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Convenience yield of accessible inventories and imports: A case study of the Chinese copper market

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ABSTRACT

Inventories have traditionally been regarded as key measures to respond to market risks. Although benchmark exchanges are increasingly important, their inventories actually utilized are those in the local markets. The perspective that we benefit from the inventories that are available and in proximity is conceptualized as the accessibility of inventories. To explore the accessibility issue, this study analyzes the convenience yields of the Chinese domestic copper market for the period of January 2011 through April 2015. The results indicate that local markets benefit from and are influenced by accessible inventories, but not from less accessible inventories. Furthermore, imports act as inventory inflows, which can be considered the movement of the accessible inventories that provide convenience yields to local markets. In addition, we show that volatility is the central difference between the cost-of-carry and option pricing models, which are representative estimation methods for convenience yields.

1. Introduction

There is a growing perspective that the copper markets of China's Shanghai Futures Exchange (SHFE) and the London Metal Exchange (LME) are becoming highly interrelated with the development of international trade. Specifically, spatial arbitrage is considered the major contributor for this interrelationship. According to reports from Sanderson (2015), traders and investors have taken advantage of arbitrage opportunities between the SHFE and LME, and Orient Securities Futures (2015) reported that arbitrage opportunities have been realized as physical trading. Previous studies also empirically detected the interrelationship between the SHFE and LME. For example, Li and Zhang (2009) found a strong linkage in the price discovery process between the copper prices of the SHFE and LME, and Rutledge et al. (2013) verified the SHFE and LME positively influence each other and have formed significant mutual integration. Wang et al. (2007) found strong spillover effects between the LME and SHFE markets. Finally, Hua et al. (2010) and Fung and Tse (2010) found the cointegration and price discovery process among the LME, SHFE, and Commodity Exchange, Inc. (COMEX).

The above discussion that the SHFE and LME copper markets are interrelated appears rationale for prices. However, whether this argument is valid for inventories is unclear. As copper inventories of the major exchanges are key signals for the international copper market, the inventories could have global influence. However, previous studies (Geman and Smith, 2013; Omura et al., 2015) and market reports (Cha, 2013; Hong, 2013; Angel and Antonioli, 2013; Home, 2016) propose a counterview. The SHFE maintains copper inventories inside its territory, and even when importing LME inventories to achieve arbitrage profit, the copper for Chinese delivery has been typically shipped from Asian countries nearby, such as Singapore, South Korea, and Malaysia. In addition, considering the characteristics of inventories, which are accumulated for emergencies and supply disruptions, China is likely to utilize its SHFE inventories or Asian inventories for immediate access (Omura et al., 2015) by taking geographical advantage of the SHFE and Asian inventories. Therefore, although the copper prices of benchmark exchanges, the SHFE and LME, are highly interrelated, the effect of inventories could be confined to each regional market.

We suppose that the limited effect of inventories is mainly due to the intraregional nature of the inventories. When there is excess supply, inventories tend to be accumulated in the warehouses located inside each region and released to the regional market if necessary. Regional markets typically utilize their domestic warehouse inventories

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since they are highly accessible and can be utilized promptly during supply disruptions and demand upsurges. The benefit inventory owners gain from holding inventories during risky conditions is defined as a convenience yield, which is assumed to be realized when the availability of inventories guarantees the smooth supply of goods or stable prices. Convenience yields are considered the reward for holding goods as inventories, despite the financial loss from spot prices being higher than futures prices. Milonas and Thomadakis (1997) and Omura et al. (2015) emphasized convenience yields as the relative value of physical inventories to futures contracts since, when urgent supplies are needed, inventory is readily available but futures cannot be accessed before their maturity. However, inventories that are distant or impossible to trade may not provide convenience yields. Therefore, the proximity or accessibility of inventories is assumed to determine the size of convenience yields, and more accessible inventories would provide larger convenience yields to regional markets.

Some studies have deliberated the accessibility of inventory empirically. Geman and Ohana (2009) investigated the accessibility of oil and gas traded on the New York Mercantile Exchange (NYMEX) and found that local U.S. inventories provide more significant convenience yields than the global Organisation for Economic Co-Operation and Development (OECD) inventories do. Geman and Smith (2013) analyzed the six major base metal inventories of the LME, COMEX, U.S. Geological Survey (USGS), and SHFE, and concluded that the LME gains convenience yields from their own inventories. Omura et al. (2015) estimated regional convenience yields for the base metals of the Asian, American, and European markets with the inventories of the SHFE, COMEX, and LME. They showed that convenience yields and inventory levels of base metals are better explained by Asian data than for other regions. Although these studies investigated whether the convenience yields of inventories are dependent on accessibility, the results are insufficient for the Asian copper market. For example, Omura et al. (2015) presented an ambiguous finding that Asia gains significant copper convenience yields from the LME inventories and that the addition of the SHFE inventories to the LME inventories reduces the significance of the results. A possible reason for this result could be the price data problem. In their study, the convenience yields of the Asia were calculated using the LME's spot and future prices, rather than SHFE's spot and future prices. Thus, their conclusion that the copper convenience yields of Asia resulted in a closer relation to the LME inventories than the SHFE inventories may be inappropriate. Geman and Smith (2013) did not consider convenience yields from Asia as they focused on the convenience yields of the LME. The SHFE inventories were used to show the non-linear relationship with the LME's convenience yields as one of the major inventories, but not to explore Asia.

This study aims to investigate whether the effect of inventories in terms of convenience yields is related to the accessibility of the inventory. This study focuses on identifying regional inventories where the SHFE copper market, for example the Chinese local copper market, gains convenience yields. The SHFE copper market should be investigated, considering the soaring demand in China and the growing importance of the Chinese market (Rutledge et al., 2013; Fung and Tse, 2010). In particular, the following two research questions are thoroughly discussed in this study. First, does the SHFE copper market gain convenience yields from accessible inventories, including inventories in China and nearby Asian countries? The inventories in China and nearby Asian countries qualify the preconditions of accessibility in terms of their proximity. As such, the accessibility of inventories in China can be discussed more clearly than previous studies (Omura et al., 2015; Geman and Smith, 2013) which did not conclude this issue. Second, do the copper imports from nearby Asian countries provide convenience yields to the SHFE market? As copper import can be the channel for inventories in Asian countries nearby to flow into the Chinese domestic market, we suppose that convenience yields can be obtained from the physically accessible inventories located beyond national borders. This supposition is supported by Wright and Williams' (1989) argument that imports, as well as inventories, can be a way to hedge production disruptions.

The remainder of this paper is organized as follows. Section 2 explains the research framework for answering the two research questions. Section 3 constructs a theoretical model to test the hypotheses. Section 4 describes the data and empirical results. Finally, Section 5 discusses the conclusions and offers implications.

2. Research framework

To elaborate the first research question, it is necessary to compare the effects of inventories in several regional markets on the convenience yield of the SHFE copper market. From the perspective of the SHFE market, inventories can be classified into China's domestic SHFE inventories (SHFEI), Asia's LME inventories (LME ASIAI), and the total global LME inventories (LMEI) by the accessibility of the inventory. SHFEI represents inventories in the exchange warehouses in the Chinese territory, which are authorized by the SHFE. LME ASIAI represents inventories authorized by the LME and located in Asia, such as in Busan, Gwangyang, and Incheon, Korea, Johor and Klang, Malaysia, Kaohsiung, Taiwan, and Singapore. LMEI represents the total inventories of the LME, which are widespread throughout the world. To date, as China does not allow warehouses in its territory to become LME-registered, there are no LME inventories in China (Geman and Smith, 2013). In addition, since SHFE inventories are located only inside China (e.g., Shanghai), the regional scope of the SHFE and LME inventories can be regarded as separate (Fig. 1).

We analyze how the combinations of the above three inventories affect the convenience yields of the SHFE copper market. We consider the following four combinations: i) SHFEI only, ii) the sum of the SHFEI and the LME ASIAI (SHFEI+LME ASIAI), iii) LMEI only, and iv) the quantity excluding the LME ASIAI from the LMEI (LMEI−LME ASIAI). We suppose that China would gain significant convenience yields from SHFEI and SHFEI+LME ASIAI, but not from LMEI and LMEI−LME ASIAI. SHFEI is the most accessible because it incurs no tariffs and guarantees small transaction costs. As China can import copper easily from Asian countries nearby, LME ASIAI might be another source of accessible inventory. On the contrary, LMEI would be less accessible compared to SHFEI or LME ASIAI due to location and transaction costs, unless spatial arbitrage is too attractive or stockpile competition is too aggressive. Especially, China would gain a minimal convenience yield from LMEI−LME ASIAI that China occasionally utilizes.

We are interested in both the effect of LME ASIAI and the effect of SHFEI+LME ASIAI because both SHFEI and LME ASIAI should be included as potential accessible categories. It is impossible, and not of our interest, that only LME ASIAI would be accessible, except for the domestic SHFE. In addition, because of the ambiguity of the supply and demand mechanism between the SHFEI and LME ASIAI, we cannot determine whether the convenience yield from LME ASIAI is a decreasing function as proven in the theory of storage (Brennan, 1958;

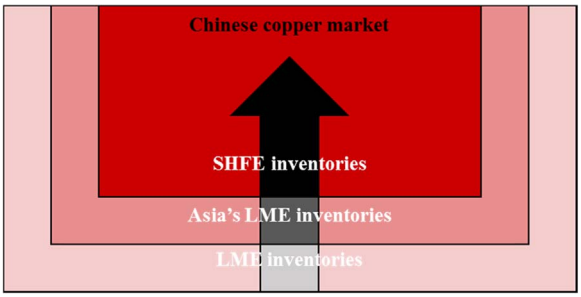

Fig. 1. Accessibility of the SHFE, Asia's LME, and LME inventories to China's local metal market.