Feasibility Study on Listing and Trading of Lithium Futures in China Futures Market

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Abstract. With China's carbon emission trading system becoming more and more perfect and mature, the financial attributes of carbon emission rights are constantly strengthened, and the nonlinear link between energy futures market, energy stock market and carbon market is constantly highlighted. Therefore, based on the development of new energy and the implementation of the "two-carbon" policy, the futures of metallic lithium have a certain development prospect in China futures market.

Keywords: Metal lithium · futures · market

1 Introduction

With the increasing application of lithium batteries, in order to meet people's requirements, enterprises are constantly expanding their production scale. In addition, as the world constantly advocates energy conservation and environmental protection, most of the electronic products produced by enterprises in response to the concept of "energy conservation and environmental protection" use lithium batteries. The repeated use of lithium batteries conforms to the concept of "energy conservation and environmental protection", so enterprises in various countries around the world are producing them in large quantities. Many enterprises have placed the production sites of lithium battery equipment in China. For example, Sanyo, the world's most famous battery company, has built its own battery production bases in Beijing, Tianjin and other places, Fujian has a battery production base of Korea's only-opened enterprise, and Vilik has built its production base in Xianyang [1]. At present, China is constantly opening up the new energy policy, and the number of enterprises producing lithium battery equipment is increasing rapidly, resulting in increasingly fierce market competition for lithium battery equipment. Of course, if an enterprise wants to occupy a place in the fierce competition, it needs to continuously introduce advanced equipment and technology to better meet the needs of customers. Therefore, the application range of metallic lithium is more and more extensive.

In China, however, the development prospect of lithium batteries has the following advantages.

With the advent of economic globalization, China has responded to the call of the world to use new energy sources and strengthen environmental protection. Therefore,

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the use of lithium battery equipment came into being. The market competition of related equipment produced by metallic lithium in China is becoming more and more fierce [2]. With the passage of time and the continuous development of science and technology, the lithium battery equipment industry will face enormous challenges and opportunities. It is not difficult to see that the development prospect of lithium battery equipment will be better and better, and the fierce market competition will stimulate the continuous breakthrough of lithium battery equipment production technology. The breakthrough of key technologies can not only ensure the production efficiency of enterprises, but also ensure the quality of lithium battery equipment, thus providing better services to people.

1.1 The Development of Automation, Standardization and Accuracy

Only by mastering the core technology can we ensure that the quality of the produced lithium battery equipment is relatively high. On the premise of ensuring the correct production technology, we can ensure that the produced lithium battery equipment is within the same standard, and we can use advanced automatic production technology to produce and improve the quality and safety of lithium batteries. High-precision production mode has become the trend and development direction of lithium battery equipment production [3].

1.2 Performance Development Prospect

At present, people's requirements for lithium battery equipment are getting higher and higher, which promotes the continuous development of lithium battery industry. Enterprises should consider people's requirements for performance, safety and applicability of lithium battery equipment from the beginning of design, and integrate design details and technologies into manufacturing, so as to ensure that the products produced by the equipment have enterprise characteristics and enhance the awareness of intellectual property rights. The Power lithium battery equipment is the most concerned lithium battery equipment at present, and many enterprises have already produced hybrid electric vehicles [4] In the near future, a large number of power lithium battery equipment will be widely used in social production and life, so as to provide people with better performance lithium battery equipment on the premise of environmental protection. It is believed that with people's continuous efforts, the safety and quality of lithium battery equipment will be higher and higher, providing people with higher quality services.

1.3 Main Products and Characteristics of Lithium Metal Related Equipment

The main equipment of lithium battery equipment involves tableting machine, winding machine, cutting machine, laminating machine and liquid injection machine, among which the tableting machine with the highest market share is the one with mature technology, and its products are mostly semi-automatic round with good performance, which can be made into lithium batteries of various sizes, and the width of the cell pole piece is 10 mm.

However, lithium metal still has some problems.

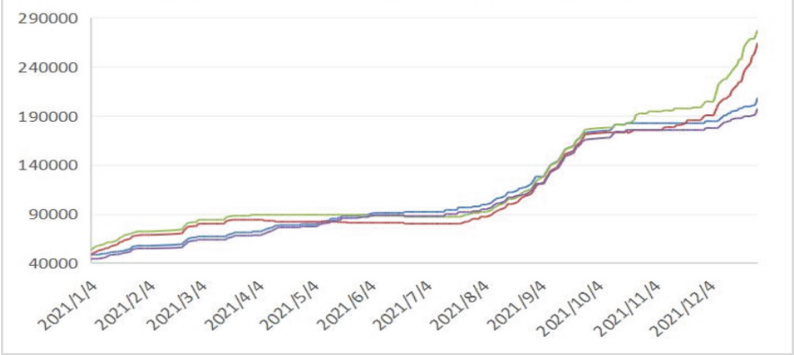

Fig. 1. Price Trend of Different Lithium Metals (Owner-draw)

With the increasingly fierce competition in the lithium battery equipment industry, and many foreign manufacturers have also introduced their sales channels to China, there are no certain rules in the whole market competition, and all enterprises are facing great challenges. The lithium-ion equipment produced in China is still in the primary stage, but the foreign technology and products are relatively mature. Therefore, compared with China's products, the competitiveness in the market is relatively weak, and the production cost is relatively high. In order to stand out in the fierce competition market, Chinese enterprises try their best to find solutions to reduce costs and continuously improve the level of production technology, which effectively promotes the development of domestic lithium battery equipment industry and the innovation of production technology. This rapidly developing market situation will inevitably bring great impact to the development of lithium battery equipment industry in China. Figure 1 shows the price trend of different lithium metals.

From the above chart, we can see that the systemic risks of raw materials and products in the industry are rising.

Therefore, through the establishment of the lithium metal futures market, hedging can be effectively realized, and the risks caused by the price fluctuations of raw materials or products can be avoided.

2 Realistic Analysis

2.1 There are Precedents in Foreign Futures Markets

International commodity exchanges are speeding up the listing of lithium metal futures. On September 26th this year, Singapore Stock Exchange launched the first batch of lithium futures contracts, becoming the third exchange in the world to list lithium futures contracts after London Metal Exchange (LME) and Chicago Mercantile Exchange (CME).

The lithium futures contract will help market participants to manage the price risk of key raw materials of new energy vehicles, so as to cope with the drastic fluctuation of raw material prices caused by the rapid development of new energy vehicles.

2.2 China Metal Futures Market is Very Mature

China's mineral resources futures market started late, and its development process is tortuous, which is mainly due to many reasons such as social system and economic system. After the founding of New China, especially after the reform and opening up, the domestic mineral products futures market just started. Wang Keqiang summarized the starting time gap of various futures products of mineral resources between China and foreign countries. Among them, non-ferrous metal futures products (copper and tin) were first produced in England in 1877, while China didn't have aluminum mineral futures until 1992, and the time difference between them is more than a century [5].

Even though it started late, the nonferrous metal industry is still the earliest, most mature, most market-oriented and internationalized representative industry in China's futures market Its development process was arduous. In 1986, 52 large and medium-sized enterprises of China Nonferrous Metals Industry Corporation began to prepare and set up a joint-venture exhibition center in Shenzhen. After many discussions and organizations, they reported to the Shenzhen Municipal Government for approval to set up a non-ferrous metal exchange in December 1990. This application was officially approved on June 10, 1991. Until January 18, 1992, Shenzhen Nonferrous Metals Exchange officially opened, becoming the first nonferrous metals exchange in China. In the same year, Shanghai Metal Exchange was established on May 28, 1992 with the approval of the Ministry of Domestic Trade and the Shanghai Municipal Government. The above two exchanges are the origins of China's nonferrous metal futures market. Their listed varieties are copper, aluminum, lead, zinc, tin and nickel. In 1993, Shanghai Metal Exchange launched the first copper standard futures contract, which marked the official start of real futures trading of non-ferrous minerals. Among the futures trading of the above six non-ferrous minerals, the development of copper products is the most stable, while the trading of aluminum products is not very stable. Due to poor market liquidity, the four mineral products, lead, zinc, tin and nickel, stopped trading in 1999 [6].

Since 1999, non-ferrous metal futures have only been traded in Shanghai Futures Exchange, initially realizing the marketing pattern of "one product, one market". With the development of China's economy and the improvement of related systems, the futures market of non-ferrous mineral products is maturing and growing. According to the timeline, on March 26, 2007, zinc futures were listed and traded again in Shanghai Futures Exchange. On March 24th, 2011, lead futures were officially listed on Shanghai Futures Exchange. On March 27th, 2015, tin futures and nickel futures were officially listed on Shanghai Futures Exchange at the same time. So far, China's six basic non-ferrous metal futures market patterns have finally been completely constructed. Until now, after more than 20 years of market baptism, copper futures have become the most mature and stable product in China's non-ferrous minerals futures market, followed by aluminum futures, and the other four major non-ferrous minerals futures are also developing and maturing in an orderly manner.

2.3 China Capital Market Pays Great Attention to Lithium Industry

The investment and financing projects of China lithium battery industry chain reached a record high, and Jiangxi Ganfeng Lithium Industry Co., Ltd. Was listed in Hong Kong, raising HK$ 4.869 billion.

Jiangxi Ganfeng Lithium Industry Co., Ltd. is a high-tech enterprise integrating science, industry and trade recognized by Jiangxi Science and Technology Department. It is an internationally renowned enterprise specializing in the R&D and production of lithium, rubidium, cesium and their derivatives. Founded in 2000, the company is headquartered in Xinyu Economic Development Zone, Jiangxi Province, with a registered capital of 75 million yuan. The company has 450 employees, including 123 engineers and managers.

With three production bases and a provincial enterprise technology center, the company has the most complete industrial chain of lithium series products in China, is one of the largest suppliers of lithium metal in the world, and is at the leading level in the product development and production of lithium series organic compounds in China. In five years, the company has been recognized as "Key New Products in Jiangxi Province" by Jiangxi Science and Technology Department, one product has been recognized as "National New Products", one project has been supported by "National Innovation Fund for Small and Medium-sized Enterprises", two projects have been supported by "Innovation Fund in Jiangxi Province", and one project has been supported by "Guiding Fund for High-tech Industrialization of Provincial Planning Commission". In February, 2003, the trademark "Ganfeng" was recognized as "Jiangxi Famous Trademark" by Jiangxi Industrial and Commercial Bureau, and it was renewed in June, 2006. In August, 2004, it won the title of Excellent High-tech Enterprise in Jiangxi Province in 2003 by Jiangxi High-tech Industry Association; In November, 2006, it won the honorary title of national outstanding private enterprise in science and technology; In 2006 and 2008, it was awarded the title of "Advanced Public-owned Enterprise of Sakura and Elm" in Jiangxi Province.

3 Spot Market Pricing Model

3.1 International Market

The international market will price futures according to their value. The most common products are lithium ore, battery and industrial lithium hydroxide, battery and industrial lithium carbonate, etc. To calculate their futures value, the following formula can be adopted.

VAR model is usually used to predict related time series systems and the dynamic influence of random disturbance on variable systems. It was first proposed by Sims and applied to economics. In each equation of VAR model, the lag values of all endogenous variables in the model are regressed with the endogenous variables of the current period, so as to estimate the dynamic relationship among all endogenous variables, without any prior constraints in the estimation process. Expression of bivariate VAR model of futures price and spot price (1)

$$y_t = B_0 + A_{1y_{t-1}} + A_{2y_{2-1}} + \cdots + A_{py_{t-p}} - \epsilon_t \tag{1}$$

where yt is a two-dimensional endogenous variable vector, namely yt = (FtSt)', Ft is the futures price, St is the spot price, P is the lag order, A1, …, Ap is a 2 × 2 dimensional coefficient matrix. ε is a two-dimensional disturbance vector, which can be correlated at

the same time, but not with its own lag period and other variables on the right side of the equation.

Based on VAR model (1), Johansen cointegration test model (2) of futures price and spot price can be obtained:

$$\Delta_{y_t} = \Pi_{y-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta_{y_{t-i}} + Bx_t + \epsilon_t \tag{2}$$

If both the futures Ft and spot price St follow the I (1) process, then δ FT and δ ST are both stationary in the first order, so only yt−1 is an I (0) vector, that is, there is a cointegration relationship between Ft-1 and St-1, which can guarantee that δ YT is a stationary vector. Trace test and maximum eigenvalue test can be used to determine whether there is cointegration relationship between variables.

3.2 Domestic Market

There are no benchmark products and benchmark prices for lithium in the market. The specific pricing modes of main products are as follows: floating pricing and fixed pricing.

Analysis of buyer's choice behavior can provide basis for dynamic pricing. Talluri et al. built Logit model to study the factors that influence futures buyers' choice behavior and put forward floating pricing strategy. By analyzing the buyer's choice behavior, Shan Xinghua put forward a revenue management system combining static pricing strategy with dynamic pricing strategy. On the basis of analyzing the price demand elasticity of buyers, Jin Qin constructed the elasticity function based on Logit model, and established a multi-period dynamic pricing and futures allocation collaborative optimization model with the goal of maximizing the total revenue of expected futures quantity, so as to effectively raise the total revenue level of futures.

Fixed price refers to an agreement between members of a combination to sell their products at the same price, so as to eliminate the competition among members in the price of products. The main purpose of fixing the price of products by agreement between enterprises is to eliminate the competition between them, so as to safeguard their own interests.

Therefore, in essence, fixed price is a typical restrictive business practice. The so-called restrictive business practices are generally considered to mean that enterprises restrict entry into the market by abusing or seeking to abuse the dominant position of market forces, or unduly restrict competition in other ways, which will adversely affect the development of trade or commerce; Or through formal or informal, written or unwritten agreements or arrangements between enterprises. China's more formal definition of this refers to "in economic activities, enterprises engage in mergers and acquisitions (monopoly activities in a narrow sense) for high profits, or collude to conduct improper business activities (restrictive business practices in a narrow sense) such as bid rigging, price manipulation, market division, etc." [7]. According to the legislation of various countries, there are many kinds of restrictive business practices, such as compulsory price, boycott, output quota agreement, etc. However, due to the different competition policies of various countries, there are some differences in the specific scope of legal control, all of which include fixed prices.

4 Brief Introduction of Foreign Lithium Futures

Up to now, only Chicago Mercantile Exchange (CME), London Metal Exchange (LME) and Singapore Exchange (SGX) can trade metallic lithium futures in the global futures market.

Chicago Mercantile Exchange (CME) and London Metal Exchange (LME) listed lithium futures contracts in May and July, 2021, respectively. The lithium futures of these two exchanges are lithium hydroxide futures; Singapore Stock Exchange (SGX) listed two kinds of lithium futures contracts-lithium carbonate futures and lithium hydroxide futures in September 2022.

Lithium is a silver-white light metal, which is light and soft. In terms of electrochemical properties, lithium metal has low electrochemical potential and strong electrochemical activity, and it is easy to form compounds with other elements.

Lithium carbonate is a basic chemical containing lithium, with the chemical formula of Li2CO3. It is the most commonly used raw material for lithium-ion batteries, and can also be used in ceramics, glass, drugs, catalysts and other fields. According to different quality, lithium carbonate can be divided into two types: industrial lithium carbonate and battery lithium carbonate.

The sources of lithium are salt lakes and rock mines. Salt lakes are saline waters rich in elements such as potassium, lithium, magnesium and boron. Salt lake resources are mostly distributed in South American countries such as Chile and Argentina. Refining lithium in salt lake mainly uses solar energy to naturally evaporate, concentrate and precipitate lithium carbonate from lithium-containing brine in evaporation pool.

The rocks include spodumene, lepidolite and petalite, among which spodumene is mainly distributed in Australia, Canada, Zimbabwe, Zaire, Brazil and China, while lepidolite is mainly distributed in Zimbabwe, Canada, the United States, Mexico and China. Lithium ore is used to smelt lithium by cave mining, extracting solid stone, and then using sulfuric acid method to obtain lithium carbonate.

5 Selection of the Subject Matter for Listing and Trading of Lithium Futures in China

5.1 Selection Principle of Subject Matter

Firstly, the mechanical properties are calculated by conventional strength theory. Among them, the mechanical properties mainly include: tensile strength, yield strength, elongation, area shrinkage, impact energy, hardness, etc. These properties are not only affected by the smelting method and chemical composition of the material, but also related to the cross-section size, shape and heat treatment conditions of the parts. Among them, the mechanical properties of metal materials can be found in the corresponding material standards or related manuals. These data are obtained through a large number of experiments, production practices, systematic demonstration and analysis, and on the basis of long-term statistical accumulation, they have been upgraded to all levels of standards. Therefore, when designers calculate the strength of product parts, they can directly select from the corresponding material standards according to the load size, distribution mode

and working conditions of the parts, and then complete the part drawing design, material brand and standard selection after checking.

The selection of materials must be based on the domestic market, and at the same time, the rational utilization of national resources and the current domestic production and supply situation must be considered. For example, domestic materials containing rare elements such as Ni, Cr and Cu should be used as little as possible or not. On the premise of ensuring the performance of parts, Mn-containing alloy should be used instead of Ni-containing and Cr-containing alloy as much as possible. The choice of materials should give priority to the standard materials in China, and try not to use or use less non-standard materials. At the same time, try not to use or use less materials with special specifications, brands and standards. Material selection must fully consider its generalization. We know that the development and progress of any product technology depends on inheritance and innovation. Without innovation, products can't win the market and users, and without inheritance, innovation can't be discussed at all. Especially for products, market users' demand for them is changing with each passing day. However, due to the difference of design time and designers, the same material often gives different technical requirements, which brings a lot of inconvenience to the aspects of purchasing, inspection, management and versatility in production and use, which not only increases the material cost and causes unnecessary waste, but also directly restricts the production progress. Therefore, applying the principle of material standardization, reasonably reducing, unifying and universalizing the material requirements, on the premise of ensuring the product quality and meeting the technological requirements, we can achieve a high degree of unification of materials and requirements for similar parts of different products, and realize the generalization of materials used in series products [8].

The economy of a material is the relative price of the material itself. When the materials with strong versatility and low price can meet the requirements, the materials with high price should not be used.

5.2 The Subject Matter Suggests Battery-Grade Lithium Carbonate and Battery-Grade Lithium Hydroxide

Table 1 shows the Domestic price trend of lithium cobaltate and Table 2 shows the output trend of lithium cobaltate.

In 2017, the whole lithium cobalt market fluctuated greatly. The price of lithium cobaltate was 225,000–410,000 yuan/ton, with an average price of 376,000 yuan/ton, up 180,000 yuan/ton compared with 2016. In the first quarter of 2017, as the price of cobalt salt was affected by the price increase of imported raw materials, its sales price also continued to rise, soaring by 50% compared with the past. As the raw material needed

Table 1. Domestic price trend of lithium cobaltate (Owner-draw)

Year	2012	2013	2014	2015	2016	2017
Price	18.8–20.4	17.2–19.0	16.5–17.5	16.0–17.7	19.8–22.5	22.5–41.0

Table 2. Output trend of lithium cobaltate (Owner-draw)

Year	2012	2013	2014	2015	2016	2017
Production	32000	36450	43000	52000	51000	60000

Market situation analysis

for the production of lithium cobaltate, the price of cobaltosic oxide is also rising continuously, which makes the production cost of lithium cobaltate increase substantially. Various manufacturers have increased their quotations, and the price of lithium cobaltate has increased strongly, jumping from 220,000 yuan/ton to 410,000 yuan/ton. All demanders have replenished their stocks, and the market transactions are active. In the second and third quarters, the price of cobaltosic oxide dropped. At the same time, the downstream small 3C consumer battery manufacturers couldn't bear the excessive cost, and their acceptance of the market price rising too fast was low. The downstream market entered the off-season and the demand declined. Some demanders began to purchase ternary materials or lithium manganate because of the high price. However, the price of lithium carbonate has been rising all the way since the end of the second quarter, and it is difficult to purchase, so they still gave some support to lithium cobaltate. Under the comprehensive effect, the price of lithium cobaltate dropped and stabilized at 390,00 yuan/ton. At the same time, the lithium cobaltate producers are polarized, the orders of large enterprises are stable, the purchase price of raw materials is good, and the production is stable; Small and medium-sized producers began to cut production due to the weak market and declining orders. Then, in the fourth quarter, the price of cobaltosic oxide, the raw material of lithium cobaltate, rose, while the lithium cobaltate producers refused to sell at the reserve price because of the high cost. The whole market price rose slightly, and the price of lithium cobaltate rose to 400,000 yuan/ton.

6 Conclusion

From the practical application point of view, the current mainstream cathode materials are lithium cobaltate, ternary materials, Ferrous lithium phosphate, lithium manganate, etc. In the past two years, the lithium battery industry has been affected by state subsidies and the pursuit of the capital market, and a large number of enterprises in the field of cathode materials have been transformed and expanded, especially ternary materials and Ferrous lithium phosphate. The first impact is on the digital product market, the core application field of lithium cobaltate. However, compared with ternary materials, lithium cobaltate has a series of performance and technical advantages. In fact, at present, the only mature battery that can meet the standby requirements of mobile devices is lithium cobaltate. In the field of consumer digital products, lithium cobaltate is still in a dominant position. Although the market demand of ternary materials has increased, its market share is still different from that of lithium cobaltate. We still have a positive attitude towards the future lithium cobaltate market, and the market orientation plays a decisive role. In the traditional high-end digital lithium battery industry, lithium cobaltate still occupies a stable position. Therefore, the futures of lithium metal still have great prospects in the China market.

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