The Impact of Chinese Interbank Liquidity Risk on Global Commodity Markets

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ABSTRACT

In this paper, we show that short-term funding liquidity risk in the Chinese interbank system affects global commodity markets. To circumvent capital controls, investors in China engage in commodity financing deals, by importing commodities, collateralizing them, and investing in high-yielding shadow banking products. Previous literature has focused on the interest rate differential between China and global markets to measure the demand for commodities as collateral. We add to the discussion by examining how the risk of shadow banking products affects commodity markets. Specifically, due to maturity mismatch problems of these products, we focus on Chinese short-term interbank funding liquidity risk. We find strong empirical support that this liquidity risk affects commodities futures risk premiums in China and global markets. Moreover, we show that this impact is stronger for metal commodities, which is expected, as metal commodities are better suited as collateral. Our findings provide new evidence on how the financing use of commodities affects the pricing of production assets.

JEL classification: G12, F30, F38, Q02

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I. Introduction

A number of studies (see, for example, Tang and Xiong (2012), Singleton (2013), Cheng, Kirilenko, and Xiong (2014), Henderson, Pearson, and Wang (2014), Sockin and Xiong (2015), and Basak and Pavlova (2016)) show that financial investors affect commodities markets through financial instruments. This is commonly referred to as the financialization of commodity markets.

Tang and Zhu (2016) look at one specific channel for the financialization of commodity markets – the collateral use of commodities in China. Chinese commodity financing deals (CCFDs) are financial instruments designed to circumvent restrictions on capital movements. In a typical CCFD, Chinese investors start the process by importing commodities. Then, these investors obtain loans using the commodities as collateral. The goal of these loans is to invest in high-yielding shadow banking products in China. To hedge their commodity positions, the CCFDs investors use commodity futures markets. Tang and Zhu (2016) show, theoretically and empirically, that CCFDs generate a demand for commodities as collateral. This demand ultimately affects commodity spot prices in China and in global commodity markets. In their empirical setting, they measure the demand for commodities as collateral by the carry trade return. This is simply the hedged currency returns between USD and CNY plus the spread between the 3-month Shanghai interbank loan rate (SHIBOR) and the London interbank loan rate (LIBOR). The intuition is that when the carry trade return is high, the gains from CCFDs are high. Thus, the demand for commodities as collateral increases, which eventually affects commodity spot prices.

We add to the discussion by investigating if risk in the Chinese shadow banking can also affect this demand and, thus, commodity markets. Specifically, the risk we have in mind is short-term funding liquidity risk in the Chinese interbank system. Commercial banks in China play crucial roles in CCFDs: (i) they issue letters of credit that allow commodities imports, (ii) they loan against pledged commodities, and (iii) they provide the unsecured high-yielding shadow banking products. More importantly, these banks in China frequently use the interbank market to resolve maturity mismatch problems of the shadow banking products involved in CCFDs. Thus, an increase in the Chinese interbank liquidity risk may lead to increased risk in CCFDs. This, in turn, reduces the demand for commodities as collateral.

As CCFDs become less attractive due to their risk, there will be less need to hedge commodity positions related to CCFDs. Hence, and according to the theory of normal backwardation (Keynes (1930)), this decrease in the hedging demand for commodities should result in a decrease of commodities futures risk premium.

We empirically test the relation between the short-term interbank liquidity risk in China and commodity futures excess returns for the period starting in October 2006 and ending in March 2016. As a proxy for short-term funding liquidity risk in the Chinese interbank market, we use the weekly spread between the 3-month SHIBOR and the overnight SHIBOR. We compute weekly futures excess returns for sixteen commodities that have active futures contracts in both developed countries (e.g., the United States, the United Kingdom, and Japan) and China. We then investigate how our measure of risk relates to the commodity futures excess returns in developed markets as well as in China.

We find strong supportive evidence that short-term funding liquidity risk in the Chinese interbank system affects commodity markets. First, we find that the weekly spread between the 3-month SHIBOR and the overnight SHIBOR is negatively correlated with the contemporaneous commodity futures excess returns in both developed and Chinese commodity markets. More interestingly, we find that our measure of risk is able to predict next week's commodity futures excess returns, again for both markets. As expected, a week of high risk is followed by a week of negative commodity futures excess returns.

Our results hold when we control for macroeconomic conditions and the Tang and Zhu (2016) proxy for the demand for commodities as collateral. Our measure of risk in the Chinese shadow banking system consistently affects the commodity futures risk premium, while the Tang and Zhu (2016) measure is occasionally not significant or with the wrong sign. Interestingly, we discover interaction effects between the two measures. We find that interbank liquidity risk in China impacts the commodity futures risk premium more severely when the gains from trading CCFDs (as measured by the carry trade return) are low. Whereas in times when the potential gains are high, liquidity risk has less of an impact on the commodity risk premium.

Following Tang and Zhu (2016), we distinguish between metal and nonmetal commodities. If the interbank liquidity risk in China is affecting commodity markets through CCFDs, we should see a stronger effect on metal commodities because their physical characteristics are better suited to be collateral. As expected, we find a much stronger effect of our measure of risk on commodity futures excess returns for the metal commodities than for the nonmetal commodities

Next, we split our sample into two sub-periods: before and after July 2009. The reason to do so is twofold. First, we want to test that our results are not driven by the financial crisis period. Second, there is some anecdotal evidence that CCFDs started to become popular in 2009 onwards. Hence, we expect the relationship between our risk measure and commodity markets to be stronger for the subperiod after July 2009. We find empirical evidence supporting this.

Lastly, we show that the impact of our specific risk measures on the commodity futures risk premium is robust to various types of funding liquidity measures: general funding liquidity risk in the U.S. and in China, longer-term Chinese interbank liquidity risk, and liquidity risk as measured by Chinese repurchase agreement rates. That is, the effect of Chinese interbank markets is limited to the very specific short-term liquidity risk, which is highly relevant in resolving maturity mismatch problems of the shadow banking products. Therefore, our robustness results shed light on the link between the Chinese interbank market and global commodity markets.

Our paper relates to the recent literature on the financialization of commodities. For example, Tang and Xiong (2012) find that commodity markets have become less segmented as the popularity of investments in commodities indexes such as S&P GSCI and DJ-UBSCI have risen since 2004. Singleton (2013) provide evidence that changes in index investors and managed-money spread positions are able to predict excess returns of crude oil futures. The effect is particularly significant in the 2008, when a boom and bust of oil price is observed.[1] Henderson et al. (2014), using commodity-linked notes (CLNs) data, document that there are two channels that affect the commodity futures returns: (i) the issuers' hedging demand for their commodity exposures, (ii) the extent to which they unwind positions at the end of their contracts. Basak and Pavlova (2016), on the other hand, provide a theoretical framework of the relationship between institutional investment flows into commodity indices and commodity futures markets.

Tang and Zhu (2016) present a theoretical model and respective empirical evidence on how commodities are financialized in China due to capital controls and scarce domestic collaterals. They show that higher demand for commodities as collaterals increase commodity spot prices in China and global markets. Our paper complements this theory of commodities as collateral (Tang and Zhu (2016)) by adding the short-term interbank liquidity risk as a new channel that affects the collateral and hedging demand for commodities. In addition, we provide new evidence that Chinese commodity financing deals connect the Chinese commercial banking sector, Chinese shadow banking sector, and global/Chinese commodity futures markets. Our findings provide stronger evidence on the collateral use of commodities as a new channel for the financialization of commodity markets.

Moreover, our evidence on the financialization of commodities gives new insights to the literature on the theory of normal backwardation (see Keynes (1930), Hicks (1946), Stoll (1979), Carter, Rausser, and Schmitz (1983), Chang (1985), Hirshleifer (1988, 1990), Bessembinder (1992), De Roon, Nijman, and Veld (2000), Dewally, Ederington, and Fernando (2013), and

[1] Whereas Büyükahin and Robe (2014) and Hamilton and Wu (2015) find that there is little evidence of the correlated relationship between index traders positions and commodity futures risk premium.

Cheng et al. (2014), among others). Based on the theory of normal backwardation, commodity futures risk premium comes from the commodity producers' demand for hedging against commodity price fluctuations. On the opposite side, speculators are compensated for taking the risk of long positions. While financial investors have been considered as speculators in the recent literature (e.g., Acharya, Lochstoer, and Ramadorai (2013), Etula (2013)), our results show that financial investors also take short positions, thereby adding substantial hedging demand to those already existing hedging demand from commodity producers. This suggests that the hedging demand of financial investors should be additionally considered when studying the commodity futures risk premium.

Lastly, our findings are the first, to our knowledge, to link asset risk premiums and the vulnerability of shadow banking system in China with regard to maturity mismatch. This is related to the one of the main catalysts for the 2007-2008 financial crisis, which was the pervasive maturity mismatch in financial intermediaries' shadow banking securities such as asset-backed commercial papers (ABCPs).[2] Those financial intermediaries who invested long-term assets in short-term debts were exposed to crucial rollover risk. In this environment, a series of events (the defaults of the Bear Sterns and the Lehman Brothers) brought about serious funding liquidity crunches, which burned down the financial intermediaries with maturity mismatch.[3] It impacted the value of all related assets across the world. In the same spirit, our results suggest that market participants should exercise vigilance in the impact of the financial intermediaries with maturity mismatch and their funding liquidity condition in China.

The rest of the paper is organized as follows. Section II describes CCFDs and the connection to the Chinese shadow banking system. Section III provides the details on our data – commodity futures excess returns, the risk measures, and our set of covariates. Section IV then presents our main empirical results and robustness of our results over another set of potentially relevant liquidity risk measures. Section V concludes the paper.

[2]Acharya and Richardson (2009) and Brunnermeier (2009) well document a process of the financial crisis of 2007-2008. Kacperczyk and Schnabl (2010) and Covitz, Liang, and Suarez (2013) document how the collapse of the ABCP market aggravate the financial crisis of 2007-2008.

[3]Acharya, Gale, and Yorulmazer (2011) and He and Xiong (2012) model how a small change in the asset value can impact the crisis when the debt market is made up of sequentially rolled over short-term debts. Brunnermeier and Oehmke (2013) focus on why financial institutions cling to the maturity structure of short-term financing and long-term investing in spite of maturity mismatch risk

II. Chinese Commodity Financing Deals and Chinese Shadow Banking System

In this section, we discuss how potential changes in the conditions of the Chinese shadow banking system can affect the global commodity markets. We first describe the institutional details of CCFDs showing how the Chinese shadow banking system can affect global commodity markets through CCFDs. Next, we discuss that the Chinese shadow banking system is vulnerable to risks in the commercial banking sector. These risks can affect the demand for CCFDs as well as demand for hedging against commodity price risk. This, in turn, impacts commodity futures risk premium in developed markets and China.

A. Chinese Commodity Financing Deals (CCFDs)

There are many variations of CCFDs[4], but here we describe the standard conditions of such deals (for more details on CCFDs, see Layton, Yuan, and Currie (2013), Garvery and Shaw (2014)). For the purpose of this paper, the standard deal is sufficient to illustrate the financial attractiveness and the risks of CCFDs as well as their connection to the Chinese shadow banking. Figure 1 depicts the multiple of a typical CCFD.

The deal is initiated by an investor, usually a commodity importer in China, who contracts to import a commodity into China with an offshore commodity exporter. To guarantee the payment, the investor opens a letter of credit (LC) in US dollars at LIBOR plus spread for a 3-6 months period with an onshore bank. This letter is then issued to the offshore commodity exporter (Step 1). The offshore commodity exporter then sells the commodity by sending a commodity warrant to the investor (Step 2). This gives the owner the right to hold the commodity in a bonded warehouse. Note that this bonded warehouse is outside of the Chinese customs territory. If the investor wants to take advantage of just the price spread between foreign commodity markets and domestic commodity markets, the investor can import the commodity into China and sell it to the domestic markets rather than holding the commodity warrant in the bonded warehouse.[5]

In the standard case, the investor exploits the interest rate differentials between US dollars and Chinese Yuan Renminbi (CNY) by taking the following steps. In Steps 3 and 4, the investor approaches another onshore bank and using the commodity warrant as collateral, acquires a CNY loan.[6] To be precise, the CNY loan is a form of a repurchase agreement

[4]Garvery and Shaw (2014) and Lewis, Hsueh, and Fu (2014) describe various ways in which investors construct CCFDs in practice.

[5]Yuan, Layton, Currie, and Cai (2014a) argue that there are bidirectional trading incentives to capture the spread between London Metal Exchange (LME) and Shanghai Futures Exchange (SHFE).

[6]Commodity inventory has been allowed to use as loan collateral by the new property rights law in

(repo) where the investor sells the commodity warrant to the bank and then repurchases it when the CNY loan expires. The size of the repo CNY loan is the risk-adjusted market value of the pledged commodity.[7] At the same time, the investor hedges against the collateralized commodity price by taking a short position in the commodity futures market (Step 5). In our standard case, the investor will take a short position in the commodity futures market outside of China as the commodity warrant is for commodities in an offshore bonded warehouse.

Step 6 shows how the investor can boost the return from the CCFD. Using this CNY repo funding, the investor makes domestic investments, usually in high-yielding unsecured shadow banking assets such as wealth management products (WMPs). WMPs are composed of pooled time-deposit accounts to invest in a variety of assets, such as bonds, trust products, repurchase agreements, real estate loans, private equity funds, and local government financing vehicles (LGFVs) loans, providing the main source of credit to nonbank credit intermediaries such as trust companies, brokerage firms, guarantee companies, and unofficial lenders. Higher returns of WMPs (over 5% on average in 2014) than capped deposit interest rates (ranged 2-3% in 2014) attract investors to WMPs. (Perry and Weltewitz (2015))

Before the CNY loan matures, the investor pays it off from the proceeds of the WMPs (Steps 7 and 8). The investor then liquidates the commodity warrant and finishes the commodity financing deal by paying off the initial letter of credit (Step 9). This one cycle of the standard CCFD can be repeated many times. Layton et al. (2013) presume the investor repeats one cycle of CCFDs 10-30 times during a 6-month period.

The financial attractiveness of CCFDs is twofold. First, CCFDs can provide high returns. According to Garvery and Shaw (2014), the investor can earn about an 11% return over a 6-month period with the standard CCFDs. Layton et al. (2013) estimate that the interest rate arbitrage from trading LME copper using CCFDs is at least 3.5% over six months. This is a conservative estimate given that they do not consider investing in high-yielding unsecured assets in China. Ultimately, CCFDs allow investors to capture the interest difference between the domestic market (high) and foreign market (low) that is derived from capital controls in China.

The second advantage of CCFDs is the access to cheaper financing. Chinese companies that cannot access formal lending channels due to poor collateral quality can engage in CCFDs to get better financing conditions. For instance, Zhang (2012) reports that the lending rate of informal financing for small and medium enterprises in the city Wenzhou was

China that went into effect on October 1, 2007. The new property rights law made it possible to use movable properties such as accounts receivables and inventories as collateral. For additional information of the China's property rights law reform, see Marechal, Tekin, and Guliyeva (2009).

[7] The risk-adjusted market value is obtained by the difference between the market value of the pledged commodity (%) and the repo margin (haircut) (%).

24.4% in mid-2011. Ping (2013) notes that the average lending rates of banks for micro and small enterprises in 2012 were 20-40 percentage points higher than the interbank benchmark lending rates. Furthermore, CCFDs not only provide the access to cheaper financing but also resolve urgent liquidity needs. In sum, the seemingly profitable returns of the CCFDs, as well as the demand for extra liquidity circumventing capital controls, drive the collateral and hedging demand for commodities.

One potential concern is whether CCFDs are prevalent enough to have a sizeable impact on commodity markets. While Tang and Zhu (2016) empirically prove that the collateral demand for commodities affects the commodity prices in developed markets and China, there are also some anecdotal evidence worth some attention. Yuan, Layton, Currie, and Courvalin (2014b) estimate that, in 2013, about 31% of China's total FX short-term debts are related to CCFDs (the LC in Step 1). Tang and Zhu (2016) estimate that, in 2012, 5.7% of China's annual copper demand (or, equivalently, 2.4% of the world's copper demand) is linked to CCFDs. Taking into account the cases of multiple CCFDs with one commodity warrant, these estimates can be conservative. Moreover, there are several events which show that the Chinese regulators and banks are concerned about the ramifications of CCFDs on the financial markets. For example, in May, 2013, the State Administration of Foreign Exchange in China announced that they would start to limit banks' short positions, while thoroughly monitoring the details of the commodity transactions of the importing/exporting companies.[8] The culminating event was the Qingdao port probe in 2014 and the following crackdown on commodity financing by Chinese authorities, which investigated fake copper warehouse receipts made for multiple loans. These fraudulent practices hit many global banks such as HSBC, Standard Chartered, Citi, and others. In addition, copper prices in London fell for a few weeks after the report of the probe.[9] As a result, banks largely exposed to CCFDs in terms of CNY loans pledged by commodities saw the quality of their collateral deteriorate due to the plunging of commodity prices.[10]

B. Risks in Chinese Interbank Market and Shadow Banking, and Their Impact on CCFDs and Commodity Futures Markets

As described above, in one cycle of the typical CCFD, the final return from CCFDs can be decomposed into two parts: (i) the difference between the return from the domestic

[8] S. Rabinovitch, "China to crack down on faked export deals", Financial Times, May 6, 2013.

[9] L. Hornby, "China probe sparks metals stocks scramble", Financial Times, June 10, 2014. X. Rice and L. Hornby, "Ripples spread from China metals probe", June 12, 2014.

[10] C. Sau-wai, "Commodity financing exposure in Asia-Pacific hits banks hard", South China Morning Post, January 25, 2015.

investment and the interest rate of the USD loan, and (ii) appreciation of CNY. If the domestic investment is made in the riskless assets such as government bonds, the return will closely follow the usual carry trade return. However, the domestic investments in CCFDs are usually made in shadow banking products, which are high-yielding unsecured assets that cannot be hedged. Therefore, the risks in the shadow banking sector can be another important driving factor of the collateral demand for commodities and subsequent demand for hedging.

For example, on March 5, 2014, a relatively small Chinese solar equipment producer, Shanghai Chaori Solar unexpectedly defaulted on its corporate bonds. Over the next week copper futures price in LME plunged by 8.9%. The tumble in copper price is likely to be the result of investors reevaluating default risk of shadow banking products due to the first Chinese corporate bond default. The perceived higher risk might have reduced the demand for copper as collateral, hence copper price dropped.

Moreover, commodity futures risk premium can also be affected by the risks in the shadow banking sector through the CCFDs channel. When the collateral demand for commodities decreases due to higher risk in the shadow banking sector, the investors' demand for hedging against commodity prices declines. This leads to a decline in the commodity futures risk premium according to the theory of normal backwardation. This decline in the futures premium should be observed both in China and other global markets as the investors can hedge in either market depending on the location of their warranted commodities. Investors are likely to hedge in global markets if they do the standard CCFDs, while they are likely to hedge in the Chinese futures market if they do some variations of CCFDs which use commodities stocked in China.

What then constitutes risks in the Chinese shadow banking system? We discuss now that the maturity mismatch risk in WMPs, which is linked to the liquidity risk in the interbank money market, is a major risk in the Chinese shadow banking system (Elliott, Kroeber, and Qiao (2015) and Li (2014)). Since most of the WMPs expire ahead of the underlying assets[11], the issuers, typically the commercial banks and trust companies, are exposed to a maturity mismatch risk and have to frequently roll over WMPs. The maturity mismatch risk brings about an urgent liquidity problem to pay back the principal and interests or to patch up some defaulted underlying assets. It was reported by a local press that about 27-29 trillion yuan, about 55% of GDP in 2012, was at maturity mismatch risk in the Chinese shadow banking system in 2012.[12]

[11] According to Li (2014), about 80% of bank-issued WMPs have their maturity shorter than 6-month in 2012.

[12] W. Lihua, "Nearly 30 trillion shadow banking mismatches accumulate", Economic Information Network, January 30, 2013.

The liquidity or default problems in WMPs then should be resolved in the interbank money market.[13] This is because commercial banks are heavily involved in the operation and management of WMPs. The commercial banks directly issue to investors and manage WMPs (pure bank WMPs) or sell WMPs to trust companies (bank-trust cooperation WMPs). Even in the latter case, the banks conventionally enter into repurchase agreements in the WMPs. According to Perry and Weltewitz (2015), outstanding WMPs as of June 30th, 2014 which account for 17.2 trillion CNY, consist of pure bank WMPs (11%), direct bank-trust cooperation WMPs (16%), indirect bank-trust cooperation WMPs (9%), collective trust products (19%), and other channel WMPs (45%). Except for the collective trust products, the commercial banks are to manage risks of the other three types of the WMPs which account about 81% of all the WMPs. In short, liquidity problems in the interbank money market can lead to defaults in WMPs, which make the shadow banking system vulnerable and, ultimately, affecting the commodity markets through CCFDs.

It may be helpful to note that WMPs are quite similar to asset-backed commercial paper (ABCP) conduits in their asset compositions: the ABCP conduits are composed of medium- to long-terms assets funded by short-term asset-backed commercial papers, and WMPs are composed of medium to long-term assets funded by pooled time deposit accounts. Due to their composition structures with short-term debts, both ABCP and WMP bear maturity mismatch risks. This maturity mismatch risk was the main reason why ABCP aggravated the financial crisis of 2007-2008 (Covitz et al. (2013), Goldsmith-Pinkham and Yorulmazer (2010), and Gorton and Metrick (2012)).

In sum, CCFDs create interconnections between Chinese shadow banking system, Chinese interbank market, and global commodity markets. The vulnerability of the shadow banking system heavily depends on the liquidity in the interbank money market. If banks cannot resolve maturity mismatch of WMPs in the interbank money market, the shadow banking sector faces higher default risk. Increased risk in the banking system can make the system more vulnerable, which would then decrease the demand for CCFDs and, hence, demand for commodities as collateral. Furthermore, when the interbank market is unstable, banks would downsize the CNY loans backed by commodity collaterals or at least reluctant to enlarge their CNY loan positions. All the reactions converge to decrease the investor's hedging position (short the commodity futures) in the commodity futures markets. This eventually leads to decline in commodity futures risk premium.

[13] "China's banks: Ten days in June", July 6 2013, The Economist, reports "...Wealth-management products raise money, mostly from better-off individuals, for fixed periods (often less than six months). The cash is invested in a variety of assets, some of them riskier than others. These products added to the cash crunch because they often matured before the underlying assets did. The banks grew used to borrowing money in the interbank market to redeem maturing products until they could sell new ones..."

III. Data

A. Proxy variables for the risk of the Chinese interbank market

We use the spread between the 3-month SHIBOR and the overnight SHIBOR as a main proxy for the short-term interbank liquidity risk in China. A large spread between the 3-month SHIBOR and the overnight SHIBOR indicates that it is harder for a bank to borrow from other banks. This, in turn, can make the shadow banking system unstable due to the maturity mismatch risk in WMPs. Ultimately this leads to a decrease in the collateral and hedging demand for commodities.

Large spreads between the 3-month SHIBOR and the overnight SHIBOR indicate problems for the Chinese shadow banking system. However, a negative spread might also be problematic and this has happened a few times in China. The Chinese interbank money market is not fully mature and a sudden freeze in the short term interbank money market can lead to a moment of market failure. This leads to a negative spread in the interbank money market.[14] For example, China Everbright Bank Co. Ltd., China's 11th largest bank by assets, announced that they defaulted on the 6.5 billion yuan overnight loan from China Industrial Bank Co. Ltd. on June 5th, 2013. At the end of the week, the spread between the 3-month SHIBOR and the overnight SHIBOR was -3.72. The negative spread continued for the following two weeks.[15]

To address this issue, from the spread between the 3-month and the overnight SHIBOR, we construct two proxy variables, *Slope* and *Negative Dummy*. If the spread is positive, *Slope* is defined to be the difference between the 3-month and the overnight SHIBOR and *Negative Dummy* is set to 0. Conversely, if the spread is negative, *Slope* becomes 0 and *Negative Dummy* is set to 1.[16]

Figure 2 shows *Slope* and *Negative Dummy* from October, 2006 to March, 2016. During this period, the spread between the 3-month SHIBOR and the overnight SHIBOR was negative for 19 times. In other words, our *Negative Dummy* has a value of 1 for 19 weeks. A series of *Negative Dummy* in the middle of 2013 shows the overnight loan default of the

[14] There was a view that those market failures were intended by the Chinese government to raise the alarm over the commercial banks' moral hazard. See "Re-education through SHIBOR", June 29th, 2013, The Economist and Farhi and Tirole (2012).

[15] D. McMahon, "China Everbright Admits to Interbank-Loan Default", The Wall Street Journal, December 16, 2013. M. Zhang. "China Everbright Bank Co. Ltd (SHA:601818) 'Admits' To 6.5 Billion Yuan Interbank Loan Default", International Business Times, December 16, 2013

[16] Our methodology follows Fama and French (1992) who use a positive earnings ratio and a negative dummy for negative ratios. As a robustness, we have used the original difference between 3-month SHIBOR and the overnight SHIBOR as our main proxy for short-term liquidity risk and also absolute value of the difference. The findings presented in the paper are robust to these different measures.

China Everbright Bank.

B. Commodity futures excess returns, basis, and aggregate controls

We obtain commodity futures end-of-week prices from October 9th, 2006 to March 25th, 2016 from Datastream.[17]

To compare similar sets of commodities across markets and following Tang and Zhu (2016) we only keep commodities that have active futures contracts in both developed countries (e.g., the United States, the United Kingdom, and Japan) and China.[18] We end up with sixteen commodities, which we divide into the metal group (aluminum, copper, lead, zinc, gold, and silver) and the nonmetal group (corn, soybeans, soybean meal, soybean oil, wheat, cotton, palm oil, rubber, sugar, and fuel oil).

Next, for each commodity, we compute futures excess returns and basis following Gorton and Rouwenhorst (2006) and Gorton, Hayashi, and Rouwenhorst (2013). To be precise, the excess return of commodity futures i over week t to week $t+1$, $Excess\ Return^i_{t+1}$, is given as follows:

$$Excess\ Return^i_{t+1} = \frac{F^i_{t+1,T_1} - F^i_{t,T_1}}{F^i_{t,T_1}}, \tag{1}$$

where F^i_{t,T_1} is the price of the nearest futures of the commodity i (among the futures contracts that do not expire during the next month) at the end of week t with the expiration date T_1. Note that we only use futures prices from the leading exchanges in developed markets and in China.

Fama and French (1987), Gorton and Rouwenhorst (2006), Singleton (2013), and Hong and Yogo (2012) use the basis as a proxy for convenience yield or as a control for the effect of the hedging pressure hypothesis. Furthermore, Yang (2013), Szymanowska, Roon, Nijman, and Goorbergh (2014), and **?** among others show that the basis has predictive power for commodity futures risk premiums. Hence, we include the basis as a commodity-specific control and construct the annual basis for commodity i in week t, $Basis^i_t$, as

$$Basis^i_t = \frac{F^i_{t,T_1} - F^i_{t,T_2}}{F^i_{t,T_2}} \times \frac{365}{D^i_{t,T_2} - D^i_{t,T_1}}, \tag{2}$$

where F^i_{t,T_2} is the price of the second nearest commodity futures contract at the end of week t with the expiration date T_2, and D^i_{t,T_1} and D^i_{t,T_2} are the remaining days of each futures

[17] The beginning of our sample period is restricted by the availability of SHIBOR data.

[18] One exception is fuel oil futures that are available only in China. We do not drop this commodity as we use CME heating oil futures to proxy the fuel oil futures in developed markets. This seems reasonable as fuel oil is one type of heating oil.

until the last trading date.

We also control for the currency-hedged carry trade returns which Tang and Zhu (2016) used as a proxy for the collateral demand for commodities. The currency-hedged carry trade returns are calculated as the sum of (1) the interest rate difference between the 3-month SHIBOR and 3-month LIBOR and (2) the hedged currency returns from the official USD-CNY spot exchange rate and the USD-CNY 3-month nondeliverable forward (NDF) exchange rate. We call the currency-hedged carry trade returns as *TZ*. Figure 3 shows the evolution of *TZ* during our sample period.

Note that *TZ* assumes investing in the safe domestic interbank market rather than in the high-yielding shadow banking products. Hence, *TZ* could be seen as a conservative measure of potential returns from CCFDs, and, thereby, of the collateral demand for commodities. However, and more importantly, *TZ* ignores any considerations about risk in the Chinese shadow banking system. To be precise, we expect that *TZ* overestimates the collateral demand for commodities in periods of high risk.

We include macroeconomic fundamentals as control variables to ensure that the effect of our interbank liquidity risk measures is not driven from macroeconomic conditions. General economic conditions affect both commodity producers' and speculators' fundamental hedging demand, thereby affecting the commodity futures risk premium.[19]

Following Tang and Xiong (2012), Acharya et al. (2013), Singleton (2013), and Henderson et al. (2014), we include *MSCI* – the difference between MSCI Emerging Markets Asia Index weekly return and the weekly USD LIBOR. This captures the growth of emerging Asian economies. In the same spirit, we control for the excess returns of developed countries with *SPX* – the difference between the weekly return of the S&P 500 index and the weekly USD LIBOR. As Tang and Xiong (2012), we add the returns to the U.S. Dollar Index futures. This controls for fluctuations in commodity prices due to changes in exchange rates. Following Bakshi, Panayotov, and Skoulakis (2011), we use the log changes in the Baltic Dry Index (BDI) to proxy for the aggregated commodity demand.

Lastly, we add controls for general funding liquidity shocks from global markets. These can have an impact on assets' risk premium (Brunnermeier, Nagel, and Pedersen (2008), Asness, Moskowitz, and Pedersen (2013), and Gârleanu and Pedersen (2013)). We use two common liquidity risk measures in the literature: (i) the TED spread, which is the difference between the 3-month Eurodollars and the 3-month Treasury Bill; (ii) the LIBOR-Repo spread, which is the spread between the 3-month USD LIBOR and the 3-month USD term

[19]Concerning the speculators' reactions to macroeconomic fundamentals, Acharya et al. (2013) note that the commodity risk premium is related to equity holders' marginal rate of intertemporal substitution. Singleton (2013) considers cross-market trading strategies between equity and commodity markets.

repurchase agreement rate.

Table I shows the summary statistics for *Slope* and *Negative Dummy*, weekly excess returns and annual basis of aggregate commodities (all, metals, and nonmetals), and for our control variables.[20] During the sample period, the excess returns of all of the commodities, *MSCI*, and *SPX* are statistically indifferent from 0, and most of the commodities are in contango, as they have a negative basis on average. Consistent with the theory of storage and Fama and French (1987) and Gorton et al. (2013), the standard deviation of basis is lower for more storable commodities such as metals than nonmetals. It is also noteworthy that the 3-month currency-hedged carry trade returns (TZ) show 0.72% quarterly excess returns on average. This is fairly high, and it suggests that CCFDs have been quite lucrative since the carry trade return is a conservative estimate of the returns from CCFDs.

IV. Empirical Evidence

In this section, we test if our proxies for the short-term interbank liquidity risk in China, *Slope* and *Negative Dummy* have an impact on the commodity futures risk premium. Following Hong and Yogo (2012), Acharya et al. (2013), and Singleton (2013), we test if our measures predict next week's commodity futures excess returns. We also examine the contemporaneous relationship between our proxies and commodity futures excess returns. This is done both for the developed and for the Chinese markets. Next, we run a separate analysis for metal commodities and non-metal commodities, as we expect short-term interbank liquidity risk to have a stronger impact on metals. Lastly, we present two tests to check the robustness of our results. First, we show that our results are stronger when CCFDs were reported to be more prevalent. Second, we show that short-term interbank liquidity risk affects commodity futures risk premium even after controlling for a battery of general funding liquidity risk measures.

A. Commodity futures excess returns by market

We start our empirical analysis by looking into the commodity futures risk premium in the developed markets with all commodities (aluminum, copper, lead, zinc, gold, silver, corn, soybeans, soybean meal, soybean oil, wheat, cotton, palm oil, rubber, sugar, and heating oil[21]). We do so by regressing commodity futures excess returns for week $t+1$ of commodity i onto our variables of interest, *Slope* and *Negative Dummy* while controlling for the *Basis*

[20] The summary statistics for each individual commodity are shown in Table A1.
[21] This corresponds to the fuel oil in the Chinese commodity futures market.

of each commodity as follows:

$$Excess\ Returns^i_{t+1} = \beta_0 + \beta_1 Slope_t + \beta_2 Negative\ Dummy_t + \beta_3 Basis^i_t + \gamma X_t + \epsilon^i_{t+1}, \quad (3)$$

where X_t is a vector of aggregate control variables including TZ and ϵ^i_{t+1} is an error term. We repeat the exercise with the contemporaneous excess returns instead of one-week ahead excess returns:

$$Excess\ Returns^i_t = \beta_0 + \beta_1 Slope_t + \beta_2 Negative\ Dummy_t + \beta_3 Basis^i_t + \gamma X_t + \epsilon^i_t. \quad (4)$$

In both regressions, we perform a panel regression including individual commodity fixed effects and an AR(1) disturbance. Table II shows the regression results for developed markets: Panel A presents the predictive regression results while Panel B shows the contemporaneous results.

In columns (1) and (5) of Table II where we do not have any aggregate controls, we see that the estimate on *Slope* is, as expected, negative and statistically significant at the 1% level. An increase of 78 basis points of *Slope* (one standard deviation of *Slope*) predicts a decrease of 0.31 percentage points (0.78×0.40) in next week's commodities futures excess returns. This translates to a decrease of 16.2 percentage points annually. This is in line with our expectation that the short-term interbank liquidity risk in China negatively impacts commodity futures risk premiums. The effect of *Slope* is virtually the same for contemporaneous excess returns. Note that *Negative Dummy*, however, is not significant.

In columns (2) and (6) we include *TZ*, the proxy for collateral demand in Tang and Zhu (2016), to check whether our measures contain the same information as *TZ*. We find that the estimates on *Slope* continue significant and are even bigger in magnitude, in particular for the contemporaneous regression. The effect of *TZ* is positive as expected, as an increase in the potential returns of CCFDs leads to an increase of the collateral and hedging demand for commodities, thereby, enhancing commodity futures premiums. Interestingly, the effect of *Negative Dummy* is negative and statistically significant for the contemporaneous excess returns which again suggests that our measures are capturing something different from *TZ*.

Next in columns (3) and (7), we investigate potential interactions between *TZ* and *Slope*. For example, it is interesting to check if commodity futures risk premiums are more severely affected by the risk in the Chinese shadow banking system when potential CCFD returns are low (when *TZ* is low). Alternatively, short-term interbank liquidity risk might be less important when potential CCFD returns are high. To test this, we add interaction terms for *TZ* and *Slope*. To be specific, we add *Slope* × *Low TZ* and *Slope* × *High TZ*. *Slope* × *Low TZ* equals *Slope* if *TZ* in that particular week is in the bottom quartile of the *TZ* distribution. We define *Slope* × *High TZ* analogously. The results show that, as before, our measure *Slope* remains strongly significant statistically and economically, both in predictive and contemporaneous regressions. This means that in normal times of *TZ* (neither low or high CCFDs potential returns), short-term interbank liquidity risk affects commodities futures risk premiums. Note that *TZ* is significant in the contemporaneous regression, but loses its significance in the predictive regression. Results in column (3) show that the estimate on *Slope* × *Low TZ* for the predictive regression is negative and statistically significant. This suggests that the short-term interbank liquidity risk in China, as expected, affects the commodity futures risk premium more severely when the estimated gains from trading CCFDs are low. On the other hand, the coefficient on *Slope* × *High TZ* is positive. This supports an alleviating effect of high CCFD returns over the risk in the short-term interbank market. Note that this alleviating effect does not cancel the overall effect of *Slope*, since the estimate on *Slope* is −0.44 while the estimate of textitSlope × High TZ is 0.17. We do not find the same pattern for the contemporaneous regression in column (7), as both interaction terms are insignificant.

Our results so far suggest that our measures of the short-term interbank liquidity risk have quite substantial impacts on the commodity futures risk premium. A natural concern to this interpretation is that our measures are simply correlated with fundamental macroeconomic variables that naturally affect the commodity futures risk premium. To alleviate this concern, we add a set of control variables as described in Section III.B: *MSCI*, *SPX*, *DXY*, *BDI*, *TED spread* and *LIBOR-Repo spread* (see Table I for descriptions). Column (4) shows that the estimates on *Slope* and *Slope* × *Low TZ* are roughly the same as before after controlling for the macroeconomic fundamentals. Surprisingly, *TZ* now has a negative effect, which might indicate that some of the information in *TZ* is captured by the macro variables. For the contemporaneous returns, we find in column (8) that the estimate on *Slope* drops to -0.27 but remains significant. Looking at the estimate of *Slope* × *High TZ* it is now significant and equal to 0.29. This implies that when the potential return from CCFDs is high enough, the interbank liquidity risk in China does not affect the contemporaneous commodity futures excess returns.

In summary, Table II shows that our measures of the short-term interbank liquidity risk in China have an impact on the commodity futures risk premiums in developed markets. The interbank liquidity risk has the predictive power as well as the explanatory power for commodity futures excess returns. The impact of our measures remains strong after controlling for the collateral demand proxy in Tang and Zhu (2016) and fundamental macroeconomic variables. We also find an interesting interaction between our measure of risk and the measure of potential CCFD returns used in Tang and Zhu (2016). When the potential CCFD returns are low, the Chinese interbank liquidity risk affects more significantly next week's commodity futures excess returns. When the potential CCFD returns are high, the negative impact of risk on next week's commodity futures excess returns is reduced.

We next turn our attention to the effects on commodity futures markets in China. Table III shows our results on the same set of regressions as in the developed markets. All eight estimates on *Slope* are negative and statistically significant at the 1% level. Interestingly, columns (1) to (4) show that *Negative Dummy* is statistically and economically significant when predicting the commodity futures risk premium. For example, column (4) shows that weeks when the spread between 3-month SHIBOR and the overnight SHIBOR is negative are followed by a decrease in the following week of 0.45 pps futures excess returns. These rare events seem to be very important when predicting the commodity futures risk premiums in Chinese markets. For contemporaneous commodity futures excess returns, this effect does not hold when macroeconomic conditions are controlled for. This suggests that these 19 weeks of the negative spread between 3-month SHIBOR and the overnight SHIBOR are highly correlated with overall bad economic conditions.

Focusing on columns (4) and (8), the results show the same pattern of estimates for *Slope* × *Low TZ* and *Slope* × *High TZ* as in developed markets. However, the magnitude of the impact of *Slope* seems to be smaller for China. For example, column (4) shows that the overall impact of *Slope* when *TZ* is low on next week's excess returns in China is -0.66 percentage points (-0.33 +(-0.33)). For developed markets, this estimate is -0.91 percentage point (-0.47 + (-0.44)).

We conclude that an increase in liquidity risk in the Chinese interbank system decreases the commodity futures risk premiums in both developed markets and in China. In contrast, Tang and Zhu (2016) predict that when the demand for CCFDs decreases, commodity futures risk premium should increase in developed markets and decrease in China. This is because, in their theoretical model, investors hedge their commodity positions only in the Chinese market. In reality, however, investors can also hedge in developed markets, which might explain why we find that the short-term interbank liquidity risk has a negative impact on both markets. Moreover, Tang and Zhu (2016) do not find any empirical evidence on the impact of *TZ* on commodity futures risk premium [22], but only on spot prices. Looking at Tables II and III, we find that *TZ* is only relevant when interacted with *Slope*. This is strong evidence that *TZ* cannot solely capture the demand for CCFDs and our measures of interbank liquidity risk can be an important determinant of such demand.

[22] Tang and Zhu (2016) say that it may be due to the joint hypothesis test of the theory of normal backwardation and their theory of commodity as collateral. They argue that the theory of normal backwardation lacks the empirical evidence on the commodity risk premium.

One may argue that our measures of the short-term interbank liquidity risk capture other factors of the commodity risk premium rather than the demand for CCFDs. For example, the interbank liquidity risk may show a fundamental commodity producer's default risk (Acharya et al. (2013)). If the interbank liquidity risk affects the producer's default risk, the commodity producer's fundamental hedging demand would increase when the risk is high. This would imply an increase in the commodity futures risk premium – this is opposite to what we find. We can also consider the cases when the interbank liquidity risk captures the risk aversion (Etula (2013) and Adrian, Etula, and Muir (2014)) or the capital risk (He, Kelly, and Manela (2017)) of a financial intermediary as a marginal investor. When the interbank liquidity risk goes up, either the risk aversion or the capital risk of a financial intermediary as a marginal investor also goes up. However, the financial intermediary as a marginal investor plays a role of a speculator in commodity futures markets. This implies that the financial intermediary's capacity of taking risk decreases. Thus, according to this story, the commodity futures risk premium should increase when the interbank liquidity risk increases, which, again, is contrary to our findings.

B. Commodity futures excess returns – metals vs. nonmetals

Next, we examine whether the effect of the short-term interbank liquidity risk differs for metal and nonmetal commodities. We expect that the interbank liquidity risk should impact the risk premium of metal commodities more severely than nonmetal commodities because metals are better suited as collateral. Metals are a better medium of CCFDs than nonmetals due to their storability and lower volume per value. Metals in our data include aluminum, copper, lead, zinc, gold, and silver, while nonmetals include corn, soybeans, soybean meal, soybean oil, wheat, cotton, palm oil, rubber, sugar, and heating/fuel oil. As before, regressions include fixed effects at the individual commodity level and an AR(1) disturbance.

We first look at the impact of our measures *Slope* and *Negative Dummy* on the commodity futures excess returns of the metal group and nonmetal group each by running predictive and contemporaneous regressions for developed markets. We then repeat the exercise for the Chinese market. In Table IV, columns (1) to (4) present the predictive regression results for the metals in developed markets. Results for the nonmetals are shown in columns (5) to (8). Lastly, in column (9) we test for differences in the effect of the interbank liquidity risk between metals and nonmetals by having the dummy for metal commodities interacted with our measures *Slope* and *Negative Dummy*.

First, consistent with our results in the previous subsection, for all nine specifications

Slope is significant at the 1% level. Second, we indeed find that our measures of the interbank liquidity risk affect the futures risk premium of metal commodities more severely than nonmetal commodities. Comparing the coefficients of *Slope* in metals and nonmetals, we find that these are more negative for metal commodities than nonmetal commodities. More importantly, in column (9) we see that the coefficient on the interaction term *Metals* × *Slope* is -0.31 and statistically significant at the 5% level. Economically, this is a very significant effect given that the estimate on *Slope* is -0.35. In other words, the impact of the interbank liquidity risk for metal commodities is twice as much as for nonmetal commodities. Third, we find that the aggravating effect of low *TZ* is stronger for metals than for nonmetals. The coefficient on the interaction term *Slope* × *Low TZ* for metals is estimated to be larger than for nonmetals (-0.75 from column (4) vs. -0.27 from column (8)). This means that when the currency hedged carry trade returns are low (low *TZ*), a deterioration of the interbank liquidity condition is twice more severe for metal commodities than nonmetal commodities – -1.38 (-0.63-0.75) vs. -0.65 (-0.38-0.27). The alleviating effect of high *TZ* is about the same in the absolute size between metals and nonmetals. This leads to a significant effect of the short-term interbank liquidity risk for metals and a weak effect for nonmetals (-0.30 vs. -0.06) when *TZ* is low.

We do the same analysis for contemporaneous commodity futures excess returns in developed markets. Table V presents, overall, the same picture as Table IV. Specifically, the estimates on *Slope* are more negative for metal commodities than for nonmetals. Moreover, in column (9) we see again that this difference is statistically significant at the 5% level and economically significant – the estimate on *Metals* × *Slope* is -0.29. The only difference between the results in Table IV and Table V is that now the interaction term, Slope × Low TZ, is not statistically significant.

Next, we repeat the exercise for Chinese markets. Table VI, which presents the panel regression results for predicting one-week ahead commodity futures excess returns, again provide supporting evidence for our hypothesis. As before, *Slope* estimates in all columns are statistically significant at 1% level, and the estimates in columns (1) to (4) are larger in absolute value than the ones in columns (5) to (8). However, in column (9) this difference is not statistically significant as shown by the estimate on *Metals* × *Slope*. We again observe that *Slope* × *Low TZ* has a statistically significant effect in the predictive regressions. Moreover, *Slope* × *Low TZ* has the stronger effect in metals futures excess returns than in nonmetals returns (-0.46 vs. -0.28).

Interestingly, *Negative Dummy* plays a role in Chinese markets as shown in Table VI. *Negative Dummy* is statistically significant at 1% level in all specifications of metals but none of the nonmetals. In column (9), the interaction term *Metals* × *Negative Dummy* is also significant. Overall, Table VI provides evidence that our measures of the Chinese interbank liquidity risk predict the risk premium in Chinese commodity futures markets, and the predictive power of the interbank liquidity risk is very strong when the Chinese interbank market faces the moment of market failure, measured by *Negative Dummy*.

Table VII completes the picture by showing the regression results for contemporaneous commodity futures excess returns in China. *Slope* estimates in all columns are statistically significant at 1% level. Contrary to the previous results, we do not find any differences between metals and nonmetals in the contemporaneous effect of *Slope* or *Negative Dummy*.

In summary, the predictive power of Chinese interbank liquidity risk on commodity futures risk premium is larger for metals than nonmetals. This is valid for commodities in developed markets, as well as in Chinese markets. Our findings reveal the same pattern as Tang and Zhu (2016) as they find that the demand for CCFDs measured by *TZ* is more relevant to metals than nonmetals in both developed markets and China.

C. Robustness tests

In this section, we perform two additional tests to check the robustness of our results. First, we examine whether our results are stronger when CCFDs were reported to be more prevalent. Second, we introduce additional controls for general funding liquidity risk in China and in the global markets to show that it is the Chinese short-term interbank liquidity risk, not other general liquidity conditions in the market, that affects commodity futures risk premiums.

There are several signs that the degree of CCFDs activity has soared since 2009. For example, copper bonded warehouse inventory and short-term foreign currency lending in China have increased five times since 2009 (Layton et al. (2013)). And the value of gold imports from Hong Kong into China, which is considered to be used in gold financing deals, has increased more than 10 times since 2009 (Yuan et al. (2014a)). Given so, we split our sample into two subperiods, recognizing that we do not have direct evidence of when exactly CCFDs became popular. We decide to define the subperiods as during and after the recent global financial crisis so that we can also address the potential concern that our results may be driven by some comovement or contagion effect across different financial sectors during the recent financial crisis (Aloui, Aïssa, and Nguyen (2011), Reinhart and Rogoff (2008), and Longstaff (2010)). Specifically, we define a dummy variable *Non-crisis* to be equal to 1 if it is after July 3rd, 2009 following the Business Cycle Dating Committee of the National Bureau of Economic Research (NBER)[23], and 0 otherwise.

[23] http://www.nber.org/cycles.html

We then repeat the same set of panel regressions as performed in Table II and III adding interaction terms of the *Non-crisis* dummy variable with *Slope* and *Negative Dummy*. If indeed CCFDs are more popular after 2009, we would expect a negative coefficient for the interaction terms. Table VIII presents the results of the regression with the full set of controls, confirming our expectations.

Column (1) of Table VIII presents the regression results of forecasting commodity futures excess returns in developed markets. We first see that the predictive power of *Slope* exists only after the crisis. The coefficient on *Slope* for the crisis period is not significant, whereas the coefficient on *Non-crisis* $\times$ *Slope* is -0.63 and statistically significant at 1% level. Interestingly, *Negative Dummy* is both significant in the unpopular and popular periods of CCFDs. While the positive significance of *Negative Dummy* during the crisis is puzzling, after the crisis it is negative as expected.

More puzzling are the results of *TZ*. During the crisis, its effect is unexpectedly negative with a magnitude almost twice as large as the post-crisis period. The same holds true for the aggravating and alleviating effects of *TZ*: the magnitude of the effects are bigger during the crisis than the post-crisis period. This suggests that the impact of *TZ* on commodity futures risk premiums is largely driven by the crisis period when the CCFDs are thought not to be a popular practice.

We find quite similar results in the contemporaneous relationship, shown in the column (2) of Table VIII. Our measures of the short-term interbank liquidity risk, *Slope* and *Negative Dummy*, show the stronger contemporaneous relationship with the commodity futures excess returns after the crisis than before. The Chinese market results in columns (3) and (4) also confirm the stronger impacts of the short-term interbank liquidity risk on the commodity futures excess returns after the crisis.

In short, we conclude that the short-term interbank liquidity risk strongly affects the commodity risk premiums since 2009, the period when we believe that CCFDs started to become a popular practice. Furthermore, this provides strong evidence that our main results are not driven by contagion effects during the recent global financial crisis.

Next, we test for the robustness of our results to various other funding liquidity measures. Recall that in our previous regressions with the full set of controls, we included the TED spread and the LIBOR-repo to control for general funding liquidity shocks from global markets. In this section, we first add two liquidity measures to control for other types of general funding liquidity risk than the Chinese short-term interbank liquidity risk. Asness et al. (2013) uses the swap-T-bill spread, the TED spread, and the LIBOR-Repo spread as overall funding liquidity risk measures. Then, we also control for general funding liquidity risk in the U.S. with the spread between the interest rate swaps and the short-term U.S. Treasury bill rate (*Swap-Tbill spread*). For China, unfortunately, the Chinese versions of the TED spread and the LIBOR-repo spread lack reliable data. Hence, we only include the Chinese version of the LIBOR-Repo which is defined as the spread between the 3-month SHIBOR and the term repurchase rate in China (*SHIBOR-Repo spread*). This should control for the general funding liquidity risk specific to China. Moreover, to shed more light on the role of maturity mismatch risk we control for two other measures. We first include the spread between the 3-month SHIBOR and the 1-month SHIBOR (*SHIBOR spread*). Commercial banks trying to resolve their maturity mismatch problems depend on short-term rather than long-term interbank liquidity. Thus, we do not expect this variable to overturn our previous results. Finally, we also add the spread between the 3-month repo rate and the overnight repo rate (*Repo 3M-ON spread*). Chinese repo markets require qualified collaterals to use interbank money markets, but Shibor markets do not (see Kendall and Lees (2017) for more information about the Chinese repo markets). However, we do not know exactly which market commercial banks use to solve their maturity mismatch problems. Including both markets allows us to answer this question.

Next, we test for the robustness of our results to other types of funding liquidity risk than the Chinese short-term interbank liquidity risk. Recall that in our previous regressions with the full set of controls, we included the TED spread and the LIBOR-Repo spread to control for general funding liquidity shocks from global markets. In this section, we introduce one more liquidity measure for global market conditions, the spread between the interest rate swaps and the short-term U.S. Treasury bill rate (*Swap-Tbill spread*), following Asness et al. (2013) who uses the swap-T-bill spread, the TED spread, and the LIBOR-Repo spread to measure overall funding liquidity risk in the U.S. We also introduce the Chinese version of LIBOR-Repo which is defined as the spread between the 3-month SHIBOR and the term repurchase rate in China (*SHIBOR-Repo spread*). This should control for the general funding liquidity risk specific to China. Note that for China, unfortunately, the Chinese versions of the TED spread and the Swap-Tbill spread lack reliable data, so we do not add these measures. Lastly, to shed more light on the role of maturity mismatch risk we control for two other measures. We first include the spread between the 3-month SHIBOR and the 1-month SHIBOR (*SHIBOR spread*). Commercial banks trying to resolve their maturity mismatch problems depend on short-term rather than longer term interbank liquidity. If the impact of Chinese interbank liquidity risk on the commodity futures risk premium is limited to the short-term risk, it can be a strong suggestive evidence of the role of CCFDs and shadow banking products. Finally, we also add the spread between the 3-month repo rate and the overnight repo rate (*Repo 3M-ON spread*). Chinese repo markets require qualified collaterals to use interbank money markets, but Shibor markets do not (see Kendall and Lees

(2017) for more information about the Chinese repo markets). However, we do not know exactly which market commercial banks use to solve their maturity mismatch problems. Including both markets allows us to answer this question.

In Panel A of Table IX, we present the results for the predictive regressions with the full set of controls in developed markets where we add each of our extra liquidity measures in columns (1) to (4) and then all the measures together in column (5). In a nutshell, the effect of the Chinese short-term interbank liquidity risk on the commodity futures risk premiums is robust to the inclusion of other types of funding liquidity risk. When we add each of the other considered liquidity measures, the coefficient on *Slope* remains close to 50 bps per week. Note that *SHIBOR spread*, a longer-term Chinese interbank liquidity risk measure, does not show any significance as expected. Interestingly, when added all together the impact of *Slope* on futures risk premium more than doubles, stressing the importance of *Slope*. Regarding the use of Shibor and repo markets, column (4) shows that the short-term liquidity risk as measured by the 3-month-overnight Shibor spread impacts commodity futures risk premium while the repo spread does not. This suggests that the impact of Chinese interbank market on the commodity futures risk premium is very specific to our short-term liquidity measure.

The contemporaneous regression results in Panel B present the same picture. The effect of *Slope* is robust to the inclusion of all other liquidity measures and the results are also consistent with our main results in Table II. Interestingly, none of our extra liquidity measures shows any significant comovement with the commodity futures excess returns.

We next report in Table X the robustness of our main results for the Chinese market. Overall, both the predictive power and explanatory power of *Slope* and *Negative Dummy* are robust both in significance and in magnitude after controlling for the extra liquidity measures. The only exception is column (9) where the commodity futures excess returns seem to co-move more closely with the Chinese 3-month-overnight repo spread instead of *Slope*. Overall, our robustness test results support that CCFDs are behind the risk spillover from the short-term Chinese interbank to the Chinese shadow banking, then to global commodity markets. The stronger effect of the Chinese short-term interbank liquidity risk after the crisis is suggestive of the role of CCFDs on the relationship between the Chinese interbank market and global commodity markets. On the other hand, the fact that the effect of Chinese interbank market is limited to the very specific short-term liquidity risk uncovers the link from maturity mismatch risk in the Chinese shadow banking sector to global commodity markets.[24]

[24]We have also checked the robustness of our main findings to alternative specifications of the 3-month and the overnight SHIBOR spread, the results of which we omit in the paper, but are available upon requests. First, following Asness et al. (2013) where the residuals from the AR(2) model of the spreads are used as a

V. Conclusion

In this paper, we show that short-term interbank liquidity risk in China impacts commodity futures risk premium in global markets, through the CCFD channel. Briefly, due to capital restrictions, investors import and collateralize commodities in order to invest in high-yielding shadow banking products in China. In these deals, commercial banks in China play crucial roles in issuing letters of credit for the import of commodities, providing CNY loans against the pledged commodities and creating the shadow banking products. More importantly, banks face maturity mismatch problems of the shadow banking products. To resolve these problems, banks in China frequently use the interbank market. Hence, we expect that an increase in the short-term interbank liquidity risk in China turns CCFDs less attractive, reducing the collateral and hedging demand for commodities. Moreover, and according to the theory of normal backwardation, a decrease in the demand should imply lower commodity futures risk premium. Empirically, we find strong support for this claim. We start by measuring the short-term interbank liquidity risk in China by the spread between the 3-month SHIBOR and the overnight SHIBOR. We then find that an increase in this spread predicts a decrease in the commodity futures risk premium one-week ahead in both developed markets and China. We also find a negative contemporaneous comovement between the interbank liquidity risk in China and commodity futures risk premiums. To verify that CCFDs are the likely channel behind this result, we follow three different approaches. First, we show that the effect of the interbank liquidity risk in China is, as expected, stronger for metal commodities than nonmetal commodities given that the former is better as collateral. Second, we provide evidence that the effect is stronger during periods when CCFDs are known to be more prevalent. Lastly, we find that our results remain significant even after controlling for other funding liquidity measures that are not related to maturity mismatch risk. Our results shed light on an unexplored side of the financialization of commodities. Capital controls in China create unexpected links from the Chinese interbank money market and shadow banking to global commodity markets. This specific but substantial example of financialization of commodities calls for new attention from both researchers and policymakers. In particular, because changes in financial conditions in China can impact commodity markets and, eventually, affect the production of real assets at a global scale.

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measure for the short-term interbank liquidity risk, we ran the same set of predictive and contemporaneous regressions with the residuals from the AR(1), AR(2), and AR(3) models each instead of *Slope* and *Negative Dummy*. We also test the effect of changes in the 3-month and the overnight SHIBOR spread, instead of the spread itself. The results are consistent with the main findings presented in the paper.

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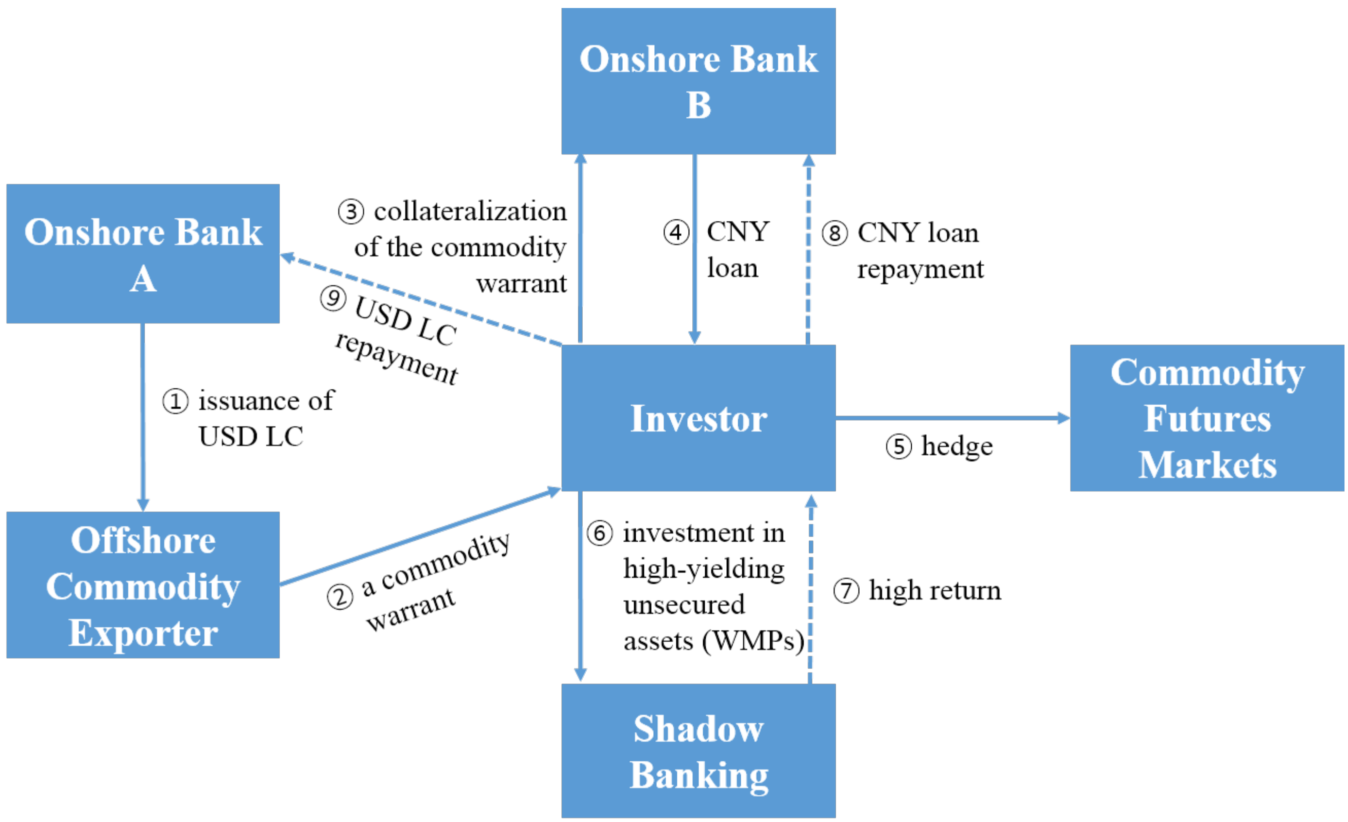

Figure 1. A typical Chinese commodity financing deal (CCFD).
This figure illustrates a series of transactions that completes one cycle of the standard Chinese commodity financing deals. It is reported that this one cycle is repeated many times in the practice. Note that Steps 6-9, shown in the dashed blue line, take place about 3–6 months after the previous transactions.

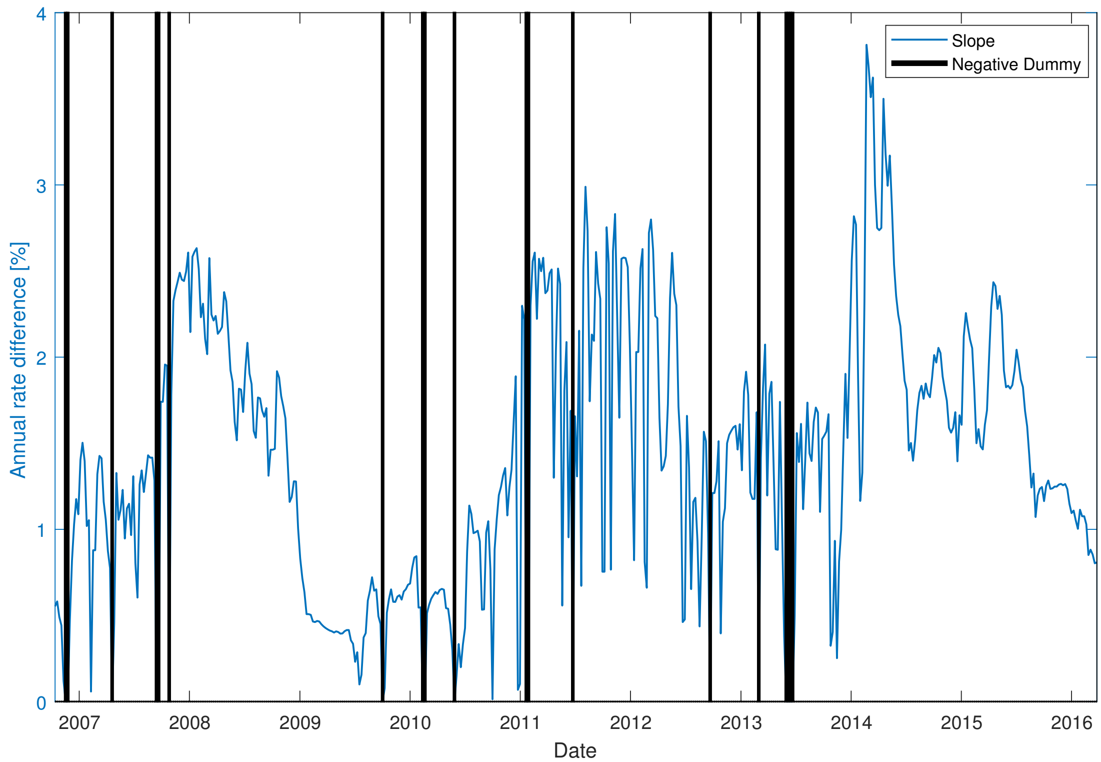

Figure 2. The spread between the 3-month SHIBOR and the overnight SHIBOR. The blue line (*Slope*) indicates the positive spread between the 3-month SHIBOR and the overnight SHIBOR. The black bar (*Negative Dummy*) indicates the negative spread between the 3-month SHIBOR and the overnight SHIBOR.

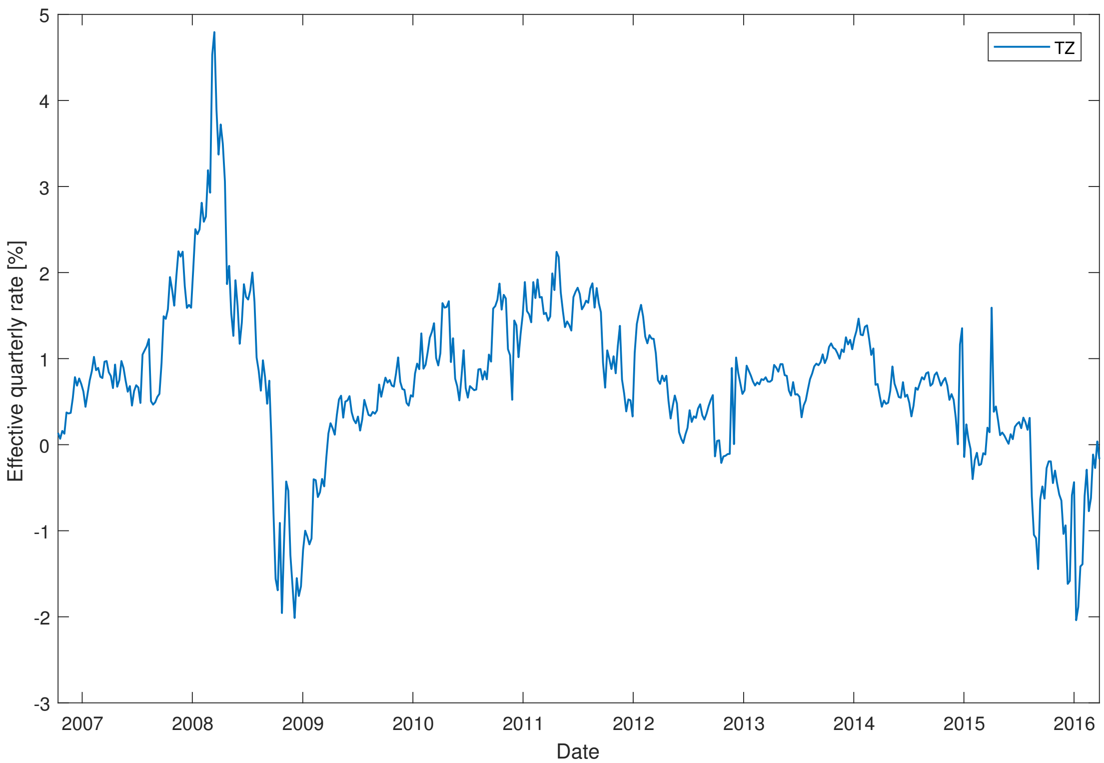

Figure 3. The 3-month currency-hedged carry trade returns (TZ) by Tang and Zhu (2016). The currency-hedged carry trade returns are calculated as the sum of the interest rate difference between the 3-month SHIBOR and 3-month LIBOR and the hedged currency returns from the official USD-CNY spot exchange rate and the USD-CNY 3-month nondeliverable forward (NDF) exchange rate.

Variable	Description	Mean	Std. dev	Max	Min
Excess Returns	Weekly excess returns of all commdodities in developed markets [%]	0.05	4.13	28.02	-27.39
	Weekly excess returns of all commdodities in China [%]	-0.04	2.77	16.91	-20.60
	Weekly excess returns of metals in developed markets [%]	0.03	4.20	28.02	-27.39
	Weekly excess returns of metals in China [%]	-0.08	2.90	15.34	-17.73
	Weekly excess returns of nonmetals in developed markets [%]	0.07	4.10	24.20	-21.83
	Weekly excess returns of nonmetals in China [%]	-0.01	2.71	16.91	-20.60
Basis	Annual Basis of all commdodities in developed markets [%]	-1.61**	14.78	272.77	-39.45
	Annual basis of all commdodities in China [%]	-2.32**	23.27	469.82	-499.26
	Annual basis of metals in developed markets [%]	-1.95**	7.40	89.43	-35.04
	Annual basis of metals in China [%]	-1.46**	7.08	47.01	-62.51
	Annual basis of nonmetals in developed markets [%]	-1.38**	18.49	272.77	-39.45
	Annual basis of nonmetals in China [%]	-2.73**	27.88	469.82	-499.26
Slope	Positive value of the spread between the 3-month and the overnight SHIBOR (CNY) [%]	1.40**	0.78	3.81	0.00
Negative Dummy	Negative dummy variable of the spread between the 3-month and the overnight SHIBOR (CNY)	0.04**	0.19	1.00	0.00
$i_t^* - i_t$	3-month SHIBOR (CNY) - 3-month LIBOR ($) at date t [%]	0.60	0.56	1.50	-0.66
s_t	$s_t = log($ Spot (CNY/\$)$_t)$ - $log($3-month NDF (CNY/\$)$_t)$ [%]	0.12*	1.02	4.37	-2.64
TZ	$TZ = i_t^* - i_t + s_t$; 3-month currency-hedged carry trade returns [%]	0.72**	0.90	4.79	-2.04
MSCI	Weekly excess returns of the MSCI emerging markets Asia index [%] over one week LIBOR ($)	0.02	3.26	13.90	-18.87
SPX	Weekly excess returns of the S&P 500 index [%] over one week LIBOR ($)	0.06	2.66	11.34	-20.16
DXY	Weekly log changes in the dollar index [%]	0.02	1.17	4.77	-4.14
BDI	Weekly log changes in the Baltic dry index [%]	-0.47	9.25	42.83	-43.47
TED spread	Spread between 3-month Eurodollars ($) and 3-month Treasury Bill ($) [%]	0.47**	0.41	2.61	0.02
LIBOR-Repo spread	Spread between 3-month LIBOR ($) and 3-month Repo ($) [%]	0.37**	0.45	4.07	-0.05

* $p < 0.05$, ** $p < 0.01$.

Table I. Summary statistics. All variables are calculated from Oct. 13th, 2006 to Mar. 25th, 2016. The table shows the average (mean), standard deviations (SD), maximum (Max), minimum (Min) of the variables and sample mean test of the null hypothesis that each variable is zero.

Variables	A. Predictive				B. Contemporaneous			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Slope	-0.40**	-0.47**	-0.44**	-0.47**	-0.41**	-0.59**	-0.61**	-0.27**
	(0.06)	(0.07)	(0.08)	(0.08)	(0.06)	(0.07)	(0.08)	(0.07)
Negative Dummy	0.07	-0.05	-0.03	-0.07	-0.33	-0.66*	-0.66*	-0.29
	(0.26)	(0.26)	(0.26)	(0.26)	(0.26)	(0.26)	(0.26)	(0.24)
Basis	-0.00	-0.00	-0.00	-0.00	0.02**	0.02**	0.02**	0.02**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TZ		0.17**	-0.14	-0.27**		0.45**	0.38**	-0.06
		(0.05)	(0.09)	(0.09)		(0.05)	(0.09)	(0.08)
Slope × *Low TZ*			-0.47**	-0.44**			-0.07	-0.11
			(0.10)	(0.10)			(0.10)	(0.10)
Slope × *High TZ*			0.17*	0.33**			0.08	0.29**
			(0.08)	(0.08)			(0.08)	(0.08)
MSCI				-0.05**				0.23**
				(0.02)				(0.02)
SPX				0.06**				0.13**
				(0.02)				(0.02)
DXY				-0.01				-0.74**
				(0.04)				(0.04)
BDI				0.01				0.01
				(0.01)				(0.00)
TED spread				-0.79**				-0.27
				(0.27)				(0.25)
LIBOR-Repo spread				0.08				-0.10
				(0.25)				(0.23)
Constant	0.61**	0.59**	0.84**	1.20**	0.68**	0.61**	0.68**	0.58**
	(0.11)	(0.11)	(0.12)	(0.14)	(0.11)	(0.11)	(0.12)	(0.12)
Observations	7884	7884	7884	7868	7868	7868	7868	7868
Adjusted R^2	0.004	0.005	0.008	0.013	0.010	0.018	0.018	0.157

Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$.

Table II. Commodity futures excess returns in developed markets. This table presents the panel regression results in developed markets (aluminum, copper, lead, zinc, gold, silver, corn, soybeans, soybean meal, soybean oil, wheat, cotton, palm oil, rubber, sugar, and heating oil) with fixed effects at the individual commodity level and an AR(1) disturbance. Panel A including columns (1) to (4) reports results for predicting commodity futures excess returns ($Excess\ Returns^i_{t+1} = \beta_0 + \beta_1 Slope_t + \beta_2 Negative\ Dummy_t + \beta_3 Basis^i_t + \gamma X_t + \epsilon^i_{t+1}$). Panel B reports results for contemporaneous commodity futures excess returns ($Excess\ Returns^i_t = \beta_0 + \beta_1 Slope_t + \beta_2 Negative\ Dummy_t + \beta_3 Basis^i_t + \gamma X_t + \epsilon^i_t$).

Variables	*A. Predictive*				*B. Contemporaneous*			
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Slope	-0.35**	-0.36**	-0.34**	-0.33**	-0.30**	-0.39**	-0.42**	-0.24**
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Negative Dummy	-0.46*	-0.49*	-0.47*	-0.45*	-0.37	-0.53**	-0.52**	-0.23
	(0.19)	(0.19)	(0.19)	(0.19)	(0.19)	(0.19)	(0.19)	(0.18)
Basis	-0.01**	-0.01**	-0.01**	-0.01**	0.01**	0.01**	0.01**	0.01**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TZ		0.04	-0.16*	-0.30**		0.22**	0.05	-0.20**
		(0.04)	(0.06)	(0.06)		(0.04)	(0.06)	(0.06)
Slope × *Low TZ*			-0.32**	-0.33**			-0.17*	-0.17*
			(0.07)	(0.07)			(0.07)	(0.07)
Slope × *High TZ*			0.10	0.23**			0.18**	0.34**
			(0.06)	(0.06)			(0.06)	(0.06)
MSCI				-0.02				0.22**
				(0.01)				(0.01)
SPX				0.08**				-0.03
				(0.02)				(0.02)
DXY				-0.12**				-0.23**
				(0.03)				(0.03)
BDI				0.00				0.01**
				(0.00)				(0.00)
TED spread				-0.00				0.15
				(0.20)				(0.19)
LIBOR-Repo spread				-0.47**				-0.61**
				(0.18)				(0.17)
Constant	0.45**	0.45**	0.62**	0.82**	0.42**	0.40**	0.55**	0.54**
	(0.07)	(0.07)	(0.08)	(0.09)	(0.07)	(0.07)	(0.08)	(0.09)
Observations	7221	7221	7221	7210	7205	7205	7205	7205
Adjusted R^2	0.009	0.009	0.012	0.025	0.008	0.012	0.013	0.105

Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$.

Table III. Commodity futures excess returns in China. This table presents the panel regression results in Chinese commodity futures markets (aluminum, copper, lead, zinc, gold, silver, corn, soybeans, soybean meal, soybean oil, wheat, cotton, palm oil, rubber, sugar, and fuel oil) with fixed effects at the individual commodity level and an AR(1) disturbance. Panel A including columns (1) to (4) reports results for predicting commodity futures excess returns ($Excess\ Returns^i_{t+1} = \beta_0 + \beta_1 Slope_t + \beta_2 Negative\ Dummy_t + \beta_3 Basis^i_t + \gamma X_t + \epsilon^i_{t+1}$). Panel B including columns (5) to (8) reports results for contemporaneous commodity futures excess returns ($Excess\ Returns^i_t = \beta_0 + \beta_1 Slope_t + \beta_2 Negative\ Dummy_t + \beta_3 Basis^i_t + \gamma X_t + \epsilon^i_t$).

Variables	A. Metals				B. Nonmetals				C. All
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Slope	-0.60**	-0.64**	-0.55**	-0.63**	-0.28**	-0.36**	-0.36**	-0.38**	-0.35**
	(0.11)	(0.12)	(0.13)	(0.13)	(0.08)	(0.09)	(0.10)	(0.10)	(0.09)
Negative Dummy	-0.29	-0.36	-0.33	-0.37	0.28	0.14	0.15	0.08	0.13
	(0.44)	(0.44)	(0.44)	(0.44)	(0.33)	(0.33)	(0.33)	(0.33)	(0.33)
Basis	0.04	0.04	0.04	0.01	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.03)	(0.03)	(0.03)	(0.03)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TZ		0.09	-0.34*	-0.43**		0.19**	-0.05	-0.17	-0.27**
		(0.09)	(0.15)	(0.15)		(0.07)	(0.11)	(0.11)	(0.09)
Slope × *Low TZ*			-0.76**	-0.75**			-0.32*	-0.27*	-0.44**
			(0.17)	(0.18)			(0.13)	(0.13)	(0.10)
Slope × *High TZ*			0.16	0.33*			0.17	0.32**	0.33**
			(0.13)	(0.14)			(0.10)	(0.10)	(0.08)
MSCI				-0.09**				-0.04	-0.05**
				(0.03)				(0.03)	(0.02)
SPX				0.04				0.08*	0.06**
				(0.04)				(0.03)	(0.02)
DXY				-0.00				0.01	-0.01
				(0.07)				(0.05)	(0.04)
BDI				-0.01				0.02**	0.01
				(0.01)				(0.01)	(0.01)
TED spread				-0.46				-0.99**	-0.79**
				(0.46)				(0.34)	(0.27)
LIBOR-Repo spread				-0.55				0.46	0.08
				(0.42)				(0.31)	(0.25)
Metals × *Slope*									-0.31*
									(0.13)
Metals × *Negative Dummy*									-0.54
									(0.54)
Constant	0.88**	0.86**	1.19**	1.57**	0.45**	0.42**	0.62**	0.95**	1.20**
	(0.18)	(0.18)	(0.21)	(0.23)	(0.13)	(0.13)	(0.15)	(0.17)	(0.14)
Observations	2958	2958	2958	2952	4926	4926	4926	4916	7868
Adjusted R^2	0.008	0.008	0.014	0.023	0.001	0.002	0.004	0.009	0.013

Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$.

Table IV. Metals vs. nonmetals for commodity futures risk premiums in developed markets. This table presents the panel regression results of one-week ahead commodity futures excess returns ($Excess\ Returns^i_{t+1} = \beta_0 + \beta_1 Slope_t + \beta_2 Negative\ Dummy_t + \beta_3 Basis^i_t + \gamma X_t + \epsilon^i_{t+1}$) on metals vs. nonmetals in developed countries with fixed effects at the individual commodity level and an AR(1) disturbance. Panel A including columns (1) to (4) reports results for aluminum, copper, lead, zinc, gold, and silver. Panel B including columns (5) to (8) reports results for corn, soybeans, soybean meal, soybean oil, wheat, cotton, palm oil, rubber, sugar, and heating oil. Panel C reports results for both metals and nonmetals with the metals dummy variable.

Variables	A. Metals				B. Nonmetals				C. All
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Slope	-0.63**	-0.81**	-0.88**	-0.43**	-0.31**	-0.48**	-0.47**	-0.19*	-0.17*
	(0.11)	(0.11)	(0.13)	(0.12)	(0.08)	(0.09)	(0.10)	(0.09)	(0.09)
Negative Dummy	-0.15	-0.48	-0.49	0.07	-0.47	-0.79*	-0.78*	-0.47	-0.41
	(0.43)	(0.44)	(0.44)	(0.39)	(0.33)	(0.33)	(0.33)	(0.31)	(0.31)
Basis	0.15**	0.14**	0.14**	0.11**	0.02**	0.02**	0.02**	0.02**	0.02**
	(0.03)	(0.03)	(0.03)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TZ		0.47**	0.46**	-0.03		0.46**	0.35**	-0.06	-0.06
		(0.09)	(0.15)	(0.14)		(0.07)	(0.11)	(0.11)	(0.08)
Slope × Low TZ			0.13	0.10			-0.17	-0.22	-0.11
			(0.17)	(0.16)			(0.13)	(0.12)	(0.10)
Slope × High TZ			0.12	0.33**			0.05	0.25*	0.29**
			(0.13)	(0.13)			(0.10)	(0.10)	(0.08)
MSCI				0.36**				0.15**	0.23**
				(0.03)				(0.02)	(0.02)
SPX				0.07				0.18**	0.13**
				(0.04)				(0.03)	(0.02)
DXY				-0.84**				-0.67**	-0.74**
				(0.06)				(0.05)	(0.04)
BDI				0.00				0.01	0.01
				(0.01)				(0.01)	(0.00)
TED spread				-0.57				-0.12	-0.27
				(0.41)				(0.32)	(0.25)
LIBOR-Repo spread				0.18				-0.18	-0.10
				(0.38)				(0.29)	(0.23)
Metals × Slope									-0.29*
									(0.12)
Metals × Negative Dummy									0.33
									(0.49)
Constant	1.13**	1.05**	1.06**	0.82**	0.54**	0.47**	0.56**	0.51**	0.58**
	(0.18)	(0.18)	(0.21)	(0.20)	(0.13)	(0.13)	(0.15)	(0.16)	(0.12)
Observations	2952	2952	2952	2952	4916	4916	4916	4916	7868
Adjusted R^2	0.018	0.026	0.026	0.223	0.009	0.018	0.018	0.126	0.158

Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$.

Table V. Metals vs. nonmetals for contemporaneous futures excess returns in developed markets. This table presents the panel regression results of contemporaneous commodity futures excess returns ($Excess\ Returns_t^i = \beta_0 + \beta_1 Slope_t + \beta_2 Negative\ Dummy_t + \beta_3 Basis_t^i + \gamma X_t + \epsilon_t^i$) on metals vs.. nonmetals in developed countries with fixed effects at the individual commodity level and an AR(1) disturbance. Panel A including columns (1) to (4) reports results for aluminum, copper, lead, zinc, gold, and silver. Panel B including columns (5) to (8) reports results for corn, soybeans, soybean meal, soybean oil, wheat, cotton, palm oil, rubber, sugar, and heating oil. Panel C reports results for both metals and nonmetals with the metals dummy variable.

Variables	A. Metals				B. Nonmetals				C. All
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Slope	-0.45**	-0.47**	-0.41**	-0.40**	-0.29**	-0.31**	-0.31**	-0.31**	-0.28**
	(0.08)	(0.09)	(0.10)	(0.10)	(0.06)	(0.06)	(0.07)	(0.07)	(0.06)
Negative Dummy	-1.08**	-1.11**	-1.10**	-1.01**	-0.18	-0.22	-0.21	-0.21	-0.17
	(0.35)	(0.36)	(0.36)	(0.36)	(0.22)	(0.22)	(0.22)	(0.22)	(0.22)
Basis	0.01	0.01	0.01	0.01	-0.01**	-0.01**	-0.01**	-0.01**	-0.01**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TZ		0.04	-0.18	-0.33**		0.06	-0.13	-0.27**	-0.30**
		(0.07)	(0.11)	(0.12)		(0.05)	(0.07)	(0.08)	(0.06)
Slope × *Low TZ*			-0.40**	-0.46**			-0.28**	-0.27**	-0.34**
			(0.12)	(0.13)			(0.09)	(0.09)	(0.07)
Slope × *High TZ*			0.05	0.18			0.12	0.25**	0.23**
			(0.10)	(0.10)			(0.07)	(0.07)	(0.06)
MSCI				-0.03				-0.03	-0.02
				(0.03)				(0.02)	(0.01)
SPX				0.06				0.09**	0.08**
				(0.03)				(0.02)	(0.02)
DXY				-0.15**				-0.10**	-0.12**
				(0.05)				(0.04)	(0.03)
BDI				-0.01				0.01*	0.00
				(0.01)				(0.00)	(0.00)
TED spread				0.66				-0.34	-0.01
				(0.39)				(0.23)	(0.20)
LIBOR-Repo spread				-1.43**				-0.04	-0.46**
				(0.35)				(0.21)	(0.18)
Metals × *Slope*									-0.17
									(0.10)
Metals × *Negative Dummy*									-0.91*
									(0.40)
Constant	0.62**	0.62**	0.81**	0.97**	0.38**	0.37**	0.53**	0.74**	0.83**
	(0.14)	(0.14)	(0.16)	(0.18)	(0.09)	(0.09)	(0.10)	(0.11)	(0.09)
Observations	2346	2346	2346	2344	4875	4875	4875	4866	7210
Adjusted R^2	0.010	0.010	0.013	0.032	0.010	0.010	0.012	0.024	0.026

Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$.

Table VI. Metals vs. nonmetals for commodity futures risk premiums in China. This table presents the panel regression results of one-week ahead commodity futures excess returns ($Excess\ Returns^i_{t+1} = \beta_0 + \beta_1 Slope_t + \beta_2 Negative\ Dummy_t + \beta_3 Basis^i_t + \gamma X_t + \epsilon^i_{t+1}$) on metals vs. nonmetals in China with fixed effects at the individual commodity level and an AR(1) disturbance. Panel A including columns (1) to (4) reports results for aluminum, copper, lead, zinc, gold, and silver. Panel B including columns (5) to (8) reports results for corn, soybeans, soybean meal, soybean oil, wheat, cotton, palm oil, rubber, sugar, and fuel oil. Panel C reports results for both metals and nonmetals with the metals dummy variable.

Variables	A. Metals				B. Nonmetals				C. All
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Slope	-0.35**	-0.41**	-0.43**	-0.18*	-0.28**	-0.38**	-0.42**	-0.27**	-0.22**
	(0.08)	(0.09)	(0.10)	(0.09)	(0.06)	(0.06)	(0.07)	(0.06)	(0.06)
Negative Dummy	-0.53	-0.66	-0.66	-0.20	-0.32	-0.49*	-0.48*	-0.26	-0.19
	(0.35)	(0.36)	(0.36)	(0.33)	(0.22)	(0.22)	(0.22)	(0.22)	(0.22)
Basis	0.00	0.01	0.01	0.01	0.01**	0.01**	0.01**	0.01**	0.01**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TZ		0.17*	0.06	-0.26*		0.24**	0.03	-0.18*	-0.20**
		(0.08)	(0.11)	(0.11)		(0.05)	(0.07)	(0.07)	(0.06)
Slope × Low TZ			-0.09	-0.10			-0.22*	-0.22**	-0.18*
			(0.12)	(0.11)			(0.09)	(0.09)	(0.07)
Slope × High TZ			0.12	0.31**			0.20**	0.35**	0.34**
			(0.10)	(0.10)			(0.07)	(0.07)	(0.06)
MSCI				0.32**				0.17**	0.22**
				(0.02)				(0.02)	(0.01)
SPX				-0.06				-0.01	-0.03
				(0.03)				(0.02)	(0.02)
DXY				-0.36**				-0.17**	-0.23**
				(0.05)				(0.03)	(0.03)
BDI				0.01				0.01*	0.01**
				(0.01)				(0.00)	(0.00)
TED spread				-0.07				0.24	0.15
				(0.35)				(0.22)	(0.19)
LIBOR-Repo spread				-0.55				-0.65**	-0.61**
				(0.32)				(0.21)	(0.17)
Metals × Slope									-0.07
									(0.09)
Metals × Negative Dummy									-0.13
									(0.39)
Constant	0.44**	0.43**	0.52**	0.51**	0.42**	0.38**	0.56**	0.57**	0.54**
	(0.14)	(0.14)	(0.16)	(0.17)	(0.09)	(0.09)	(0.10)	(0.11)	(0.09)
Observations	2340	2340	2340	2340	4865	4865	4865	4865	7205
Adjusted R^2	0.004	0.005	0.005	0.164	0.010	0.015	0.017	0.083	0.105

Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$.

Table VII. Metals vs. nonmetals for contemporaneous commodity futures excess returns in China. This table presents the panel regression results of contemporaneous commodity futures excess returns ($Excess\ Returns_t^i = \beta_0 + \beta_1 Slope_t + \beta_2 Negative\ Dummy_t + \beta_3 Basis_t^i + \gamma X_t + \epsilon_t^i$) on metals vs. nonmetals in China with fixed effects at the individual commodity level and an AR(1) disturbance. Panel A including columns (1) to (4) reports results for aluminum, copper, lead, zinc, gold, and silver. Panel B including columns (5) to (8) reports results for corn, soybeans, soybean meal, soybean oil, wheat, cotton, palm oil, rubber, sugar, and fuel oil. Panel C reports results for both metals and nonmetals with the metals dummy variable.

Varibles	*A. Developed Markets*		*B. China*	
	Predictive *(1)*	*Contemporaneous* *(2)*	*Predictive* *(3)*	*Contemporaneous* *(4)*
Slope	0.12	0.46**	-0.01	0.24
	(0.18)	(0.17)	(0.13)	(0.13)
Negative Dummy	1.15**	1.08**	0.52	0.55*
	(0.37)	(0.34)	(0.27)	(0.26)
Basis	-0.00	0.02**	-0.01**	0.01**
	(0.00)	(0.00)	(0.00)	(0.00)
TZ	-0.95**	-0.47**	-0.64**	-0.47**
	(0.14)	(0.13)	(0.10)	(0.10)
Slope × *Low TZ*	-1.68**	-0.01	-0.15	0.07
	(0.37)	(0.34)	(0.26)	(0.26)
Slope × *High TZ*	0.89**	0.55**	0.75**	0.60**
	(0.17)	(0.15)	(0.12)	(0.12)
Non-crisis × *Slope*	-0.63**	-0.74**	-0.32*	-0.46**
	(0.17)	(0.16)	(0.13)	(0.12)
Non-crisis × *Negative Dummy*	-2.08**	-2.18**	-1.50**	-1.07**
	(0.51)	(0.47)	(0.36)	(0.35)
Non-crisis × *TZ*	0.50**	0.39*	0.21	0.18
	(0.19)	(0.17)	(0.13)	(0.13)
Non-crisis × *Slope* × *Low TZ*	1.28**	-0.05	-0.25	-0.27
	(0.39)	(0.36)	(0.28)	(0.27)
Non-crisis × *Slope* × *High TZ*	-0.71**	-0.34*	-0.62**	-0.32*
	(0.18)	(0.17)	(0.13)	(0.13)
MSCI	-0.06**	0.23**	-0.02	0.22**
	(0.02)	(0.02)	(0.01)	(0.01)
SPX	0.06**	0.13**	0.08**	-0.02
	(0.02)	(0.02)	(0.02)	(0.02)
DXY	-0.01	-0.73**	-0.12**	-0.22**
	(0.04)	(0.04)	(0.03)	(0.03)
BDI	0.01	0.00	0.00	0.01**
	(0.01)	(0.00)	(0.00)	(0.00)
TED spread	-1.66**	-0.96**	-0.61**	-0.40*
	(0.29)	(0.27)	(0.21)	(0.20)
LIBOR-Repo spread	0.45	-0.41	-0.66**	-0.87**
	(0.30)	(0.28)	(0.22)	(0.21)
Constant	1.50**	0.77**	1.11**	0.74**
	(0.15)	(0.14)	(0.10)	(0.10)
Observations	7868	7868	7210	7205
Adjusted R^2	0.022	0.163	0.035	0.111

Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$.

Table VIII. Commodity futures excess returns for pre-CCFD period (during the financial crisis) vs. CCFD-prime period (after the financial crisis). This table presents the panel regression results when we divide our sample period into two subperiods: during and after the recent global financial crisis. The end of the crisis roughly coincided with the time when CCFDs were reported to gain popularity. All the regressions include fixed effects at the individual commodity level (aluminum, copper, lead, zinc, gold, silver, corn, soybeans, soybean meal, soybean oil, wheat, cotton, palm oil, rubber, sugar, and heating oil/fuel oil) and an AR(1) disturbance. Column (1) reports results for predicting commodity futures excess returns in developed markets. Column (2) reports results for contemporaneous commodity futures excess returns in developed markets. Column (3) reports results for predicting commodity futures excess returns in China. Column (4) reports results for contemporaneous commodity futures excess returns in China. Note that $Non-crisis$ becomes 1 starting from July 3rd, 2009.

Varibles	*A. Predictive*					*B. Contemporaneous*				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*
Slope	-0.54**	-0.47**	-0.46**	-0.56**	-1.28**	-0.27**	-0.29**	-0.31**	-0.26**	-0.52*
	(0.08)	(0.08)	(0.09)	(0.11)	(0.23)	(0.07)	(0.07)	(0.08)	(0.10)	(0.22)
Negative Dummy	-0.16	-0.06	-0.09	-0.02	0.50	-0.29	-0.26	-0.19	-0.29	-0.02
	(0.26)	(0.27)	(0.28)	(0.27)	(0.33)	(0.24)	(0.25)	(0.26)	(0.25)	(0.31)
Basis	-0.00	-0.00	-0.00	-0.00	-0.00	0.02**	0.02**	0.02**	0.02**	0.02**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TZ	-0.28**	-0.27**	-0.27**	-0.28**	-0.29**	-0.06	-0.05	-0.05	-0.05	-0.06
	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Slope × *Low TZ*	-0.40**	-0.44**	-0.44**	-0.44**	-0.41**	-0.11	-0.11	-0.10	-0.11	-0.10
	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Slope × *High TZ*	0.33**	0.33**	0.33**	0.32**	0.34**	0.29**	0.29**	0.30**	0.29**	0.30**
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
MSCI	-0.06**	-0.05**	-0.05**	-0.06**	-0.07**	0.23**	0.23**	0.23**	0.23**	0.23**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
SPX	0.08**	0.06**	0.06**	0.06**	0.08**	0.13**	0.13**	0.13**	0.13**	0.14**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
DXY	0.01	-0.01	-0.01	-0.01	-0.00	-0.74**	-0.74**	-0.74**	-0.74**	-0.74**
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
BDI	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TED spread	0.37	-0.79**	-0.79**	-0.82**	0.40	-0.29	-0.26	-0.27	-0.27	-0.21
	(0.43)	(0.27)	(0.27)	(0.27)	(0.44)	(0.40)	(0.25)	(0.25)	(0.25)	(0.41)
LIBOR-Repo spread	0.24	0.08	0.09	0.10	0.26	-0.10	-0.11	-0.13	-0.10	-0.12
	(0.25)	(0.25)	(0.25)	(0.25)	(0.25)	(0.23)	(0.23)	(0.23)	(0.23)	(0.23)
Swap-Tbill spread	-1.44**				-1.49**	0.02				-0.09
	(0.42)				(0.43)	(0.38)				(0.40)
SHIBOR-Repo spread		0.02			0.74**		0.06			0.18
		(0.09)			(0.24)		(0.09)			(0.22)
SHIBOR spread			-0.02		-0.02			0.09		0.09
			(0.08)		(0.12)			(0.08)		(0.11)
Repo 3M-ON spread				0.12	0.75**				-0.01	0.20
				(0.10)	(0.22)				(0.09)	(0.21)
Constant	1.46**	1.20**	1.19**	1.17**	1.48**	0.58**	0.60**	0.63**	0.59**	0.64**
	(0.16)	(0.14)	(0.14)	(0.14)	(0.17)	(0.14)	(0.13)	(0.13)	(0.13)	(0.16)
Observations	7868	7868	7868	7868	7868	7868	7868	7868	7868	7868
Adjusted R^2	0.014	0.012	0.012	0.013	0.015	0.157	0.157	0.157	0.157	0.157

Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$.

Table IX. Robustness to various types of funding liquidity risk for developed markets. This table presents the panel regression results for developed markets to show robustness of our results to various types of funding liquidity risk for developed markets. Panel A reports results for predicting commodity futures excess returns ($Excess\ Returns^i_{t+1} = \beta_0 + \beta_1 Slope_t + \beta_2 Negative\ Dummy_t + \beta_3 Basis^i_t + \gamma X_t + \epsilon^i_{t+1}$). Panel B reports results for contemporaneous commodity futures excess returns ($Excess\ Returns^i_t = \beta_0 + \beta_1 Slope_t + \beta_2 Negative\ Dummy_t + \beta_3 Basis^i_t + \gamma X_t + \epsilon^i_t$). We first add each of the extra liquidity measures, the Swap-Tbill spread (USD) (columns (1) and (6)), the 3M SHIBOR - 3M Repo spread (CNY) (columns (2) and (7)), the SHIBOR 3M-1M spread (CNY) (columns (3) and (8)), and the Repo 3M-Overnight spread (CNY) (columns (4) and (9)). Lastly, we include all the extra liquidity measures together (columns (5) and (10)). Note that all the regressions include fixed effects at the individual commodity level (aluminum, copper, lead, zinc, gold, silver, corn, soybeans, soybean meal, soybean oil, wheat, cotton, palm oil, rubber, sugar, and heating oil) and an AR(1) disturbance.

Varibles	*A. Predictive*					*B. Contemporaneous*				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*
Slope	-0.34**	-0.35**	-0.35**	-0.33**	-0.76**	-0.27**	-0.28**	-0.30**	-0.13	-0.40**
	(0.06)	(0.06)	(0.06)	(0.07)	(0.16)	(0.05)	(0.05)	(0.06)	(0.07)	(0.15)
Negative Dummy	-0.46*	-0.41*	-0.41*	-0.45*	-0.08	-0.26	-0.15	-0.10	-0.30	-0.08
	(0.19)	(0.19)	(0.20)	(0.19)	(0.24)	(0.18)	(0.18)	(0.19)	(0.18)	(0.23)
Basis	-0.01**	-0.01**	-0.01**	-0.01**	-0.01**	0.01**	0.01**	0.01**	0.01**	0.01**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TZ	-0.30**	-0.29**	-0.30**	-0.30**	-0.30**	-0.20**	-0.18**	-0.19**	-0.18**	-0.19**
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Slope × Low TZ	-0.33**	-0.33**	-0.33**	-0.33**	-0.33**	-0.16*	-0.17*	-0.17*	-0.17*	-0.15*
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Slope × High TZ	0.23**	0.24**	0.24**	0.23**	0.24**	0.34**	0.35**	0.35**	0.34**	0.36**
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
MSCI	-0.02	-0.02	-0.02	-0.02	-0.03	0.22**	0.22**	0.22**	0.22**	0.22**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
SPX	0.08**	0.08**	0.08**	0.08**	0.08**	-0.02	-0.02	-0.03	-0.03	-0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
DXY	-0.12**	-0.12**	-0.12**	-0.12**	-0.12**	-0.22**	-0.23**	-0.23**	-0.23**	-0.22**
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
BDI	0.00	0.00	0.00	0.00	0.00	0.01**	0.01**	0.01**	0.01**	0.01**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TED spread	0.20	0.01	-0.01	-0.00	0.26	0.61*	0.18	0.14	0.18	0.79**
	(0.31)	(0.20)	(0.20)	(0.20)	(0.32)	(0.30)	(0.19)	(0.19)	(0.19)	(0.31)
LIBOR-Repo spread	-0.44*	-0.48**	-0.48**	-0.47**	-0.43*	-0.55**	-0.64**	-0.66**	-0.63**	-0.58**
	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)	(0.17)	(0.17)	(0.17)	(0.18)
Swap-Tbill spread	-0.25				-0.31	-0.57				-0.77**
	(0.30)				(0.31)	(0.29)				(0.30)
SHIBOR-Repo spread		0.09			0.48**		0.17**			0.19
		(0.07)			(0.16)		(0.06)			(0.16)
SHIBOR spread			0.03		-0.04			0.13*		0.07
			(0.06)		(0.08)			(0.06)		(0.08)
Repo 3M-ON spread				0.00	0.41**				-0.14*	0.06
				(0.07)	(0.15)				(0.07)	(0.15)
Constant	0.87**	0.85**	0.84**	0.82**	0.90**	0.65**	0.60**	0.61**	0.58**	0.77**
	(0.11)	(0.10)	(0.10)	(0.10)	(0.12)	(0.10)	(0.09)	(0.09)	(0.09)	(0.11)
Observations	7210	7210	7210	7210	7210	7205	7205	7205	7205	7205
Adjusted R^2	0.025	0.026	0.025	0.025	0.026	0.105	0.106	0.105	0.105	0.106

Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$.

Table X. Robustness to various types of funding liquidity risk for China. This table presents the panel regression results for China to show robustness of our results to various types of funding liquidity risk. Panel A reports results for predicting commodity futures excess returns ($Excess\ Returns^i_{t+1} = \beta_0 + \beta_1 Slope_t + \beta_2 Negative\ Dummy_t + \beta_3 Basis^i_t + \gamma X_t + \epsilon^i_{t+1}$). Panel B reports results for contemporaneous commodity futures excess returns ($Excess\ Returns^i_t = \beta_0 + \beta_1 Slope_t + \beta_2 Negative\ Dummy_t + \beta_3 Basis^i_t + \gamma X_t + \epsilon^i_t$). We first add each of the extra liquidity measures, the Swap-Tbill spread (USD) (columns (1) and (6)), the 3M SHIBOR - 3M Repo spread (CNY) (columns (2) and (7)), the SHIBOR 3M-1M spread (CNY) (columns (3) and (8)), and the Repo 3M-Overnight spread (CNY) (columns (4) and (9)). Lastly, we include all the extra liquidity measures together (columns (5) and (10)). Note that all the regressions include fixed effects at the individual commodity level (aluminum, copper, lead, zinc, gold, silver, corn, soybeans, soybean meal, soybean oil, wheat, cotton, palm oil, rubber, sugar, and fuel oil) and an AR(1) disturbance.

Appendix A. Data description

Sector	Commodity	Exchange (Code)	N	Excess Return Mean	Excess Return SD	*Basis* Mean	*Basis* SD
Panel A: Developed Market							
Industrial	Aluminum	LME (AH)	494	-0.17	3.17	-5.35**	4.25
Metals	Copper	LME (CA)	494	0.00	3.97	0.55**	2.21
	Lead	LME (PB)	494	0.15	5.42	-0.93**	3.79
	Zinc	LME (ZS)	494	-0.11	4.49	-3.15**	3.50
Precious	Gold	NYMEX (GC)	494	0.15	2.70	-1.45**	1.73
Metals	Silver	NYMEX (SI)	494	0.14	4.82	-1.73**	1.53
Grains	Corn	eCBOT (C)	494	0.00	4.46	-4.78**	18.74
	Soybeans	eCBOT (S)	494	0.23	3.48	4.53**	19.73
	Soybean Meal	eCBOT (SM)	494	0.42	3.97	12.32**	24.77
	Soybean Oil	eCBOT (BO)	494	0.02	3.33	-4.84**	3.37
	Wheat	eCBOT (W)	494	-0.16	4.64	-10.26**	10.38
Softs	Cotton	ICE US (CT)	494	0.03	3.97	-1.58**	17.56
	Palm Oil	KLCE (FCOP)	494	0.22	3.84	1.29	17.03
	Rubber	TOCOM (N/A)	494	-0.02	4.79	-4.48**	21.50
	Sugar	ICE US (SB)	494	0.07	4.26	-0.41	20.93
Energies	Heating Oil	NYMEX (HO)	494	-0.12	4.02	-5.54**	9.92
Panel B: China							
Industrial	Aluminum	SHFE (AL)	494	-0.13	1.99	-2.38**	7.31
Metals	Copper	SHFE (CU)	494	0.01	3.55	2.83**	7.01
	Lead	SHFE (PB)	262	-0.13	2.02	-1.53**	6.98
	Zinc	SHFE (ZN)	470	-0.16	3.46	-3.80**	5.62
Precious	Gold	SHFE (AU)	429	0.07	2.63	-1.53**	6.79
Metals	Silver	SHFE (AG)	203	-0.31	3.11	-4.01**	5.68
Grains	Corn	DCE (C)	494	-0.05	1.26	-4.25**	16.39
	Soybeans	DCE (B)	494	0.19	2.34	-4.81**	25.92
	Soybean Meal	DCE (M)	494	0.30	2.71	11.13**	23.90
	Soybean Oil	DCE (Y)	494	0.06	2.89	-3.33**	16.39
	Wheat	DCE (WS)	494	-0.11	1.39	-11.42**	19.07
Softs	Cotton	ZCE (CF)	494	-0.01	2.14	-0.00	17.24
	Palm Oil	DCE (P)	439	-0.35	3.32	-9.95**	54.80
	Rubber	SHFE (RU)	494	-0.08	3.97	-2.24**	19.78
	Sugar	ZCE (SR)	494	0.07	2.49	-3.75**	16.73
Energies	Fuel Oil	SHFE (FU)	494	-0.11	3.37	-9.13**	38.72

Table A1. Summary of individual commodity futures excess returns and basis. This table presents the summary statistics for individual weekly commodity futures excess returns and basis. Futures excess returns and basis are calculated from Oct. 13th, 2006 to Mar. 25th, 2016. The abbreviation of the exchanges is following: LME (London Metal Exchange), NYMEX (New York Mercantile Exchange), eCBOT (Electronic Chicago Board of Trade), ICE US (ICE Futures US), CME (Chicago Mercantile Exchange), KLCE (Kuala Lumpur Commodities Exchange), TOCOM (Tokyo Commodity Exchange), SHFE (Shanghai Futures Exchange), DCE (Dalian Commodity Exchange), and ZCE (Zhengzhou Commodity Exchange). The code in parenthesis indicates the ticker symbol code of commodity in the exchange. The fourth column indicates the number of the observations. The table shows average weekly excess returns (mean), the standard deviations of weekly excess returns (SD), average annual basis (mean), the standard deviations of annual basis (SD), and the sample mean tests of the null hypothesis that excess return and basis are zero, respectively. The estimates marked with two (one) asterisks are significantly different from zero at the 1% (5%) level, respectively.