



Recent experiences of copper on the Shanghai futures exchange: Some lessons for warehouse monitoring[☆]



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A B S T R A C T

The Theory of Storage of Working (1949) and Brennan (1958) predicts that demand shocks reduce inventories, raise convenience yields and generate negative forward spreads. The goals of the paper are threefold: i) Analyze the Shanghai Exchange copper forward curves over the period 2008 when the trading volumes of metals Futures contracts grew in a remarkable manner; ii) Exhibit the unprecedented dynamics of the Shanghai Exchange copper forward curve ahead and at the time of the uncovering of the problem of forged warehouse receipts related to a large warehouse located in the Chinese port of Qingdao; iii) Show that the Theory of Storage is validated on this new Exchange over the period of analysis, with weaker results when exchange inventories are augmented by stockpiles of metals stored in ‘bonded warehouses’ with duties unpaid and no immediate availability for consumption. These findings may contribute to reinforce in the direction of policy makers messages on the importance of the constant scrutiny of the forward curve changes and the role of warehouse monitoring on the other hand.

1. Introduction

The world metal markets have been marked in the last few years by two categories of events, partly correlated:

- The move towards East of the center of gravity of the trading activity, both of raw materials – with China continuing to increase its share of the world consumption of copper and other metals – and of financial instruments, as reflected by the acquisition for \$1.3 billion of the 136-year old London Metal Exchange by the Hong Kong Exchange, and the growing importance of the Shanghai Futures Exchange. This one, built in 1999, went from being ranked in 2011 the 14th largest derivatives Exchange by volume to the sixth largest one in 2016 (source, Futures Industry Association), with more than 1.6 billion contracts traded per year, *all settled by physical delivery*. Note that, still today, there is no LME- registered warehouse.
- Recent problems involved with warehouses in the US and Europe, where queues in the delivery process at maturity to those who had taken long positions in metal Futures reached unprecedented lengths in some LME – registered warehouses; we refer to the paper by Stevens and Zhang (2016) for a thorough analysis of these events.
- The risks of forgery involved in the current paper form of warehouse

receipts, as exhibited in the so-called ‘Qingdao scandal’ that erupted in June 2014 in a large state-owned bonded warehouse in Eastern China, where the same stockpiles of copper and aluminum were committed multiple times. This crisis was followed by another case of embezzlement related to the Asian warehousing company Access World in March 2017 – in this case, it seems that no metal at all was backing the warehouse receipts. Both events combined led to many hundreds of millions of dollars of losses for major banks involved in trade finance, namely the US bank Citi, the UK-headquartered Standard Chartered, the Australia- New Zealand bank and the French bank Natixis. Trade finance is arguably a useful activity for the world population and Chinese authorities recently expressed their commitment to support and extend the infrastructure around what has been known for a long time as ‘The Silk Road’.

Lending against commodities stored in a warehouse- the modern version of the Monte di Pieta founded in Perugia, Italy, in the 15th century - has been increasingly favoured by banks involved in trade finance, a \$ multi-trillion industry that includes traditional export finance and spans the whole supply chain of commodities, including logistics and shipping, hence central to the world economy. In the early days of the use of commodities as collateral, this one was anything from

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precious metals and stones to grain and rubber. Copper, the world's oldest mined commodity, has the merit of not degrading with time and being storable at a reasonable cost.

Our goal in the paper is to investigate from several perspectives the Chinese copper markets in the period 2008–2015 during which the trading activity of metals on the Shanghai Futures Exchange vastly increased across maturities and forward curves, a key source of information to our view, became available. At the same time, the Chinese economy was growing fast, and so was copper consumption for buildings and electricity networks. In parallel, there was an explosion of so-called Commodity Collateral Financial Deals (CCFDs) involving the use of a metal as collateral to borrow at a preferred rate and invest the proceeds in the high-return housing market. Copper was the main collateral, often stored in ‘bonded warehouses’, state - owned or not, in order not to pay the taxes and duties right at the moment when the metal was imported from Australia or another exporting country.

On a subject close to ours, [Tang and Zhu \(2016\)](#) analyze commodity inventory financing in China through copper, aluminum and six other commodities. Aggregating the official SHFE inventories and the bonded warehouses, they introduce a new ‘Theory of Inventory’ that leads to prices and convenience yields that increase with inventory, in contrast to the ‘Theory of Storage’ of Working (1945) and [Brennan \(1958\)](#), further tested by [Fama and French \(1987\)](#).

The remaining of the paper is as follows. [Section 2](#) provides a description of copper markets in the period 2008–2015 and the use of commodities as collateral. [Section 3](#) discusses the Shanghai Exchange inventories and forward curves, as well as the bonded warehouses’ data. [Section 4](#) recalls in details the Theory of Storage and displays the correlations of forward spreads to different inventory measures. [Section 5](#) concludes the paper.

2. World copper markets

Copper was identified very early on in various parts of the world, from India to Chile and Africa, as a crucial metal, because of its storability and conduction properties. The world copper market, both spot and derivatives, has been very large for a long time. The London Metal Exchange came to existence in 1877, less than 30 years after the Chicago Board of Trade, and has always been the reference place where mining companies and metal consumers would hedge their risks. The COMEX (Commodity Exchange) was founded in New York in 1933 and became in 1974 a major exchange for gold Futures. The LME kept its leading position for the six base metals and developed a network of licensed warehouses over the world (China still does not have any LME/HKEX warehouse on its soil as of today); these warehouses are the place of delivery of the metal for the long positions in Futures held until maturity by large consumers such as car and aircraft manufacturers or producers of aluminum- canned drinks and have to be located in various countries in order to attract to the LME trading orders from all over the world.

By 1985, the copper market was already very large, as reflected by the size of the trading activities made by the Japanese metal trading firm Sumitomo - both in spot and physical trading - that ended in a loss of two billion dollars or more, a large amount of money at the time and today. [Krugman \(1994\)](#) explains that the regulators in charge were difficult to identify between Japan, where the company was based; Britain, where the London Metal Exchange was located and the United States, where much of the copper Sumitomo owned through LME Futures was delivered. All three groups of regulators should have wondered at the time why a Japanese corporation requested *delivery* of very large amounts of Futures - related copper in Long Beach, California; arguably not to help Toyota and Honda produce their cars,

since their manufacturing plants were essentially all based in Japan at the time. Together with forward curves, warehousing issues are the primary focus of this paper.

China emerged as a major consumer of copper over the years

2000–2015. Construction, electricity grids and infrastructure pushed the country's demand for copper rise from 1.8 million tons in 2000 to over 10 million tons in 2015 and account in 2015 for 44% of the world global demand, up from 12% in 2000, according to the World Bureau of Metal Statistics. Construction and infrastructure combined represented 54% of the copper consumption in 2015. The boom of the Chinese construction sector at the beginning of the decade 2010 was illustrated by the famous statement made by Bill Gates in his blog in 2014, that China had consumed more cement over the three years 2011–2013 than the US had over the entire 20th century. An illustration, non-less interesting, pictured two cubes of cement, one small and one very large standing against the Chicago skyscraper outlines and was produced by Rhett Allain in Science, in June 2014.

The financial activity in Chinese metal markets exploded in a parallel manner, through the Futures contracts traded on the Shanghai Futures Exchange, as well as the growth of so-called ‘Commodity Collateral Financial Deals (CCFDs) where Chinese investors would borrow at better rates, to generally invest in the real estate market, against a metal used as collateral and often stored in bonded warehouses after having been imported from Australia for example. As in the case for Bourbon and other alcohols stored in bonded warehouses in Kentucky (USA), the payment of duties and taxes did not take place until the moment when the metal came into the market (or was re-expedited to the producing country if the deal failed).

2.1. Copper spot prices and spot volatility

We display in [Fig. 1](#) the price trajectory of the copper spot price in China over the period 2003–2015. After the sharp decline that followed the financial crisis of 2009, prices rebounded in 2010 and 2011 to levels as high as those of May 2008, with gigantic imports of copper for the Chinese construction and electrification. As of 2012, prices declined continuously (see [Fig. 1](#)), probably because of the reduced pace of growth of the Chinese and world economy.

Volatility - classically computed as the standard deviation of price returns and plotted in [Fig. 2](#) - exhibited in 2008 a large spike similar to the one observed in all commodity markets but was also above 20% during most of the period 2006–2015, and a high volatility of volatility. Changes in volatility are in agreement with the time-varying inventories displayed in [Fig. 3](#) and the Theory of Storage.

3. Chinese copper inventories and shanghai exchange forward curves

3.1. The SHFE inventories

The Shanghai Exchange started trading copper Futures as of 1999; according to the rule followed by any Exchange, the warehouse volumes started being published daily. As a representation of the growing importance of the SHFE compared to the LME in London/ Hong Kong

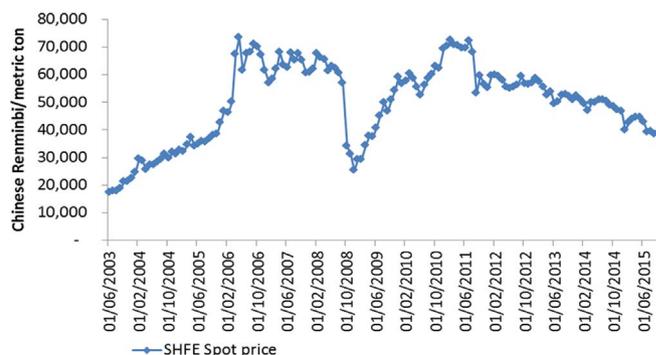


Fig. 1. SHFE spot prices in renminbi/ton over the period 2003 to 2015.

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