case studies and theory development in the social sciences. Cambridge: MIT Press; 2005.
- [12] Gerring J. Case study research: principles and practices. Cambridge: Cambridge University Press; 2006.
- [13] Hamori S, Hamori N, Anderson DA. An empirical analysis of the efficiency of the Osaka rice market during Japan's Tokugawa era. *J Futur Mark* 2001;21(9):861–74.
- [14] Hochradl M, Rammerstorfer M. The convenience yield implied in European natural gas hub trading. *J Futur Mark* 2012;32(5):459–79.
- [15] IEA. Developing a natural gas trading hub in Asia: obstacles and opportunities. 2013. Retrieved September 29, 2015, from, [http://www.iea.org/publications/freepublications/publication/AsianGasHub\\_FINAL\\_WEB.pdf](http://www.iea.org/publications/freepublications/publication/AsianGasHub_FINAL_WEB.pdf).
- [16] International Gas Union. 2016 World LNG report. 2016. Retrieved August 6, 2016, from, [www.igu.org/download/file/fid/2123](http://www.igu.org/download/file/fid/2123).
- [17] Ito M, Maeda K, Noda A. Futures premium and efficiency of the rice futures markets in prewar Japan. arXiv preprint arXiv:1404.5381. 2014.
- [18] Jayne T, Sturgess C, Kopicki R, Sitko N. Agricultural commodity exchanges and the development of Grain markets and trade in Africa: a review of recent experience. Indaba Agricultural Policy Research Institute; 2014.
- [19] Johnston BF. Japanese food management in World War II. Stanford: Stanford University Press; 1953.
- [20] Kakizaka M. Reflection on the efficiency of Dojima rice exchange during 19th century [19世紀における堂島米市場の効率性に関する一考察]. *Jpn Econ Res. 日本経済研究* 2012;66:72–87.
- [21] Kaul I, Conceição P. The new public finance: responding to global challenges. New York: Oxford University Press; 2006.
- [22] Lien D, Tse YK. A survey on physical delivery versus cash settlement in futures contracts. *Int Rev Econ Finance* 2006;15:15–29.
- [23] Mak J, Sunder S, Abe S, Kazuhiro I. Japan: why it works, why it doesn't. Honolulu: University of Hawai'i Press; 1998.
- [24] Mazighi AEH. Henry hub and national balancing point prices: what will be the international gas price reference? *OPEC Rev* 2005;29:219–30.
- [25] Miana M, Legorburo R, Díez D, Hwang YH. Calculation of boil-off rate of liquefied natural gas in mark III tanks of ship carriers by numerical analysis. *Appl Therm Eng* 2016;93:279–96.
- [26] Miyamoto M. Rice exchange institution and the fluctuation of rice price during Edo period in Osaka [近世後期大阪における米価変動と米穀取引機構/正米価格と帳合米価格の動き]. *Econ Res. 経済研究* 1975;26(4):359–68.
- [27] Moss DA, Kintgen E. The Dojima rice market and the origins of futures trading. Harvard University. Cambridge: Harvard Business Publishing; 2009.
- [28] ODCE. History. 2015. Retrieved September 22, 2015, from ODCE Exchange Introduction, <http://www.ode.or.jp/english/index.html>.
- [30] Pavaskar M. Contract design of futures contracts. *Financ Vis* 2013;1(2):45–9.
- [31] Phillips J. The theory and practice of futures trading. *Rev Mark Agric Econ* 1966;34(2):43–63.
- [32] Pirrong C. Manipulation of cash-settled futures contracts. 1999. Retrieved August 6, 2016, from, <http://www.cba.uh.edu/spirrong/cashset4.pdf>.
- [34] Porter D, Weaver D. Tick size and market quality. *Financ Manag* 1997;26(4):5–26.
- [35] Rogers HV, Stern J. Challenges to JCC pricing in Asian LNG markets. 2014, February. Retrieved September 29, 2015, from The Oxford Institute for Energy Studies: <http://www.oxfordenergy.org/wpcms/wp-content/uploads/2014/02/NG-81.pdf>.
- [36] Schaede U. Forwards and futures in Tokugawa-era Japan: a new perspective on the Dojima rice market. *J Bank Finance* 1989;487–513.
- [37] Shi X, Variam HMP. Gas and LNG trading hubs, hub indexation and destination flexibility in East Asia. *Energy Policy* 2016;96:587–96.
- [38] Silber W. Innovation, competition, and new contract design in futures markets. *J Futur Mark* 1981;1(2):123–55.
- [39] Stern J, Rogers HV. The transition to hub-based gas pricing in continental Europe. 2011. Retrieved November 16, 2016, from the Oxford Institute for Energy Studies: <https://www.oxfordenergy.org/wpcms/wp-content/uploads/2011/03/NG49.pdf>.
- [40] Takatoshi I. The efficiency of Dojima rice future exchange in the 18th century [18世紀、堂島の米先物市場の効率性について]. *Econ Res. 経済研究* 1993;44(4):339–50.
- [41] Takatsuki Y. Formation of an efficient market in Tokugawa Japan. Tokyo: Institute of Social Science, The University of Tokyo; 2008a.
- [42] Takatsuki Y. Protection of property rights in Edo-period rice exchange [近世日本米市場における財産権の保護]. Tokyo: Institute of Social Science, The University of Tokyo; 2008b.
- [43] TheJapanTimes. Time running out for formal listing of Japanese rice futures. 2014, July 23. Retrieved September 2, 2015, from The Japan Times: <http://www.japantimes.co.jp/news/2014/07/23/business/financial-markets/time-running-out-for-formal-listing-of-japanese-rice-futures/#.VgoCpNKqPhy>.
- [44] Wakita S. Efficiency of the Dojima rice futures market in Tokugawa-period Japan. *J Bank Finance* 2001;25:535–54.
- [45] West MD. Private ordering at the World's first futures exchange. *Mich Law Rev* 2000;98(8):2574–615.
- [46] Whipp L. Japan set to lift 72-year ban on rice futures trading. 2011, June 24. Retrieved September 2, 2015, from FT: <http://on.ft.com/1LYOsBT>.