Financialization of Commodity Markets

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Annu. Rev. Financ. Econ. 2014. 6:419–41

First published online as a Review in Advance on October 9, 2014

The *Annual Review of Financial Economics* is online at financial.annualreviews.org

This article's doi:
10.1146/annurev-financial-110613-034432

JEL code: G1

Keywords

financialization, speculation, hedging, risk sharing, information discovery

Abstract

The large inflow of investment capital to commodity futures markets in the past decade has generated a heated debate about whether financialization distorts commodity prices. Rather than focusing on the opposing views concerning whether investment flows caused a price bubble, we critically review academic studies through the perspective of how financial investors affect risk sharing and information discovery in commodity markets. We argue that financialization has substantially changed commodity markets through these mechanisms.

1. INTRODUCTION

Over the past decade, commodity futures have become a popular asset class for portfolio investors, just like stocks and bonds. This process is sometimes referred to as the financialization of commodity markets. According to an estimate provided by the Commodity Futures Trading Commission (CFTC) in 2008, investment inflows to various commodity futures indices from early 2000 to June 30, 2008, totaled $200 billion (CFTC 2008). Concurrently, several commodities across the energy, metal, and agricultural sectors experienced a synchronized boom and bust cycle in 2007 and 2008. During this period, the price volatility of many commodities spiked.

This high price volatility has led to growing concern of the public and in policy circles as to whether financialization has distorted commodity prices and whether more government regulation in these markets is warranted. In his 2008 testimony to the US Senate, Michael Masters (2008) argued that futures market speculation had caused a bubble in oil prices in 2007 and 2008, leading to significantly higher energy costs for consumers. This bubble view was later echoed by former Congressman Joseph Kennedy II (Kennedy 2012), extended to grain commodities in a US Senate report (US Senate Perm. Subcomm. Investig. 2009), and also advocated abroad by then British Prime Minister Gordon Brown and French President Nicolas Sarkozy in 2009 (Brown & Sarkozy 2009).

Many economists, such as Krugman (2008), Stoll & Whaley (2010), Irwin & Sanders (2012b), and Fattouh, Kilian & Mahadeva (2012), however, argue that there is little systematic evidence to support the bubble view and that speculators in commodity markets are no cause for concern. The debate between this business-as-usual view and the aforementioned bubble view has garnered substantial attention from academics and policymakers alike.

More precisely, rejecting one does not necessarily justify the other. Rather than focusing on these two extreme views, we argue that researchers should test whether financialization has affected commodity markets through the mechanisms that underpin the functioning of these markets: storage, risk sharing, and information discovery. Viewed through this lens, the evidence suggests that financialization has transformed the latter two functions of commodity futures markets.

Commodity futures markets have had a long history of assisting commodity producers to hedge their commodity price risks. The longstanding hedging pressure theory of Keynes (1923), Hicks (1939), and Hirshleifer (1988) posits that hedgers are typically on the short side of futures markets and need to offer positive risk premia to attract speculators to take the long side. By bringing several financial investors to the long side, financialization mitigates this hedging pressure and improves risk sharing, as suggested by Tang & Xiong (2012). However, as pointed out by Cheng, Kirilenko & Xiong (2013) and Acharya, Lochstoer & Ramadorai (2013), financial investors also have time-varying risk appetites owing to risk constraints and financial distress. For example, financial investors may have to unwind their long commodity positions if sudden price drops in other markets lead them to reduce risk. As a result, they transmit outside shocks to commodity markets. Financialization thus affects risk sharing in commodity markets through the dual roles of financial investors: as providers of liquidity to hedgers when trading to accommodate hedging needs and as consumers of liquidity from hedgers when trading for their own needs.

Financialization may also affect information discovery in commodity markets. Due to informational frictions in the global supply, demand, and inventory of commodities, centralized futures markets supplement commonly decentralized spot markets in information discovery, à la Grossman & Stiglitz (1980) and Hellwig (1980). For example, the futures prices of key commodities such as crude oil, copper, and soybeans have been widely used as barometers of the global economy in recent years. In the presence of informational frictions, Singleton (2012) emphasizes that heterogeneous expectations among financial investors affect the expected returns of commodity futures. Sockin & Xiong (2012) show that noise brought by trading of financial investors in futures markets can feed back to the commodity demand of final-goods producers. The key friction is that goods producers cannot differentiate whether futures prices move due to financial investor trading or due to changes in global economic fundamentals.

We revisit several focal issues in the debate from the perspective of these two mechanisms. First, informational frictions help explain the puzzling price increases of many commodities in early 2008. As pointed out by Hamilton (2009a) and Kilian (2009), a key factor in explaining the commodity price boom in recent years is strong commodity demand from China and other emerging economies coupled with a stagnant commodity supply. However, this factor fails to explain the large price increases in the first half of 2008, a period when the price of crude oil increased by more than 40% before hitting a peak of $147 per barrel in July 2008 in intraday trading. It is difficult in hindsight to argue that emerging market growth, itself slowing after late 2007, could have more than offset the slowdown of developed economies to raise oil prices by 40% over six months. One possibility is that, in the presence of severe difficulty at the time in gauging the strength of the global economy, final-goods producers increased their oil demand after temporarily mistaking the price increase in oil futures as a signal of robust economic growth when it may have been induced by noise in futures market trading.

Second, one strand of the literature examines the effects of speculation based on the premise (which is motivated by the theory of storage) that inventory must have risen if speculation distorted futures prices upward (Kilian & Murphy 2014, Juvenal & Petrella 2012, Knittel & Pindyck 2013). These studies find that the price boom of crude oil in 2007 and 2008 was not accompanied by an inventory spike and is cited as evidence supporting the business-as-usual view. However, an inventory response to the rise in prices presumes that traders in equilibrium distinguish between a rise in prices induced by speculation and a rise in prices induced by changes in economic fundamentals. This presumption may be unrealistic in the face of informational frictions in spot markets. Instead, futures market speculation may distort price discovery and induce a temporary price boom accompanied by a demand response that mistakes the futures price increase as a signal of strong future fundamentals and unaccompanied by an inventory response.

Third, a significant number of empirical studies in the debate focus on directly linking futures price changes to the trading of financial investors based on the notion that their trading must be correlated with contemporaneous futures returns or be able to predict futures returns in the presence of any distortions. Standard correlation and Granger causality tests tend to be inconclusive. These unconditional tests assume that observed changes in positions are all due to shifts in the demand curve of financial traders. The market clearing condition implies that observed position movements of financial traders comprise both shifts in their demand curve as well as shifts in the demand curve of other traders in the market. In a classic version of the simultaneity bias in econometrics this leaves undetermined the sign of unconditional correlations or Granger causality tests of futures returns with the trading of financial investors, as the link is positive at times when financial investors consume liquidity but is negative when financial investors provide liquidity to commercial hedgers. Studies that employ clearer identification strategies have provided clearer evidence on the price impact of trades initiated by financial traders.

Despite the seemingly confusing evidence presented in the debate, we emphasize that organizing the evidence in terms of risk sharing and information discovery provides a more robust picture of whether and how financial investors have affected commodity markets.

2. BASIC FACTS

2.1. Commodity Price Dynamics and Macro Fundamentals

Commodity futures prices have experienced a boom-bust cycle over the past ten years. **Figure 1** plots commodity futures prices for the Goldman Sachs Commodity Index (GSCI) total returns index and three commodities from 2000 to 2011, normalized to their average 2000 level. At their peak in the summer of 2008, oil prices were nearly four times their average 2000 price, before collapsing suddenly later that year. The GSCI Total Returns index, which tracks futures prices in a basket of commodities across agriculture, energy, and metal sectors, peaked at more than three times its average 2000 level.

In searching for explanations for this pronounced super cycle in commodity prices, researchers have noted that commodity futures price dynamics have changed substantially since 2000 and in particular around the 2007–2008 Financial Crisis. Of particular interest have been both cross-commodity correlations and correlations of commodity prices with prices in other asset classes. **Figure 2** plots the cross-commodity correlation of the different sectors of the GSCI index with the GSCI Energy Total Return Index and shows that correlations rose from a pre-2004 range of −0.2 to 0.2 to a peak of 0.7 in the middle of 2008. Even across sectors, commodity prices have tended to move together as a class since the 2000s. This is consistent with the notion that commodity prices have shared a common boom and bust cycle.

Correlations of commodity prices with prices in other asset classes have also changed. **Figure 3** plots a rolling 252-day correlation of the GSCI index with the MSCI Emerging Markets Index (measuring equity performance in more than 20 markets in the Americas, Asia, and Europe), the Reuters DXY Dollar Index (a weighted index of the euro, Japanese yen, British pound, Canadian

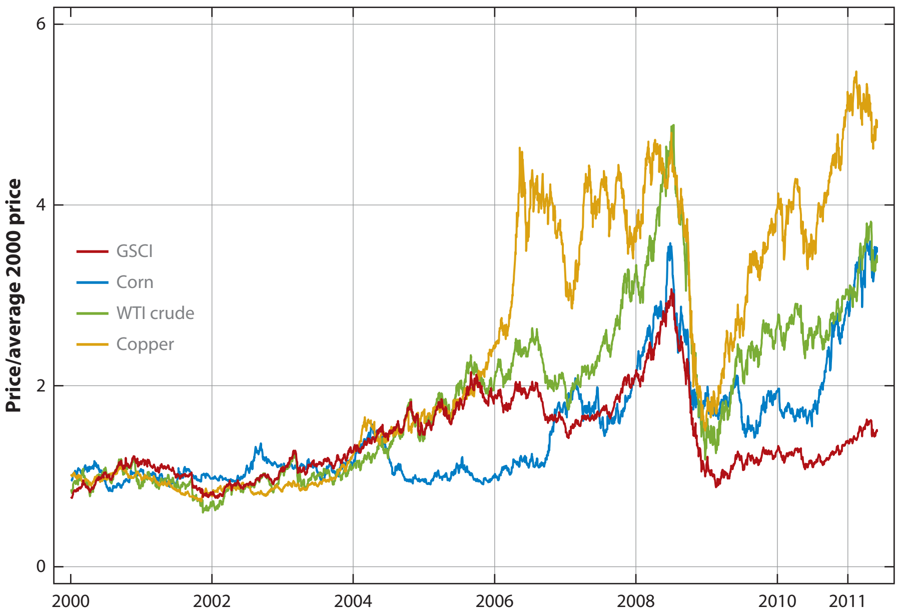

Figure 1

This figure plots the level of the GSCI Total Return Index as well as commodity prices for corn, crude oil, and copper, normalized to the average price in 2000. Data source: Bloomberg. Abbreviations: GSCI, Goldman Sachs Commodity Index; WTI, West Texas Intermediate.

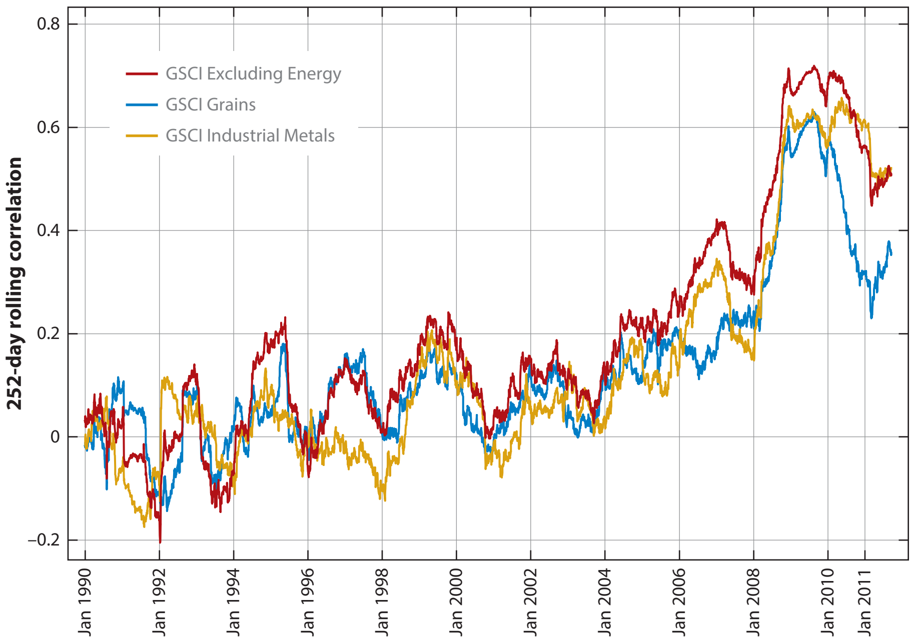

Figure 2

This figure plots the 252-day rolling correlation of percentage changes in the Goldman Sachs Commodity Index (GSCI) Energy Total Return Index with percentage changes in the GSCI Excluding Energy, GSCI Grains, and GSCI Industrial Metals Total Return indices. Data source: Bloomberg.

dollar, Swedish krona, and Swiss franc against the dollar), the Shanghai Stock Exchange A index, the change in the 10-year US Treasury yield, and the Center for Research in Security Prices (CRSP) Value-Weighted Index covering US equities. Broadly, correlations trended upward from 2004 to 2008 and have increased significantly since the collapse of Lehman Brothers in 2008. Since then, they have stayed at elevated levels compared with historical periods.[1]

Many macroeconomic explanations have been put forth in explaining these patterns. A great deal of discussion has focused on oil prices, given their historically important role in the real economy (Blanchard & Gali 2010, Hamilton 2005; for a contrary view, see Kilian 2008) and subsequent attention from policymakers (Brown & Sarkozy 2009). Although supply shocks to oil have traditionally received significant attention, which is perhaps not surprising given the history of oil supply shocks such as those in the 1970s, recent research has attributed much of the post-2003 rise in oil prices to increases in global demand (Kilian 2009, Kilian & Murphy 2014; see Kolodzeij & Kaufmann 2014 for a contrasting view). The growth of demand from emerging markets such as China and its interaction with stagnant production in the 2005–2007 period have been of particular concern (Carney 2008; Hamilton 2009a,b). The substantial increase in correlations of commodity prices with the emerging markets and Shanghai A indices plotted in **Figure 3**, as well as the increasingly negative exchange rate correlation, are consistent with the view that these fundamental demand factors from outside the United States have shaped oil prices.

[1]Extreme market volatility biases estimates of correlations (Forbes & Rigobon 2002). However, the increased correlation after the collapse of Lehman is not an artifact of this bias. A formal test that compares heteroskedasticity-adjusted correlations in the post-Lehman period with those in the pre-Lehman period all reject the null hypothesis of no change in correlation at the 1% level.

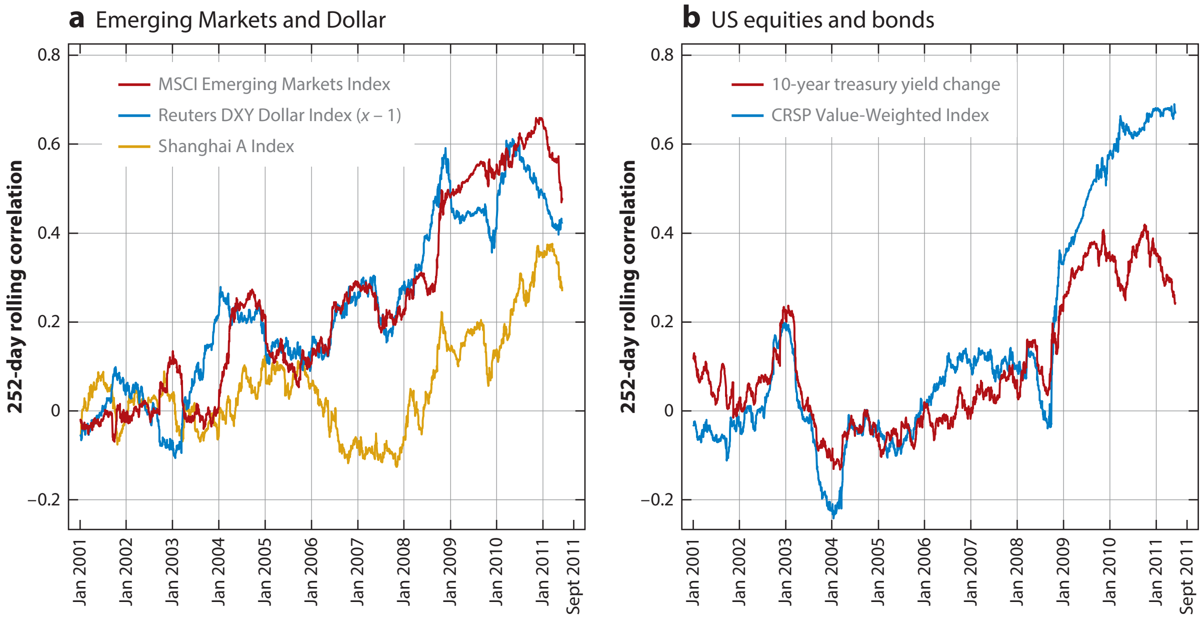

Figure 3

This figure plots the 252-day rolling correlation of the percentage change in the GSCI Total Return Index with the percentage change in the MSCI Emerging Markets Index, Reuters DXY Dollar Index (multiplied by −1), and return to the Shanghai A index in panel *a*, and the change in 10-year Treasury yield and return to the CRSP Value-Weighted Index in panel *b*. Data source: Bloomberg. Abbreviations: CRSP, Center for Research in Security Prices; GSCI, Goldman Sachs Commodity Index; MSCI, Morgan Stanley Capital International.

This growing resource demand from emerging markets, as well as the adoption of technologies such as ethanol that arguably turn agricultural commodities into substitutes for oil (Peñaranda & Micola 2011), have been cited as fundamental reasons as to why commodity prices have increased not only in oil, but across the board. (Baumeister & Kilian 2013 argue against the ethanol hypothesis.) Data from China Customs indicate that imports of soybeans, cotton, sugar, copper, and aluminum have grown significantly over the preceding decade, and markets routinely follow these numbers as leading indicators of demand. The increase in cross-commodity correlations plotted in **Figure 2** is also consistent with this conjecture that these fundamental demand factors are shaping not only oil prices, but many other commodity prices as well.

2.2. The Changing Nature of Futures Market Participation

The composition of participants in commodity futures markets has also dramatically changed over the past decade. Traditionally, researchers have viewed commercial hedgers and noncommercial traders (such as hedge funds) as the two major classes of market participants. Commercial hedgers such as farmers, producers, and consumers regularly trade commodity futures to hedge spot-price risk inherent in their commercial activities. Noncommercial traders, such as hedge funds or other managed money vehicles, invest others' money on a discretionary basis in commodities, commodity futures, and options on futures, and make extensive use of leverage.

Over the past decade, there has been a large inflow of investment capital from a class of investors, so-called commodity index traders (CITs), also known as index speculators. CITs seek exposure to commodity prices as part of a broader portfolio strategy. They treat commodity futures as an asset class just like stocks and bonds and often invest in instruments linked to broad-based indices such as the GSCI. On a practical level, CITs often establish commodity index positions by acquiring index swap contracts from financial swap dealers or purchasing exchange-traded funds and exchange-traded notes from fund companies, rather than directly taking long positions in individual commodity futures. These financial swap dealers and funds then hedge themselves by taking long positions in individual commodity futures.

The influx of CITs has led to significant changes in futures markets across two dimensions. First, gross positions in futures markets grew dramatically from 2004 through 2006. Data from the CFTC's Commitment of Traders (COT) plotted in **Figure 4** show that open interest in many commodities rose dramatically from 2004 onward. The annualized monthly growth rate among the thirteen GSCI commodities that the COT has tracked since its inception averaged 31% during the 2004–2006 period, a rate nearly triple that of 2001–2003 and not seen since the inception of the COT.

Second, although market clearing implies that the net exposure of CITs, hedge funds, or commercial hedgers need not have grown as a result of the growth in gross positions, net exposures did grow substantially, leading to the so-called financialization of futures markets. **Figure 5** shows that the growth in CIT investing has resulted in a dramatic expansion of the long side of agricultural futures markets. The figure shows that producers expanded their short positions concurrently with the expansion of long positions by CITs. These dramatic changes in market participation have led to a concern that financialization in the form of index speculation contributed to the dramatic run-up in commodity prices.

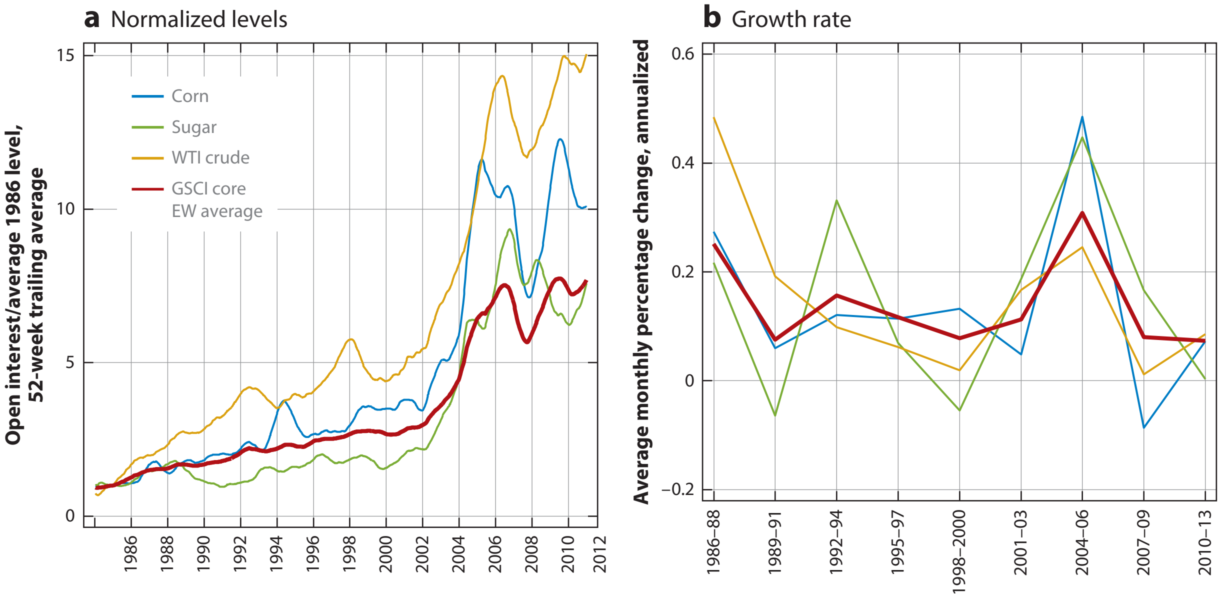

Figure 4

Panel *a* plots open interest in corn, sugar, oil and GSCI normalized to the average 1986 open interest. Panel *b* plots annualized average monthly percentage changes in open interest for three-year periods beginning in 1986. The GSCI core equal-weighted average is the equal-weighted commodity average within the GSCI commodities that have data going back to 1986. All values are 52-week trailing averages. Data source: CFTC COT reports. Abbreviations: CFTC, Commodity Futures Trading Commission; COT, Commitment of Traders; EW, equal-weighted; GSCI, Goldman Sachs Commodity Index; WTI, West Texas Intermediate.

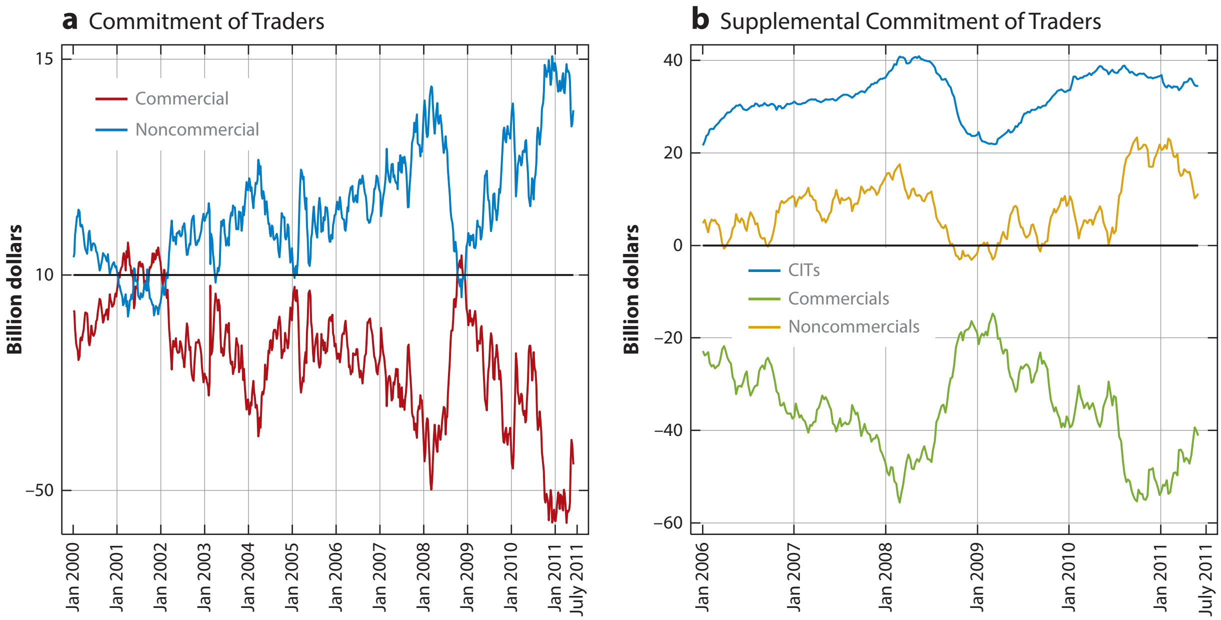

Figure 5

Panel *a* plots the aggregate net notional value for trader groups in the COT report in the 18 GSCI commodities tracked. Panel *b* plots the same for trader groups in the SCOT report for the 12 agricultural commodities tracked. Notional values are calculated using fixed prices as of December 15, 2006. Data source: Bloomberg, CFTC COT reports. Abbreviations: CFTC, Commodity Futures Trading Commission; COT, Commitment of Traders; GSCI, Goldman Sachs Commodity Index; SCOT, Supplemental Commitment of Traders.

3. ECONOMIC MECHANISMS

Before we dive into the debate about the effects of financialization, we first review several economic mechanisms through which futures market trading can impact commodity prices. We first describe the standard theory of storage, in which the spread between futures price and spot price serves as the incentive to store a commodity over time. We then describe two other mechanisms—risk sharing and information discovery. Although they have received much less attention in the ongoing debate about the financialization of commodity markets, these two mechanisms are widely regarded as the key ways in which trading may impact many other financial markets.

3.1. Commodity Storage

Kaldor (1939), Working (1949), Brennan (1958), and Telser's (1958) theory of storage emphasizes a timing option embedded in holding a storable commodity. As the holder of such a commodity can choose to either consume the commodity or save it for future consumption, the price of the commodity is the maximum of its current consumption value and the expected value from consuming it at a future date when the commodity supply is scarce. The option of delaying consumption thus makes the commodity price higher than the value of consuming all currently available supply and gives rise to a convenience yield of holding the commodity. This notion of convenience yield has motivated a strand of the literature to model the term structure of commodity futures prices by parameterizing the dynamics of the convenience yield (Brennan 1991, Gibson & Schwartz 1990, Casassus & Collin-Dufresne 2005).

The convenience yield is ultimately driven by the nonnegativity constraint of commodity inventory. When there is a shortage of a commodity, one cannot simply borrow from future supply to fulfill current consumption. Scheinkman & Schechtman (1983) first develop a dynamic rational expectations model with risk-neutral agents to analyze the impact of the nonnegativity constraint on the dynamics of commodity prices. They characterize the agent's optimal consumption/storage decision in the presence of uncertainty about the balance between future supply and demand. Their analysis formalizes the intuition from the previous literature and generalizes Wright & Williams' (1982) numerical models. Building on this dynamic framework, Deaton & Laroque (1992, 1996) highlight that commodity storage can smooth prices and induce serial dependence in prices even when commodity supply and demand follow independent and identically distributed processes. They also provide empirical evidence that this insight helps explain the serial correlation commonly observed in commodity prices.

In the theory of storage, the futures basis (the spread between the futures and spot prices) of a storable commodity is directly related to the cost of storing the commodity, which includes costs of warehousing and financing. If the spread is higher than the cost, a commodity carry trade of buying the commodity in the spot market, shorting a futures contract, and carrying the commodity to make the delivery leads to an arbitrage. Nominal interest rates are an important factor that drives the futures spread because they affect the financing cost of the carry trade, which Fama & French (1987) confirm empirically. Through this interest-rate channel, Frankel (2006) argues that monetary policy has an important effect on commodity prices. Gruber & Vigfusson (2012) provide both theoretical and empirical analyses to show that by reducing inventory cost, lower interest rates decrease commodity price volatility.[2]

Routledge, Seppi & Spatt (2000) analyze the term structures of both the price level and volatility of commodity futures prices by adopting the aforementioned rational expectations model of storage. They highlight several results. First, there is a positive correlation between the futures spread and commodity inventory, which Gorton, Hayashi & Rouwenhorst (2013) confirm using detailed inventory data in a large set of commodities. Second, inventory buffers the impact of temporary supply and demand shocks on the spot price and thus mitigates the downward sloping volatility curve attributed to the mean reversion of the supply and demand shocks by Samuelson (1965). This prediction is consistent with the earlier finding of Fama & French (1988) that among industrial metals, futures prices are less variable than spot prices when inventory is low and that the variability is similar when inventory is high.

If agents are risk neutral, commodity futures prices should reflect agents' expectations regarding future spot prices, which in turn makes the futures spread a useful predictor for future spot prices. Fama & French (1987) find only mixed evidence that the futures spread is a useful predictor of future spot prices. Instead, their analysis indicates the importance of a time-varying risk premium component in the futures spread. In subsequent studies, Gorton, Hayashi & Rouwenhorst (2013) further relate this risk premium to commodity inventory, whereas Hong & Yogo (2012) relate it to the growth of open interest. Alquist & Kilian (2010) also confirm that the futures spread of crude oil does not provide more predictive power than the current spot price and instead argue that uncertainty about future oil supply drives the futures spread through precautionary demand.

[2]The models of commodity storage tend to ignore the production side of the economy. Kogan, Livdan & Yaron (2009) fill this gap by developing an equilibrium model of oil production in which investment is irreversible and capacity constrained. This model explains a stylized fact regarding a V-shaped relationship between the volatility of oil futures prices and the slope of the forward curve.

3.2. Risk Sharing

One of the original reasons for developing commodity futures markets was to facilitate more efficient sharing of commodity price risk. Farmers are heavily exposed to price risk in crops that have not been harvested; producers of oil, copper, and gold are exposed to their respective price risk, and airlines face the risk of higher fuel costs induced by rising oil prices. Centralized commodity futures markets provide convenient platforms for producers and consumers of different commodities to hedge commodity price risk in their commercial businesses and thus to facilitate more efficient risk sharing among a broad set of agents.

3.2.1. Hedging pressure. The long-standing hedging pressure theory of Keynes (1923) and Hicks (1939) emphasizes that commercial hedgers, who are typically net short in the commodity futures market, face insufficient interest from other participants on the long side and thus need to offer premia for unloading their risks. Such risk premia, all else being equal, cause commodity futures curves to tilt toward backwardation. For this reason, this theory is also called the theory of normal backwardation. The key friction in this theory is the (partial) segmentation of commodity futures markets from the broad financial markets, which leads to inefficient risk sharing.

In the modern literature, Hirshleifer (1988, 1990) provides formal models to lay out specific assumptions that underlie inefficient risk sharing in commodity futures markets. Hirshleifer (1988) adopts a static CAPM setting with commodity producers initially endowed with both aggregate market risk and idiosyncratic commodity risk. Producers can sell a commodity futures contract to speculators to diversify the commodity risk. However, a fixed participation cost limits the risk-bearing capacity of speculators on the long side of the futures market, and thus endogenously determines the equilibrium premium for the idiosyncratic commodity risk. Hirshleifer (1990) further clarifies several other necessary conditions. In particular, he addresses why consumers who face the opposite commodity price risk from producers do not hedge, which would otherwise eliminate the producers' hedging pressure. As consumers face price risk across multiple commodities they consume, and producers face concentrated price risk in the specific commodity they produce, the fixed cost of participating in each futures market deters consumers more than producers.

On the empirical front, Carter, Rausser & Schmitz (1983) and Bessembinder (1992) provide evidence that average returns from holding commodity futures positions tend to be significantly positive conditional on hedgers taking net short positions and significantly negative conditional on hedgers taking net long positions. They also document a significant premium for idiosyncratic risk in a set of agricultural commodity futures returns. de Roon, Nijman & Veld (2000) provide evidence that hedging pressure on a commodity futures market stems from not only its own market but also hedgers' short positions in other closely related commodities, or so-called cross-market hedging. Rouwenhorst & Tang (2012) conclude from the literature, however, that the empirical support linking excess returns to hedging positions is more mixed.

3.2.2. Returns to passive investment. Several recent studies find that in the historical data, rolling over commodity futures contracts provides attractive investment returns. Gorton & Rouwenhorst (2006) analyze futures returns of a set of commodities in the GSCI from 1959–2004 and find that the average return of 5.23% per annum in excess of the short-term interest rate is comparable to the 5.65% excess return of the S&P 500 during the same period. The volatility of commodity futures returns and S&P 500 returns, 12.10% and 14.85%, respectively, are also comparable. More importantly, the commodity futures returns offer a diversification benefit, as they are negatively correlated with returns of stocks and bonds and positively correlated with changes in inflation.

One can decompose returns from investing in a passive commodity futures index into two components, one from the spot return (i.e., the spot price fluctuation of a commodity) and the other related to the slope of the futures curve. A typical index such as the GSCI requires holding the front-month futures contract of a commodity until the contract is close to maturity and then rolling it into the next futures contract. Thus, even in the absence of any fluctuation in the spot price and the futures curve, this rolling strategy of buying a more distant contract and then selling it at a shorter maturity would yield a positive return when the futures curve is in backwardation (downward sloping) but a negative return when the curve is in contango (upward sloping). This return is derived from the slope of the futures curve and is often called the roll return. Operationally, one can compute the roll return as the residual return after removing the commodity's spot return from its futures return.

Erb & Harvey (2006) characterize the return from investing in commodity futures in a 1982–2004 sample period. They highlight that the roll return is a more important source of return than the spot return in the observed high return from rolling commodity futures indices. This implies that commodity futures curves tend to be in backwardation. Furthermore, they show that futures returns from individual commodities are largely uncorrelated in their sample period, with agricultural commodities and precious metals performing particularly poorly and the energy sector performing particularly well.[3]

It is tempting to associate the high roll return with the premium hedgers offer to unload their commodity price risk. However, the slope of the futures curve, which ultimately drives the roll return, is also determined by two other important economic forces. First, when the futures curve is in contango, the standard no-arbitrage principle implies that the slope of the curve is equal to the cost of carrying the commodity between the maturity dates of two futures contracts. Second, when the futures curve is in backwardation, the aforementioned theory of storage implies that the slope of the curve is determined by the convenience yield from holding inventory. Thus, the roll return does not simply reflect the hedging premium. Instead, the hedging premium should appear in the futures return, which is the net of the spot return and roll return.

The high return from investing in passive commodity futures indices is consistent with the hedging pressure theory. In addition, two other features also indicate that commodity futures markets were partially segmented from each other and from outside markets during the period analyzed by these studies. First, the lack of correlation between the futures returns of individual commodities is in sharp contrast to the well-known large positive correlations between unrelated stocks in the same stock market and reflects the partial segmentation of individual commodity futures markets from each other. Second, the negative return correlation between commodities and stocks also suggests that systematic risk, which the asset-pricing literature identifies as a key factor in explaining returns of many asset classes such as stocks, bonds and currencies, was not an important factor in the positive returns to commodity futures.

3.3. Information Discovery

In the presence of informational frictions about global supply and demand of commodities, centralized futures market trading serves to aggregate dispersed information by market participants across the world. This makes commodity futures prices important price signals to guide commodity demand and thus an important feedback channel for futures market trading to affect both commodity demand and spot prices.

[3]Irwin & Sanders (2012a) challenge the robustness of the high returns in historical data by noting the large variation in the returns from investing in commodity futures across periods and across commodities.

3.3.1. Informational frictions. Participants of commodity markets face severe informational frictions. The globalization of many industrial and agricultural commodities has exposed market participants to informational frictions regarding the supply, demand, and inventory of these commodities around the world. Aggregating such information from different countries or regions is challenging. The statistics from emerging economies are often scarce and unreliable. The statistics from countries in the OECD (Organization for Economic Co-operation and Development), while more reliable, are often delayed and also subject to subsequent revisions. Information regarding the supply and inventory of oil is difficult to capture completely, as it incorporates aboveground, below-ground, and ship-board supplies. The process of quoting spot prices has arguably also been subject to manipulation due to these informational frictions (Scheck & Gross 2013).

Motivated by the pervasive informational frictions in commodity markets, Singleton (2012) argues that heterogeneous beliefs can lead market participants to engage in speculative trading against each other, which, in turn, may induce commodity futures prices to drift away from fundamental values, resulting in price booms and busts. Furthermore, he documents economically and statistically significant effects of investor flows on oil futures prices and attributes these effects to risk or informational channels distinct from changes in convenience yield.

3.3.2. Informational role of commodity futures prices. Trading in spot markets is subject to several practical complications. First, there is substantial heterogeneity in the quality and grades of any given commodity, for example, crude oil. This heterogeneity can lead to a significant variation in the traded prices. Second, the cost of transporting the commodity to different locations around the world allows a commodity of the same quality to be traded at different prices at different locations.

Trading in futures markets serves as an important platform for aggregating dispersed information and mitigates informational frictions in spot markets. Futures contracts are usually standardized and precisely specify the quality and grades of the commodity to be delivered at a specific location and time. The standardized contracts make their prices easier to evaluate. Furthermore, the convenience of trading futures contracts without necessarily taking or making a physical delivery allows people from all over the world to trade in a few centralized futures exchanges, such as the Chicago Mercantile Exchange, the New York Mercantile Exchange, and the London Metals Exchange.

Roll (1984) provides a classic study of how the futures price of orange juice efficiently reflects information about the temperature in central Florida, which produces most of the juice oranges in the United States. After going through several variables related to both supply and demand of orange juice, he also finds that a large fraction of price volatility remains unexplained. Garbade & Silber (1983) compare the roles of futures markets and cash markets in information discovery for a set of commodities. By estimating a vector-autoregressive model of futures and spot prices, they find that it is common for more than half of new information to be incorporated first into futures prices before flowing into spot prices.

Due to their global nature, commodity futures markets are often regarded as barometers of global economic strength. Hu & Xiong (2013) provide evidence that commodity futures prices traded in the United States reveal information relevant to East Asian stock prices. Specifically, they find that from 2005 to 2012, the stock prices of China, Hong Kong, Japan, South Korea, and Taiwan had positive reactions to lagged overnight futures prices of copper and soybeans traded in the United States, albeit with weaker reactions to crude oil. Interestingly, these East Asian economies are all net importers of these commodities. The positive price reactions indicate that East Asian stock markets tended to interpret the rising futures prices as signals of strong global demand for their produced final goods despite the higher input factor cost during the sample period.

Broadly speaking, economic policymakers across the world also pay close attention to commodity prices for information regarding inflation. On July 3, 2008, the European Central Bank (ECB) announced it would raise its key interest rate, citing high commodity prices in particular for its concern about the potential inflation risk. The awkward timing of this interest rate increase on the eve of a bust in oil prices and the worst global recession in several decades highlights the strong influence that commodity prices exert on economic policymakers.

3.3.3. Information aggregation and feedback effects. The economics literature has long acknowledged that centralized trading in asset markets serves an important role in aggregating dispersed information possessed by market participants. Grossman & Stiglitz (1980) and Hellwig (1980) developed the canonical workhorse models for analyzing information revelation in asset prices. Due to the presence of noise traders, who trade for reasons unrelated to asset fundamentals, equilibrium asset prices only partially reveal informed traders' private signals in the first model and the asset fundamental in the latter. Recently, Smith, Thompson & Lee (2013) adopt this framework to characterize the determinants of informational efficiency in commodity spot prices.

Sockin & Xiong (2012) develop a theoretical framework to analyze informational feedback effects of commodity spot and futures prices on commodity demand. Their framework integrates centralized commodity market trading under asymmetric information with an international macro setting, as in Obstfeld & Rogoff (1996) and Angeletos & La'O (2013). In this setting, a continuum of specialized goods producers whose production has complementarity—which emerges from their need to trade produced goods with each other—demand a key commodity, such as copper, as a common production input. By trading the commodity, the goods producers aggregate disperse information regarding unobservable global economic strength, which ultimately determines the demand for their produced goods and thus the goods producers' demand for the commodity. The model features a unique log-linear equilibrium in which the commodity price is a function of global economic strength and informational noise originating from either supply-side uncertainty or nonfundamental futures market trading.

In the absence of any informational frictions, standard economic intuition suggests that *a*) a higher commodity price leads to a lower quantity demanded by commodity consumers; *b*) a positive supply shock reduces price and boosts the quantity demanded; and *c*) futures prices are a shadow of spot prices through the standard no-arbitrage relation. When goods producers face unobservable shocks to demand and supply and noise in futures market trading, these standard intuitions may not hold. Due to the informational role of commodity prices, demand may increase with price. This is because a higher commodity price signals a stronger global economy and motivates each goods producer to demand more of the commodity for producing more goods. This informational effect offsets the cost effect. The complementarity in production among goods producers magnifies the informational effect through their incentives to coordinate production decisions and can lead to a positive price elasticity of their commodity demand. Due to the same mechanism, noise from futures market trading can affect goods producers' expectations of global economic strength and thus feed back to their commodity demand and the spot price of the commodity. This implies that futures prices are more than just a shadow of spot prices.

A supply shock also has an amplified price effect. As goods producers cannot differentiate a price decrease caused by a positive supply shock from a price decrease caused by a negative demand shock, they partially attribute the supply shock to the demand shock. This reduces the incentive of goods producers to demand a greater quantity of the commodity at the lowered price.

4. FOCAL ISSUES IN THE DEBATE

We now discuss several focal issues in the debate about the role of speculation in commodity futures prices through the lens of these economic mechanisms.

4.1. What Is Speculation?

The debate has largely focused on whether excessive speculation has distorted prices away from fundamental values. Conceptually, hedging is usually defined as trading in futures markets to mitigate cash flow risk in one's endowed business; speculation is defined as trading in futures markets to profit from price movements. Excessive speculation in futures markets has been defined traditionally as speculation in excess of what would be required to satisfy hedging demand (see, e.g., Working 1960).

Many academic and policy studies of futures markets tend to operationalize this definition through two long-standing practices. One practice is to classify all market participants into hedgers and speculators based on certain identification schemes and then to treat all trading by hedgers as hedging and all trading by speculators as speculation. The other practice is to treat hedgers' hedging demand as exogenous and fixed.

These practices are intuitively appealing and convenient to implement, and thus have had a long-standing influence on the measurement and study of speculative activity in futures markets. In measuring positions in futures markets, the COT report itself, dating back to 1924, classifies trader positions into two categories: those of commercial and noncommercial traders. Studies analyzing the role of speculation, dating from Working (1960), have analyzed the role of Working's *T*, also known as Working's speculative index, a ratio of the position held by speculators to that of hedgers. It is common to interpret a high index or high volatility of the index as indicative of excessive speculation. This interpretation of Working's T assumes that the total measured level of hedgers' positions is the exogenous hedging demand and that the variation in Working's T is being driven by trading by speculators.

However, these practices face serious limitations. The first practice ignores the different motives for commercial hedgers to trade in futures markets. As suggested by **Figure 5**, the volatility of commercial hedger positions is quite high. Cheng & Xiong (2013) show that although commercial hedgers in wheat, corn, soybeans, and cotton do take short positions to hedge crop exposure, the volatility in their positions is many times the volatility of output and revisions to output forecasts. Price changes prove to be a far better explanatory variable for short-term changes in hedgers' positions than changes in output forecasts. Using weekly COT data from 1994 onward in 26 commodities, Kang, Rouwenhorst & Tang (2013) and Rouwenhorst & Tang (2012) show that hedgers trade weekly in a contrarian manner by selling when prices are high and buying back when prices are low. Hartzmark (1987) shows that the daily trades of hedgers earn significant profits. Taken together, hedgers trade more than is necessary to just hedge risk in their commercial businesses.

In contrast to the second practice, speculators do not just trade among themselves—they trade with commercial hedgers. For example, the position changes of commercials and noncommercials in **Figure 5** are largely mirror images; Cheng, Kirilenko & Xiong (2013) provide evidence for trader groups defined in finer categories. This implies that any "excessive trading" by speculators is associated with "excessive trading" by commercial hedgers. In the absence of further evidence, it is difficult to distinguish those who are consuming from those who are providing liquidity in these markets.

One possibility is that commercial hedgers may attempt to exploit informational advantages by trading against speculators. For example, commercial firms may exploit informational frictions in spot markets, as they may have better knowledge of local physical market conditions. This so-called selective hedging has been observed in practice by Stulz (1996) and Knill, Minnick & Nejadmalayeri (2006). A second possibility is that participants in futures markets are not producers themselves but are market makers between the cash and futures markets who trade futures to hedge forward contracts written with the ultimate commodity producers such as farmers.

Although risk sharing is a central function of futures markets, the line between hedging and speculating is blurred in practice. If one takes the notion of speculation as trading for profit from price movements, all trader groups, including commercial hedgers, appear to be engaged in speculation on the margin. An analysis of who provides and consumes liquidity and who performs what role in different periods may be a more economically relevant analysis of trading activity rather than classifications based on trader status.

In analyzing the role of speculation by different trader groups in futures markets, the problem of treating one particular trader group as exogenous is pervasive. The market-clearing condition will imply that position changes of any trader group can alternately provide liquidity during some periods and consume liquidity in others, so that no trader group can be treated as plausibly exogenous. This problem has manifested itself most recently in the debate about the role of CITs in futures markets, to which we now turn.

4.2. Price Pressure from Index Speculation

The concern about index investment affecting commodity prices became particularly prominent after Michael Masters' testimony before the US Senate (Masters 2008). By imputing CIT positions for oil using index weights and reported positions in the SCOT (Supplemental Commitment of Traders) for Kansas City Wheat, Feeder Cattle, and Soybean Oil, he posited the so-called Masters hypothesis, which, on its face, is a simple assertion—that the large boom and bust in oil prices was caused by index investment flows.

An early wave of studies examine this by testing whether CIT position changes are either contemporaneously correlated with futures price changes or Granger-cause changes in futures prices (Brunetti & Büyükşahin 2009; Brunetti, Büyükşahin & Harris 2011; Büyükşahin & Harris 2011; Irwin & Sanders 2012a,b; Irwin, Sanders & Merrin 2009; Sanders & Irwin 2011a,b; Stoll & Whaley 2010) and find little relationship in a wide basket of commodities. However, the 13-week change in CIT futures positions for oil predicts changes in futures prices in 2006–2010 (Singleton 2012, Hamilton & Wu 2013). Gilbert (2010) argues that index investment does Granger-cause rises in food prices. Others also examine Working's T and find few increases (Sanders, Irwin & Merrin 2010, in addition to many of the above papers). Cross-sectional tests do not find higher monthly or quarterly returns in commodities in which CITs dominate the market (Sanders & Irwin 2010).

Although a useful first step in describing the data, the conflicting results from these tests highlight the limitation of their empirical design. Tests of whether CIT position changes are correlated with price changes treat CIT position changes as exogenous, leading to downward-biased estimates of price impacts in a classic version of the simultaneity bias in econometrics (Cheng, Kirilenko & Xiong 2013). Tests of Working's T often suffer from the mirror image problem of treating hedging positions as exogenous. Granger-causality tests, despite being a standard test of forecasting power, do not establish causality either way.[4]

Direct tests of price impacts and impacts on correlations should incorporate clear identification strategies in the spirit of Angrist & Pischke (2010). Recent papers that exploit variation in motives for trading have found effects of CIT trading in certain contexts. Henderson, Pearson & Wang (2012) find that trading new commodity-linked notes (CLNs), a form of index investment, leads to positive price pressure in futures markets around a two-day window of the pricing date and that this price impact increases with the size of the trade. Mou (2011) examines the interaction of hedge fund trading in response to the so-called roll of CITs and finds that these prespecified rolls allow hedge funds to profit at the expense of index investors. Further work along this line is needed.

4.3. Effects on Risk Sharing

Risk sharing is a recurring theme of commodity futures markets. To analyze the effects of risk sharing, one needs a sufficiently general framework to incorporate not only the hedging need of hedgers but also the need of financial traders to reduce risk from time to time due to their own time-varying risk appetite.

4.3.1. Index speculation and risk sharing. In asserting that the primary cause of the oil boom and bust was index investment, the Masters hypothesis oversimplifies its potential effect on commodity prices by ignoring the underlying mechanisms. The large inflow of financial capital to the long side of commodity futures markets is likely to affect risk sharing by integrating the previously segmented commodity futures markets with outside financial markets. Several findings from recent studies are consistent with such a possible integration. First, by analyzing the daily futures returns of individual commodities, Tang & Xiong (2012) find that the correlations between different commodities have increased after 2004 to significantly positive levels from levels close to zero. In particular, they find that the correlation increases are particularly pronounced for commodities inside popular commodity futures indices.[5]

Second, several studies, such as Büyükşahin & Robe (2011, 2013) and Silvennoinen & Thorp (2013), show that the return correlation between commodities and stocks has turned significantly positive after 2008, in sharp contrast to the negative correlation between them in the previous years. Büyükşahin & Robe (2011, 2013) provide further evidence linking the positive correlation between commodities and stocks to the trading of hedge funds, although this may not hold generally (Büyükşahin, Haigh & Robe 2010). They find little effect of CIT trading on commodity-equity correlations. However, it does appear that correlations across contracts within commodities have increased significantly since 2004, consistent with the rise of CIT trading (Büyükşahin et al. 2008).

[4]These issues are compounded given the issues with data from the COT reports, particularly given the simultaneous interest in oil but lack of well-measured data for CIT positions in nonagricultural commodities. Instead, much of the above literature often uses data on swap-dealer positions, either from the public disaggregated COT (DCOT), or from the proprietary CFTC Large Trader Reporting System data underlying the COT reports, to proxy for CIT positions. However, swap-dealer positions are a very noisy proxy for CIT positions, as they comingle positions of both CITs, who trade in financial swaps, and physical commodity swap dealers who are not CITs (intuitively, there were swap dealers in commodity futures markets well before the advent of CITs). Although, the original methodology proposed by Masters (2008) appears at odds with the low-frequency special call data about CIT positions in all commodities (including nonagriculturals) the CFTC has gathered via survey (Irwin & Sanders 2012b). Overall, there is no consensus on how to measure CIT positions outside of agricultural markets.

[5]This finding is consistent with an earlier study of Pindyck & Rotemberg (1990) regarding the presence of excessive comovement among seemingly unrelated commodities, which they attribute to speculation or irrational expectations.

Finally, Hamilton & Wu (2014) estimate a structural affine model of crude oil futures prices, which explicitly builds in potential hedging pressure from hedgers or financial investors. They find a significant reduction in oil futures risk premia since 2005, consistent with smaller average hedging pressure in recent years.

Recent theoretical studies help explain risk sharing in commodity markets with heterogeneous agents. Basak & Pavlova (2012) analyze an endowment economy in a continuous-time setting with multiple commodity goods and two types of agents. One type of agent has standard power utility preferences, whereas the other type—index investors—has preferences benchmarked to the level of a commodity-investment index. The presence of index investors causes the futures returns of those commodities in the index to have higher correlations with each other and with the stock return than those outside the index. Baker & Routledge (2012) develop a dynamic endowment-economy model with two goods, one of which is oil, and two types of agents with different risk preferences within the Epstein-Zin recursive preference structure. Their calibration analysis shows that dynamic risk sharing between the two types of agents can generate wide variations in prices, risk premia, and open interest over time.

Baker (2012) develops a dynamic equilibrium model with heterogeneous risk-averse participants and storage to evaluate the effects of financialization. In his model, financialization reduces the cost to household consumers of trading in a futures market, which is initially dominated by commercial producers and dealers. His calibration shows that financialization accounts for a significant reduction in the commodity futures excess return and the frequency of futures curve backwardation.

4.3.2. Time-varying risk appetite. Several recent studies, such as Etula (2010), Acharya, Lochstoer & Ramadorai (2013), and Cheng, Kirilenko & Xiong (2013), emphasize that financial investors' risk-bearing capacity, and thus the risk premium and degree of risk sharing, vary over time. They emphasize that the group of traders driving prices at any given moment is given by the group with the strongest incentive to trade. Whereas the hedging pressure theory posits that commercial hedgers comprise this group, these studies emphasize that this group can at times change to financial traders, consistent with the growing strand of intermediary pricing theory. This theory emphasizes that at times, especially during crises, reduced risk appetite may cause financial traders to unwind positions (Shleifer & Vishny 1997; Kyle & Xiong 2001; Gromb & Vayanos 2002; Brunnermeier & Pedersen 2009; Danielsson, Zigrand & Shin 2010; He & Krishnamurthy 2013).

Etula (2010) shows that the relative leverage of the broker-dealer sector (a measure of financial traders' risk-bearing capacity) has significant predictive power for futures returns of a set of commodities, especially for energy commodities. Acharya, Lochstoer & Ramadorai (2013) use the default risk of a set of energy producers to measure their hedging demand. They provide evidence that futures risk premia of the related energy commodities increase with the producers' hedging demand and, furthermore, the fraction of the futures risk premia attributable to producers' default risk is higher when broker-dealer balance sheets are shrinking.

Motivated by the financial distress experienced by many financial institutions during the recent financial crisis, Cheng, Kirilenko & Xiong (2013) analyze the reallocation of commodity risk between financial traders and hedgers during the crisis. By using changes in the VIX to proxy for shocks to financial traders' risk-bearing capacity, they find that during the crisis, albeit not before the crisis, increases in the VIX led financial traders such as commodity index investors and hedge funds to reduce their net long positions in 12 agricultural commodities. The market-clearing condition implies that this was coupled with reductions in futures prices and hedgers' short positions, leading to a reallocation of commodity price risk from financial traders to hedgers during the crisis. This result highlights financial traders' dual roles as liquidity providers and liquidity consumers to hedgers.

4.4. Did Speculation Distort Spot Prices?

A central question in the debate is whether speculation in futures markets, either by CITs or other speculators, distorted spot prices. After the price boom in 2008, several economists, such as Krugman (2008), Hamilton (2009a), and Smith (2009), pointed toward the lack of inventory response to futures prices as reason to doubt speculative effects on spot prices. The logic follows the theory of storage. If speculation drives up the futures price of a commodity, the increased futures spread to the spot price would induce more commodity storage, which in turn would drive up the spot price as less of the commodity is made available for current consumption. Knittel & Pindyck (2013) examine the US data on crude oil production, consumption, inventory, and the futures spread and find little evidence for this storage effect in the data for the 1998–2012 period.

Kilian & Murphy (2014) use a structural vector autoregressive approach to analyze speculative effects on oil spot prices through this storage mechanism. Using data on crude oil production, global real activity, the real price of oil, and above-ground oil inventories, along with sign restrictions on the impact of innovations of these four variables on other variables and bounds on demand and supply elasticities, they argue that speculative demand shocks—shocks to above-ground inventories—cannot account for the recent boom and bust in oil prices, although they do account for behavior in the 1979, 1986, and 1990 oil price shock episodes. Instead, shocks to demand associated with fluctuations in the business cycle, or flow demand shocks, account for most of the recent boom and bust in 2007 and 2008. Juvenal & Petrella (2012) use a different set of structural assumptions to estimate the role of speculative effects in this episode and find a slightly larger effect for speculative demand, although their results suggest that global demand was nonetheless the key driver of the recent oil price boom.

These studies sidestep the debate about how the trading of different groups affects futures prices and instead go directly to the question of how much variation in spot prices can be accounted for by variation in inventories using a structural vector autoregression (VAR) analysis of the real oil market. Futures market data are not used in their analysis at all. Although useful for identifying effects of futures market speculation flowing through the inventory channel, it is less useful for identifying speculative effects through the risk-sharing and information-discovery channels. Few studies have examined the effects of futures market trading on spot prices through these other two channels.[6]

Although no one doubts the importance of the theory of storage, the dramatic increase in oil prices during the first half of 2008 presents a challenge for studies that attribute it to a rise in fundamental demand. Although strong oil demand from emerging markets such as China drove prices to high levels before 2008, oil prices further increased by 40% in the first half of 2008 before peaking at $147 per barrel in intraday trading in July 2008. During this period, oil inventory did not spike, leading many to conclude that the price increase during this period was driven by strengthening demand as it was before 2008.[7]

[6]As an exception to this literature, Lombardi & Van Robays (2011) explicitly build in futures market shocks in a structural VAR model. By imposing a set of sign restrictions, their estimation results show that futures market shocks can destabilize spot prices in the short run and in particular, exacerbated oil price volatility in 2007–2009. A potential weakness of their analysis is that their sign restrictions allow the spread between futures and spot prices to deviate from their no-arbitrage relation without spelling out a specific mechanism for futures market shocks to affect spot prices.

[7]Interestingly, oil inventory in the United States dramatically increased at the end of 2008 when the price dropped to approximately $40 per barrel, less than one-third of the peak level.

However, major world economies such as the United States were falling into recession in late 2007, with the United States beginning its recession in December 2007 (as marked by the National Bureau of Economic Research). The S&P 500, FTSE 100, DAX, and Nikkei equity indices had peaked by October 2007; with the collapse of Bear Stearns in March 2008, the world financial system was facing imminent trouble. Growth in China was also slowing: Year-on-year growth in China's GDP peaked in mid-2007, and the Shanghai CSI 300, MSCI China, and broader MSCI Emerging Markets equity indices peaked in October 2007. With the benefit of hindsight, it is difficult to argue that the growth of the emerging economies, themselves slowing, was strong enough to more than offset the weakness in the developed economies to push up oil prices by more than 40% over the first half of 2008.

There was substantial uncertainty regarding the strength of the global economy at the time. As shown by Singleton (2012), the price boom in 2008 was accompanied by a large increase in the dispersion of one-year-ahead oil price forecasts by professional economists. In this environment, agents in the economy could have reasonably interpreted the large increases in futures prices of oil and other commodities as positive signals of a strong global economy, and, in particular, of robust commodity demand from China and other emerging economies. In fact, the large commodity price increases even motivated the ECB to increase its key interest rate in early July 2008, just before the bust in oil prices. Thus, the large increases of commodity prices in early 2008, a portion of which may be attributable to investment inflows into commodity markets coming from the declining real estate market (Caballero, Farhi & Gourinchas 2008), may have temporarily influenced people's expectations of global economic strength and thus commodity demand by distorting price signals.[8]

Overall, in the presence of realistic informational frictions faced by market participants, using observed commodity demand to justify high commodity prices and rule out speculative effects is insufficient. Speculation in futures markets may affect demand. This effect would not be picked up through empirical identification strategies focused on inventories. Although challenging, structural models should explicitly account for the informational role of commodity prices.

5. CONCLUSION

The bubble view and the business-as-usual view are both too simplistic to capture the impact of the financialization on commodity markets. Instead, understanding the impact of financialization on commodity prices requires a focus on how it affects the economic mechanisms of commodity markets. We highlight risk sharing and information discovery as two important channels.

The following directions will likely be particularly fruitful for future research. First, future research must update its practice of categorizing trading by hedgers as hedging and trading by speculators as speculation. A systematic modeling of the different trading motives of hedgers and speculators at different times is necessary to uncover dynamics of risk sharing in commodity futures markets. Second, incorporating informational frictions and the informational role of commodity prices into existing theoretical and empirical frameworks is likely to significantly improve our understanding of the boom and bust cycles of commodity prices. Furthermore, to the extent that commodity markets are an indispensable part of the global

[8]Such a feedback effect may also operate through commodity production, i.e., through the Hotelling (1931) principle, by inducing producers to store the oil in the ground, due to its consumable and exhaustible nature (Hamilton 2009a,b; Jovanovic 2013).

economy, it is important to understand how risk reallocation and information transmission from commodity markets affect the real economy and the global financial markets.

DISCLOSURE STATEMENT

The authors are not aware of any affiliations, memberships, funding, or financial holdings that might be perceived as affecting the objectivity of this review.

ACKNOWLEDGMENTS

We thank Lutz Kilian, James Smith, Michael Sockin, and workshop participants at Bank of Canada for helpful comments. W.X. acknowledges financial support from Smith Richardson Foundation grant #2011-8691.

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