

Provided for non-commercial research and education use.
Not for reproduction, distribution or commercial use.



This article appeared in a journal published by Elsevier. The attached copy is furnished to the author for internal non-commercial research and education use, including for instruction at the authors institution and sharing with colleagues.

Other uses, including reproduction and distribution, or selling or licensing copies, or posting to personal, institutional or third party websites are prohibited.

In most cases authors are permitted to post their version of the article (e.g. in Word or Tex form) to their personal website or institutional repository. Authors requiring further information regarding Elsevier's archiving and manuscript policies are encouraged to visit:

<http://www.elsevier.com/copyright>



Contents lists available at ScienceDirect

Resources Policy

journal homepage: www.elsevier.com/locate/resourpolInvestor demand and spot commodity prices[☆]John E. Tilton^{a,*}, David Humphreys^b, Marian Radetzki^c^a Research Professor, Division of Economics and Business, Colorado School of Mines, Golden, Colorado, USA, and Chair in Mineral Economics, Mining Centre, School of Engineering, Catholic University of Chile, Santiago, Chile^b Independent consultant and former Chief Economist for Rio Tinto and Norilsk Nickel, London, UK^c Lulea University of Technology, Luleå, Sweden

ARTICLE INFO

Article history:

Received 18 November 2010

Received in revised form

20 January 2011

Accepted 24 January 2011

Available online 22 February 2011

JEL classifications:

G12

Q00

L7

Keywords:

Commodity prices

Investor demand and stocks

Speculation

Strong and weak contango

Spot and futures markets

Copper

ABSTRACT

The on-going debate over the influence of investor demand on spot commodity prices largely attempts to assess this influence by measuring the growth in investor demand in recent years. Given the serious data problems that plague such analyses, this article pursues another approach in the hope of providing useful insights into the impact of investor demand on spot commodity prices. It focuses on the mechanisms by which investor demand affects spot prices, and in particular on two questions. First, how does an increase in investor demand on the futures markets affect the spot market and spot price? Second, when investor demand is increasing and pushing a commodity's price up, do physical stocks of the commodity also have to be rising, as economists and others widely assume?

On the first question, the article concludes that a surge in investor demand raising prices on the futures markets will have a direct and comparable effect on the spot market prices when these markets are in strong contango. However, when markets are in weak contango or backwardation, price movements in the futures markets have a much looser effect on spot prices. As a result, changes in investor demand on the futures markets may have little or no influence on spot prices in the absence of a strong contango. Instead, changes in fundamentals (that is, producer supply and consumer demand) and possibly changes in investor demand taking place directly on the spot market largely determine the spot price at such times.

On the second question, the article shows that investor demand can be pushing up a commodity's price even when investor stocks are falling, despite the widespread presumption to the contrary.

© 2011 Elsevier Ltd. All rights reserved.

Introduction

Recent years have seen a rapid growth in the involvement of investors in the commodity markets. Frequently such investors are referred to in a pejorative manner as speculators, in part because they are trading in commodities in the hope of making a profit rather than actually producing or consuming commodities. We prefer the more neutral terms of investors and investor demand, although we do not overlook the fact that there are various types of investors with different motives.

In any case, the rise of investor demand on commodity markets over the past decade or so has coincided with a surge

in many commodity prices. It is but a short step to put these two developments together and conclude that investors must have been a major force driving prices up. Yet, the impact of investor demand on commodity prices remains a highly controversial issue both with respect to its exact scale and its implications for prices. More fundamentally, there does not appear to be much agreement on the precise *mechanisms* by which investors shape market prices.

This study addresses the latter issue—the mechanisms by which investor demand influences market prices—though it does have implications for the more general question of how investor demand affects commodity prices. More specifically, it examines two questions:

- How do futures markets affect the spot market and spot prices for commodities? The reason for focusing on the influence of futures markets is that investors mostly trade on the futures markets. There are two reasons for focusing on spot prices: first, these are the most commonly quoted prices. Second, the effects of investor demand on futures markets for futures prices do not seem particularly complicated or controversial.

[☆]With the usual caveat that the ideas expressed here are ours and not necessarily theirs, we would like to thank Phillip Crowson, Keith Ellam, Christopher L. Gilbert, Peter Hollands, and Olle Ostensson for their helpful suggestions on earlier versions of this article.

* Corresponding author.

E-mail addresses: jtilton@mines.edu (J.E. Tilton), david.humphreys@talktalk.net (D. Humphreys), marian@radetzki.biz (M. Radetzki).

An outward shift in the investor demand curve on futures markets driven by an increase in investor demand should raise futures prices; and an inward shift should have the opposite effect.

- Do inventories have to rise when investor demand is driving spot commodity prices higher? This is the conventional wisdom held by economists, market analysts, and others. At first blush, it appears intuitively obvious. If investor inventories are declining, investors are adding to the available supply, which should produce a market price lower than it otherwise would be. Moreover, if true, this would eliminate any possibility that investor demand contributes to rising prices when as is often the case inventories are declining or even stable.

The scope of the analysis, it should be noted, is limited in two important respects. First, the focus is solely on the above two questions. Second, the analysis is conceptual in nature. While it does suggest various hypotheses regarding market behavior, tests of these hypotheses are not carried out here. This is in part because the data currently available on the market behavior of investors are for reasons discussed below seriously deficient in various ways. Moreover, even where the needed data are reliable, good empirical analysis requires expertise in terms of modern time series analysis and in terms of institutional knowledge of commodity markets and prices that others possess in greater depth than we. Nevertheless, we believe that the conceptual analysis by itself makes a useful contribution to the literature in this area. To our knowledge, no one else has addressed the two questions of interest and reached the conclusions advanced here.

The presentation proceeds as follows: the next section, “Investors in commodity markets”, examines the nature of investors in commodity markets. Section “Earlier studies” reviews some of the on-going public debate on the subject in order to highlight the continuing controversy over the role of investor demand on commodity prices. This review, it should be noted, is not a comprehensive critical assessment of all the relevant literature. Given the number and diversity of the studies on this topic, such an effort is well beyond the scope of the inquiry here. Section “Linkages between the spot and futures markets” then focuses of the first of our questions, the linkages between the spot and futures markets. Section “Investor demand and commodity stocks” then turns to the second question regarding the influence of investor demand on commodity prices when investor stocks are declining. Section “Conclusions and an agenda for research” highlights the conclusions and sets out an agenda for future research.

Investors in commodity markets

Investors are interested in acquiring market exposure to commodities either because they hope to make a profit from such an exposure or because they deem it will impart desirable characteristics to their overall portfolios of investments (such as, greater stability of returns). They are, in effect, interested in commodities as paper assets. They can be distinguished from producers, consumers and traders whose interest in the commodity markets is primarily physical. Traders use the markets principally to hedge price risk or in some cases to take advantage of arbitrage opportunities arising from differences in prices either on different markets or at different dates on the same market.

Another group of market participants requiring mention are swaps dealers. They are not necessarily interested in holding physical metal or in having exposure to metal prices (and thus may not strictly speaking be investors), but rather they make their living by trading financial instruments, including acting as

counterparties to investors. Nevertheless, their activities are necessary to the functioning of investors in the market and so they are logically grouped with investors rather than producers, consumers, and traders.

Investment in commodities is, of course, nothing new. As long as the commodity markets have existed, there have been those who have sought to make money by buying commodities in the hope of selling them at a higher price later on. What is new is the scale and mode of investment interest in commodities.

Investors use a variety of instruments. They can buy and sell commodity futures and traded options on exchanges, such as the London Metal Exchange (LME) or The New York Commodity Exchange (Comex). They can conduct deals directly over the counter (OTC) with counterparties, such as banks. They can buy commodity-based Exchange Traded Funds. Finally, they can buy and take physical possession of commodity stocks.

Investors can be separated into two distinct categories, long-short investors and long-only investors. Long-short investors, as the label implies, can go both long and short in the market; they can also take positions using traded options. Thus they can benefit from falling as well as rising commodity prices. Such investors are typically leveraged (that is, they use borrowed money), very price responsive, and generally quickly stopped out of their positions when the market moves against them.

Some analysts (Gilbert, 2008; Hollands, 2010b) refer to such investors as speculators while reserving the term investors for those whose primary interest is diversifying their portfolios so that they include a given amount of exposure to commodities. The latter, as noted below, are not typically leveraged, are not very price responsive, and are not easily stopped out of their positions. This study, however, refers to speculators and investors simply as investors and instead makes the distinction between long-short investors and long-only investors.

The long-short investors encompass several different groups. First, there are the Commodity Trading Advisors (CTAs). These ‘technical’ investors use computer models based on past patterns of price behavior to anticipate future price movements and to profit from them. The nature of their investment strategies means that they are sometimes referred to as ‘trend-following’ or ‘momentum’ investors. A second important group contains the hedge funds. These include both generalist hedge funds that periodically dip into commodities and specialist commodity hedge funds. Like the CTAs, they can go long and short in the market but their investment decisions tend to be more discretionary, more judgment based. Thus, while they can and do use technical tools, more often the big decisions will flow from their perspective on developments in the broader economy and from their research into the fundamentals of individual commodity markets. A third group of long-short investors includes the proprietary trading desks of the major investment banks that trade commodities on their own account. They borrow strategies from both CTAs and hedge funds.

These long-short investors, promoting the notion of commodities as a new asset class, rose to public prominence in the mid 1990s. At the time, concerns were expressed in some quarters that their activities might be distorting markets.

Also originating in the 1990s, but at the time attracting little attention and only moderate amounts of money, were the standard bearers of the other major category of commodity investors. These are the long-only commodity index funds, commonly referred to as CIFs. In contrast to long-short investors, these investors are generally unleveraged, much more price insensitive (making pre-agreed purchases on a pre-agreed time scale), and not stopped out of their positions at all. In other words, they are essentially passive investors. The two principal such funds were initially the Goldman Sachs Commodity Index fund

(now the S&P GSCI) and the DJ-AIG commodity index fund (now the DJ-UBS). These funds offer investors—typically pension funds and insurance companies—price exposure to a basket of commodities. They are thus of interest to those who believe either that there is an attractive return to be gained over time or that returns from commodities are inversely correlated with those of equities and stocks and therefore bring greater stability to broader-based portfolios. These latter notions were given a major boost by the publication of a highly influential paper by economists [Gorton and Rouwenhorst \(2006\)](#) entitled 'Facts and Fantasies about Commodity Futures'.

Investments in the commodity index funds are made through the purchase of commodity futures, which are then rolled forward by being sold at or prior to maturity and immediately replaced with a new futures purchase with a more distant maturity date. Otherwise, the investments are essentially passive. Returns potentially arise from three sources: (a) rising spot commodity prices, (b) the roll yield that occurs in backwardated markets (that is, markets where futures prices are below spot prices) when the positions are rolled over, and (c) the collateral yield, which is the interest earned on the money that has been put into the fund, but not needed to hold the positions (since futures positions are bought on margin).

Commodity index funds have assumed great significance in recent years. No comprehensive data exist on the total amounts held by these funds, and a number of tricky issues arise when trying to make an unequivocal assessment ([Kemp, 2010](#)). However, since 2009, the U.S. Commodity Futures Trading Commission (CFTC) has been publishing estimates of the total invested in commodity index funds. It estimates that net long positions held by these funds globally were \$160 billion at the end of 2009. This estimate had risen to \$211 billion by the end of November 2010 ([CFTC, 2011](#)). What no one contests is that these funds, estimated at less than \$10 billion in 2002, have grown greatly through the present century, and that the sums involved are large relative to the size of the markets in which the investments take place.

A numerical example for copper provides some perspective on the relative size issue. At the end of 2009, the CFTC reported that the total index investments in U.S. markets were \$125.5 billion. The notional value of index investments in Comex copper was a net \$6.4 billion ([CFTC, 2011](#)). Assuming that the CIF's ratio of copper holdings to total holdings is the same for non-U.S. as for U.S. markets (Comex), and that the price of copper was \$7000 per ton, then CIFs at the end of 2009 had futures positions equivalent to some 1.1 million tons of this metal. This corresponds to over 6% of global annual consumption, and is almost twice the size of copper inventories held at the time by the exchanges.

Earlier studies

The growth of investor involvement in the markets has raised concern that it is distorting commodity prices ([Verleger, 2007](#); [Kaufman, 2010](#)). Numerous press reports attribute price movements to the activities of investors ([Economist, 2007](#); [Financial Times, 2008a, b, 2010](#)). And, the circumstantial evidence is compelling. The major surge in metal and other commodity prices in the second half of 2005 and the first half of 2006—a surge that lifted prices onto a new and higher plane—coincides with an acceleration of monies flowing into commodity index funds. Yet, at the same time many analysts take the view that the major determinants of market trends are, and remain, the supply and demand for physical commodities ([Krugman, 2008](#); [Irwin and Sanders, 2010](#)). They point to the tightness in those markets for which no futures markets exist to attract investor demand, such

as iron ore and rice, where prices movements have been every bit as dramatic as for those traded on formal exchanges.

Research into the role of investors has failed to resolve this debate. [IMF \(2006\)](#) devoted a chapter to the commodities boom and its causes. It concludes that there is "little support for the hypothesis that speculative activity (as measured by net long non-commercial positions) affects either price levels over the long run or price swings in the short run. In contrast, there is evidence (both across commodities and over time) that speculative positions follow price movements". In other words, the evidence points to market fundamentals as the key driver for prices, although the possibility remains that investors could give momentum to markets, taking prices further than they might otherwise go. The IMF acknowledged, however, the limitation of their data set, an issue that has become more significant in the light of the more recent finding that certain investors in commodities have been erroneously classified as 'commercial' rather than as 'non-commercial' (see below). Also, it should be noted that the data for the IMF study do not cover much of the period of very high prices that persisted until 2008.

Nonetheless, later investigations in the United States and the United Kingdom reinforce the IMF's conclusions. For example, [HM Treasury \(2008\)](#) asserts that "the data show no consistent relationship between rising investment activity and prices across commodities". Rather, "econometric analysis finds that, in most cases, high and rising prices attract investors into the market, not the other way around. When it is found to run in the opposite direction, it is weakly significant and short term".

In similar vein, the [U.S. Interagency Task Force on Commodity Markets \(2008\)](#) interim report on crude oil states that "the increases in oil prices between January 2003 and June 2008 are largely due to fundamental supply and demand factors" and that "the Task Force's preliminary analysis to date does not support the proposition that speculative activity has systematically driven changes in oil prices".

More recently, a paper commissioned by the OECD ([Irwin and Sanders, 2010](#)) concludes after a broad review of studies on the subject that "the weight of existing evidence clearly tilts in favor of the argument that index funds did not cause a bubble in commodity futures prices".

In addition, the [IMF \(2010\)](#) returned to the issue of speculation in commodities markets. While it does not go far beyond its 2006 study, it continues to maintain that fundamentals largely determine commodity prices, concluding that "... there remains little evidence that financial investment has a significant sustained impact on commodity prices above and beyond current and expected supply-demand fundamentals".

On the other hand, the new leadership at the CFTC following the change in the U.S. administration in 2008 has shown greater receptiveness to the idea that investors might have a bigger impact than earlier research suggests. Bolstering this case is the recent acknowledgement that the CFTC's 'non-commercial' category of market participants, which the [IMF \(2006\)](#) in its study cited above and many others have used as a proxy for investors, has not included swaps dealers. The latter instead were treated as 'commercial' participants, which is likely to have led to a serious underestimation of the scale of investor activity.

In a recent study ([UNCTAD, 2009](#)), the United Nations Conference on Trade and Development also suggests that investor demand has had an important influence on commodity prices. In its conclusions, it states: "In sum, the above findings suggest that part of the commodity price boom between 2002 and mid-2008, as well as the subsequent sharp decline in commodity prices, were due to the financialization of commodity markets. Taken together, these findings support the view that financial investors have accelerated and amplified price movements driven by fundamental supply and demand factors, at least in some periods

of time.” These findings are echoed in a later report undertaken by Gilbert (2010) on behalf of UNCTAD.

One of the most outspoken exponents of the belief that investors are having a major influence on markets is Masters (2009). He claims that “speculators far outnumber bona fide physical hedgers and therefore play the dominant role in price discovery;” and that “when speculative euphoria ... takes over, speculators can and will drive prices to levels that do not reflect supply and demand conditions”. Hollands (2010a, b), who as noted earlier makes a firm distinction between speculators and investors, also contends that investors greatly influence commodity prices, though he emphasizes the importance of the commodity index funds or what he calls investors.

In response to the concerns noted above regarding the lack of good data on investor demand, the CFTC has since September 2009 begun to publish more details on the positions of participants in the markets it regulates. Thus, in place of the old commercial versus non-commercial categorization, positions are now identified under four headings—producer/merchant/processor/user (PMPUs), swap dealers, managed money, and other reportable. Still, the available data are far from adequate. In particular, little is known about investor demand outside the OECD. As a result, empirical analyses based on these new data need to be treated with considerable caution.

In addition, the *mechanism* by which the effects of futures trading are transmitted to spot prices remains poorly understood. As noted above, press reports routinely make reference to the impact on prices of investor buying or selling, but the assertions seldom specify which prices are being influenced. In particular, does investor buying on futures markets necessarily increase spot prices? And, what role do stocks play in the transmission process?

Linkages between the spot and futures markets

The analysis here adheres to the fundamental economic logic that commodity prices are driven by shifts in their market demand and supply curves. For example, an increase in the spot price can occur only as a result of an outward shift in the spot demand curve, an inward shift in the spot supply curve, or both. The same holds for futures prices, except in this case price changes are produced by shifts in the futures demand and supply curves. Our analysis also assumes that a shift in either the supply or demand curve will produce a change in the market price. We are aware, of course, that a shift in the demand curve will have no effect on price when the supply curve is completely horizontal (that is, when supply is infinitely elastic) and similarly that a shift in the supply curve will have no effect on price when the demand curve is completely horizontal (that is, infinitely elastic). However, given the low probability of either supply or demand actually being infinitely elastic, we ignore such possibilities.

With this proviso, we are ready to address our first question: how do futures markets affect the spot market and spot prices for commodities? As noted earlier, most investors operate in the futures markets. However, as Fig. 1a illustrates, the spot price is determined by the spot supply curve (SS) and the spot demand curve (TD₁). This latter in turn depends on the spot consumer demand curve (CD₁) and the spot investor demand curve (ID₁). Both of these, as drawn in Fig. 1a, are negatively related to price, so everything else being equal more is demanded by consumers and investors at a lower price.

The spot investor demand curve, it is important to note, may not have a negative slope over the entire range of possible prices. This is because investor demand depends, among other things, on the current spot price and the spot price that investors expect to prevail in the future. Assuming everything else stays the same, a

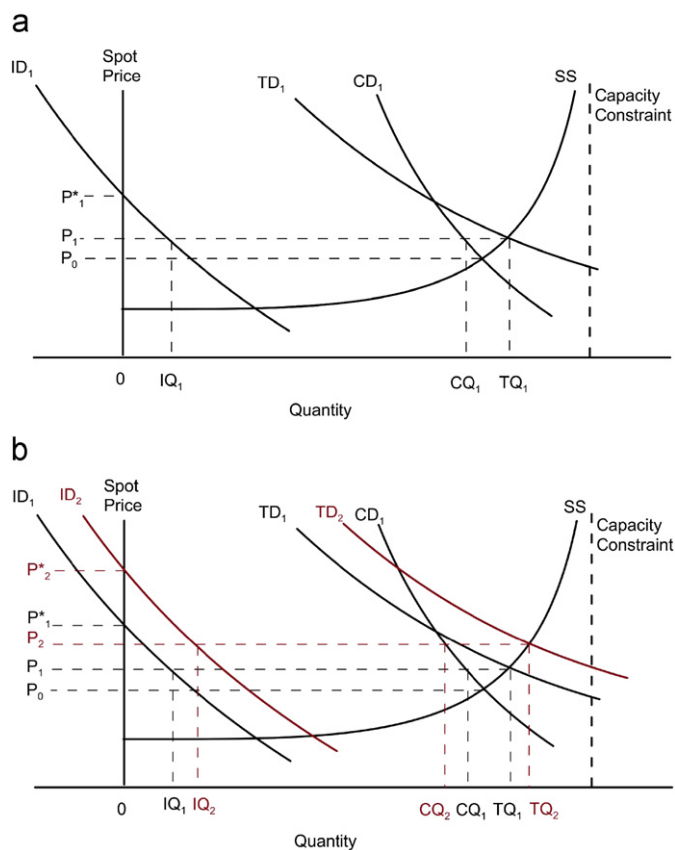


Fig. 1. Hypothetical spot supply and demand curves for a commodity illustrating rising stocks associated with higher prices due to an increase in investor demand. (a) Period 1: initial market equilibrium given the producer supply curve (SS), consumer demand curve (CD₁), investor demand curve (ID₁), and total demand curve (TD₁). (b) Period 2: market equilibrium after a rise in investor demand shifts the investor demand curve (from ID₁ to ID₂) and total demand curve (from TD₁ to TD₂).

rise in the current spot price should reduce investor demand, while a rise in the spot price expected in the future should increase investor demand. However, when the current spot price rises, this may cause expectations regarding the spot price in the future to rise as well. If so, a rise in the spot price may cause investor demand to increase, implying the spot investor demand curve has a positive slope over some range of prices.

However, if the current spot price continues to rise, at some point investors will presumably start to question the attractiveness of further increasing their demand. This is because at very high current spot prices it becomes more and more difficult to maintain the expectation that spot prices in the future will continue to rise. Instead, more and more investors are likely to become increasingly concerned that the current spot price reflects a speculative bubble and is not likely to be sustained for long. Even those investors who simply want to maintain a portion of their investment portfolio in commodities (and who are as a result relatively insensitive to price) are likely to reduce their demand for a particular commodity as its price increases. This is partly because a very high price makes other commodities (whose prices have risen less) more attractive investments. This is likely to cause a rebalancing of portfolios away from the commodity whose price has risen sharply and toward other commodities. In addition, a rise in commodity prices means that investors need less units (such as tons) to maintain a given share of the value of their portfolios in commodities.

As a result, while the spot investor demand curve can have a positive slope over a range of prices, above some price level its

slope turns negative, as shown in Fig. 1a. Moreover, at some higher price, the spot investor demand curve intersects the vertical (price) axis, and investor demand becomes negative in the sense that investors begin to reduce their stocks and on balance sell (rather than buy) commodities.

Since the spot price is determined by the spot supply and demand curves, investments made on futures markets can affect the spot price only by shifting one or more of the spot curves. The mechanisms by which this occurs and the extent to which spot and forward markets are linked are quite different when commodity markets are in strong contango (that is, when the spot price is less than futures prices by an amount equal to or greater than that needed to cover the storage and interest costs of holding stocks for future use) and when this is not the case. The latter situation encompasses all markets in backwardation (that is, when the spot price is higher than the futures prices) as well as markets in weak contango (that is, when the spot price is less than futures prices but by amounts insufficient to cover storage and interest costs).

While commodities have one spot market, they normally have a number of futures markets—markets with delivery dates of one, three, six, 12, and 24 months in the future, for example, are quite common. As a result, the spot market for a commodity at any particular time may be in a strong contango relationship with some of its futures markets and in a weak contango or even a backwardated relationship with the rest. In such cases, the impact that increasing investor demand on futures markets will have on the spot price varies as explained below depending on whether or not the relevant futures market and the spot market are in strong contango.

Markets in strong contango

A contango that exceeds the cost of storage and interest will induce swap dealers, traders, and others to buy spot and sell futures, to earn from the arbitrage. This practice, which typically arises in excess supply situations that depress spot prices, has old antecedents. Its effect is to transfer the burden of stock holding from producers to investors. The inter-temporal arbitrage shifts the spot investor demand curve to the right raising the spot price. Simultaneously, it adds to futures supply, shifting the futures supply curve to the right and reducing the futures price. In this way, investor action will tend to stabilize the strong contango at a level where the gains from arbitrage settle at or near zero.

During the course of 2009 and 2010, there was an increase in the popularity of so-called 'financing deals' for metals stocks. This is a means by which investors benefiting from low cost finance and attractive deals from warehousing companies can use the contango to earn attractive and relatively low risk returns. Their activities, although wholly independent of those of the commodity index funds, place them in the position of natural hedge shorts to match the net long positions of commodity index investors and assist with the transmission of futures prices to the spot market.

So during periods of strong contango any tendency for futures prices to rise or fall should cause the spot price to follow. Indeed, the spot price should move more or less in lock step with forward prices: 'more or less' because changes over time in interest rates and storage costs may alter somewhat the amount by which futures prices exceed the spot price.

Market in weak contango and backwardation

The incentive to buy commodities on the spot market and hold them to cover simultaneous sales on futures markets does not

exist when commodity markets are in weak contango or backwardation. Indeed, what market participants would like to do during periods of backwardation is to buy commodities in the futures markets and sell them in the spot market, but future stocks are not physically available for sale today. As a result, the strong link between spot and futures prices exists only during periods of strong contango.

While the influence of futures markets on spot prices is much looser during periods of weak contango and backwardation, it is not entirely absent due to the convenience yield of holding physical inventories. Having physical stocks readily available for use, up to some level at least, provides a benefit for consumers. If needed, these stocks do not have to be ordered, avoiding potentially costly delays and extra charges to expedite delivery. As a result, consumers are usually willing to pay something for the convenience of having stocks on hand even though they may not be immediately needed. Of course, the amount to be held for convenience depends on the cost, determined by the spread between the spot and futures price. A commodity consumer may hold onto his inventory when the spot price is \$1100, the three month futures price \$1000, and thus his cost of holding equals \$100. But he may decide to sell and manage without the inventory convenience if the spot price rises or the futures price falls, raising his cost of holding. The convenience yield implies that the spot consumer demand curve depends not just on the spot price but on futures prices as well. More specifically, an increase in futures prices due for example to a jump in investor demand will reduce the spread between the spot and futures prices and hence shift the spot consumer demand curve to the right, causing the spot price to rise as well.

This mechanism for linking spot and futures prices, however, is much looser than the mechanism that prevails during periods of strong contango. Moreover, once the spread between the spot and futures prices is sufficient to reduce the level of stocks held for convenience to zero or close to zero its influence disappears. On the other hand, as the spread declines, the level of stocks held for convenience at some point presumably reaches a maximum beyond which further reductions in the spread have little or no influence on spot investor demand. For these reasons, movements in spot prices during periods of weak contango or backwardation are likely to be determined largely by short-term considerations affecting the spot supply curve, the spot investor demand curve, and the spot consumer demand curve—considerations that have little or no influence on the prices in futures markets and that in turn are little affected by movements in futures markets. As a result, the strong correlation between spot and futures prices anticipated for markets in strong contango should be much weaker, perhaps even imperceptible, for markets in weak contango or backwardation.

In addition to the link between spot and futures prices arising from the convenience yield, some suggest that rising futures prices can have an indirect effect on spot prices by shaping expectations about price. Here, the logic presumably is that rising futures prices affect the behavior of investors on the spot market by altering their expectations about forthcoming spot price trends. Specifically, higher futures prices cause the spot investor demand curve to shift to the right, thereby causing the spot price to rise.

When markets are in backwardation, however, this argument seems questionable. During such times, despite the rise in futures prices, they remain below the spot price. This means that the market expects the spot price to be lower in the future than the present. Moreover, those investors, who contrary to the market believe the spot price 30 or 90 days in the future will be higher than the current spot price, can make more profit by buying futures now rather than buying spot and holding stocks for 30 or 90 days. As a result, it is not clear why a rise in futures prices

during periods of backwardation should shift the spot investor demand curve and raise the spot price.

The preceding raises a puzzle: namely, why does anyone during periods of backwardation buy spot in the hope of selling in the future at a higher price, if one can buy futures at a lower price and achieve the same expected future price at the time of sale? One possible explanation is that investors anticipate a squeeze on actual physical metal in the short run, specifically before the maturity date of the nearest futures contract. Another possibility is that investors have a preference for actually holding physical metal, a preference sufficiently strong that they are willing to pay a premium (in terms of lower expected profits) to hold physical metal. For whatever the reason, however, we do know that investors, though focused mostly on the futures markets, are active on the spot market during periods of backwardation and weak contango as well as during periods of strong contango.

As a result, it does not follow that spot prices during periods of weak contango or backwardation are always governed solely by fundamentals. Investor demand may also play a role. If so, the demand for physical stocks, as compared to investor demand on futures markets, can have an impact on spot demand and spot prices, even if fundamentals are likely to be the predominant influence.

Investor demand and commodity stocks

This brings us to the second of our two questions: do commodity inventories have to increase if investor demand is driving up their spot prices?

Convention in the commodity markets has it that high prices are associated with low levels of stocks, with causation running from the latter to the former. The presence of low stocks is a symptom of the supply shortages that drive prices higher. However, the growing involvement of investors in commodity markets complicates this relationship.

In principle, futures are a claim on future supply. When an investor buys a futures contract, the party taking the other side of this position may put some quantity aside (in the form of an addition to stocks) in order to meet the obligation to supply the commodity at that future date. It is this purchase of stocks that pushes the spot price higher. If the party taking the other side of the transaction does not buy in the spot market to cover the position (perhaps a producer who expects to have product to sell at that date, or a naked trader or investor) then this act will push up the futures price but it will not change inventories or affect the spot price.

In contrast then to the situation where buying for consumption is driving the market and where higher prices are likely to be associated with falling stocks, increases in price driven by the growing involvement of investors are widely expected to be accompanied by a rise in stock levels. Krugman (2008), a Nobel laureate in economics, reflects this view in discussing the impact of investor demand on oil prices:

The only way speculation can have a persistent effect on oil prices, then, is if it leads to physical hoarding—an increase in private inventories of black gunk.

Similarly, the HM Treasury report cited above notes:

[W]ere financial market activity itself driving higher commodity prices, it might be expected that stocks would be increasing as prices would be above that required to clear the spot market. However, current data shows that inventories ... have continued to fall or remain stable. This reflects fundamentals in the market ...

Another example comes from Irwin and Sanders (2010):

In addition to the logical inconsistencies, there are several ways the bubble story is not consistent with the observed

facts. First, as Krugman (2008) asserts, if a bubble raises the market price of a storable commodity above the true equilibrium price, then stocks of that commodity should increase (much like a government imposed price floor can create a surplus). Stocks were declining, not building, in most commodity markets over 2006–2008, which is inconsistent with the depiction of a price bubble in these markets.

Irwin and Sanders do go on to qualify the above statement by noting that the build-up of stocks due to a price bubble could be negligible if the price elasticity of demand for a storable commodity is very small or zero.

As the rest of this section shows, however, the relationship between commodity stocks on one hand and the influence of investor demand on prices on the other is more complex than the conventional approach to this matter and the quotes above suggest. The important feature introduced in the analysis below is that investor demand becomes negative at high prices. This follows from the assumption discussed above that the spot investor demand curve above some price level is downward sloping and that at some higher price investors are prepared to reduce their inventories.

The analysis also assumes that an increase (decrease) in investor demand causes the investor demand curve to shift to the right (left), an assumption consistent with traditional economics. This means that, following an increase in investor demand, the quantity that investors over a given time period, such as a year, add to their inventories at any particular price will rise. However, if the shift to the right of the investor demand curve causes the market price to rise sufficiently, the actual amount that investors demand can decline notwithstanding the increase in investor demand. In addition, as highlighted below, an increase in investor demand can occur while investors are actually reducing their stock holdings if the market price is sufficiently high.

Fig. 1a shows a demand curve for investors (ID_1). At the price P_1^* , this curve indicates that the quantity of the commodity that investors demand over a year or some other period of time is zero. As a group, they are neither adding to nor drawing down their stocks. When the market price is below P_1^* , investors as a group are adding to their stocks. At P_1 , for example, they are adding the quantity IQ_1 annually to their stocks. Conversely, at high prices (that is, prices above P_1^*), investor demand is negative, as investors on balance are reducing their inventories and releasing stocks back to the market. Thus, as the market price rises, the investor demand curve eventually intersects the vertical (price) axis and then rises to its left. What is not shown in Fig. 1a and subsequent figures, largely to avoid making them more complicated than they already are, is the possibility discussed above that at relatively low prices the investor demand curve may have a positive slope before bending backward at higher prices and assuming the negative slope portrayed in the figures.

Fig. 1a also shows the demand curve for consumers (CD_1) and the total demand curve (TD_1), which is simply the horizontal summation of the demand curves for investors and for consumers. Finally, Fig. 1a shows the supply curve (SS) for the producers of the commodity, which is drawn with a relatively flat slope until output approaches existing capacity, at which point it turns up sharply. The intersection of the supply curve (SS) and the total demand curve (TD_1) determine the market equilibrium output (TQ_1) and price (P_1). At a price of P_1 , CQ_1 of the available supply TQ_1 goes to consumers and IQ_1 to investors. As investors do not consume the commodity they receive, it is added to available stocks.

Fig. 1b shows the impact of an increase in investor demand that shifts the investor demand curve rightward from ID_1 to ID_2 .

This shift causes the total demand curve to shift from TD_1 to TD_2 and the market price and output to rise from P_1 and TQ_1 to P_2 and TQ_2 . Now, if the supply curve is upward sloping and the consumer demand curve downward sloping, which is almost always the case, the quantity of the commodity going to investors will increase (as at the higher price more is supplied by producers and less is demanded by consumers). Fig. 1b shows the amount of supply going to investors increasing from IQ_1 to IQ_2 . In this situation, the increase in investor demand causing the shift in the investor demand curve is associated with growing physical stocks, as the annual quantity of supply flowing to investors is positive both before and after the increase in investor demand. This is consistent with the expectations of Krugman and the other studies cited above.

As Fig. 2 demonstrates, however, this does not have to be the case. Assume that the original market price P_1 is above the price at which investor demand is positive (that is, above price P_1^*), so that investors are drawing down their stocks and thus adding to the supply coming from producers, as shown in Fig. 2a. Now, an increase in investor demand that shifts the investor demand curve outward can produce a new market price that remains above the price at which investor demand is positive (even though this price has now shifted upward from P_1^* to P_2^*). In this case, which Fig. 2b illustrates, the shift to the right in the investor demand curve would reduce the amount per year that investors are willing to withdraw from their stocks and sell, but it would not eliminate such sales. In this situation, a rise in investor demand that shifts the investor demand curve to the right and raises the market equilibrium price from P_1 to P_2 takes place while physical stocks are actually declining.

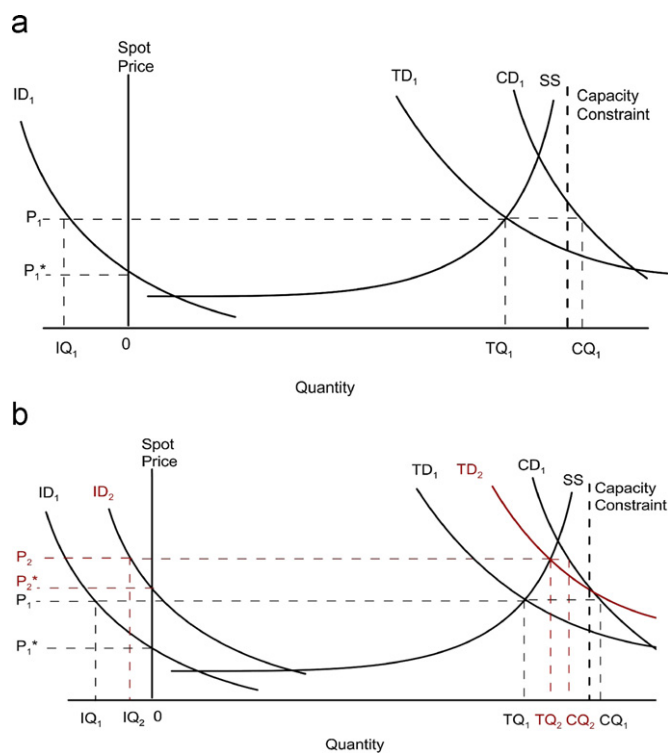


Fig. 2. Hypothetical spot supply and demand curves for a commodity illustrating falling stocks associated with higher prices due to an increase in investor demand. (a) Period 1: initial market equilibrium given the producer supply curve (SS), consumer demand curve (CD_1), investor demand curve (ID_1), and total demand curve (TD_1). (b) Period 2: market equilibrium after a rise in investor demand shifts the investor demand curve (from ID_1 to ID_2) and total demand curve (from TD_1 to TD_2).

Fig. 3 illustrates a similar scenario—one that often seems quite plausible—where investor demand can drive the market price up while at the same time physical stocks are declining. It differs from the situation portrayed in Fig. 2 in two respects. First, initially investors are adding to their stocks not depleting them. Second, it assumes that investor demand is linked to—rather than independent of—consumer demand. The rationale for this is that an inward or outward shift in the consumer demand curve is likely to lead to expectations of lower or higher prices, which may cause the investor demand curve to shift as well. The notion in this scenario of causation running from fundamentals (that is, the supply of producers and the demand of consumers) to investor demand is consistent with the findings of the IMF research cited earlier.

Fig. 3a shows an initial market situation similar to that in Fig. 1a. The market price P_1 is below the price P_1^* , at which investors neither add to nor delete their stocks. So investors are

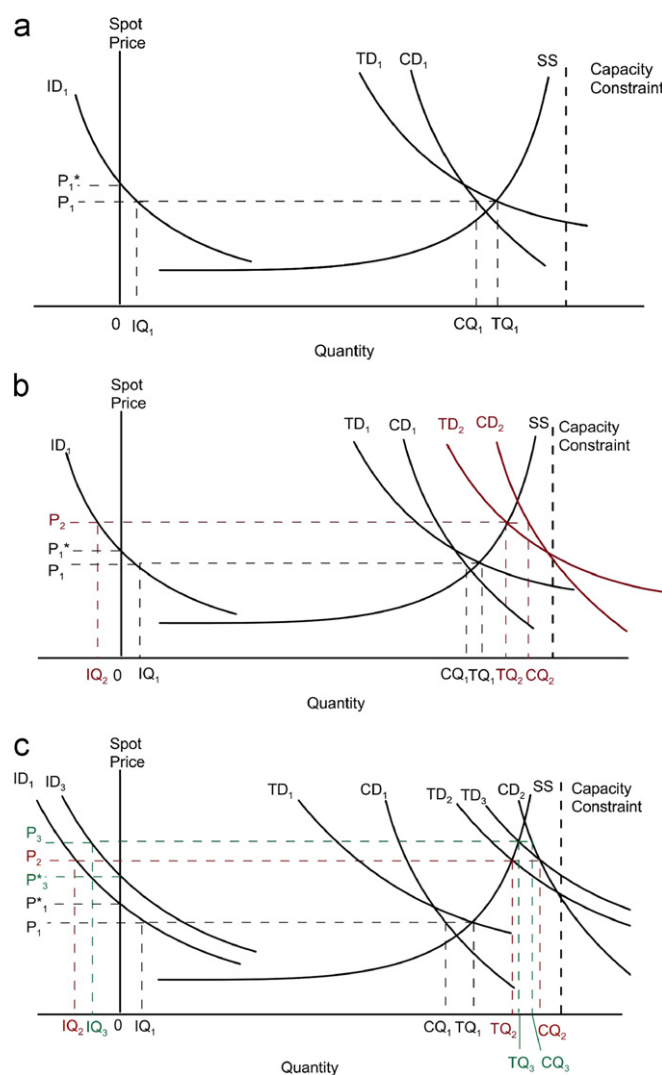


Fig. 3. Hypothetical spot supply and demand curves for a commodity illustrating falling stocks associated with higher prices due to an increase in investor demand induced by an increase in consumer demand. (a) Period 1: initial market equilibrium given the producer supply curve (SS), consumer demand curve (CD_1), investor demand curve (ID_1), and total demand curve (TD_1). (b) Period 2: market equilibrium after a rise in consumer demand shifts the consumer demand curve (from CD_1 to CD_2) and total demand curve (from TD_1 to TD_2). (c) Period 3: market equilibrium after a rise in investor demand induced by the rise in consumer demand shifts the investor demand curve (from ID_1 to ID_3) and total demand curve (from TD_2 to TD_3).

building up their stocks, and the supply offered to the market by producers is being divided between consumers and investors.

In Fig. 3b, the consumer demand curve shifts outward, from CD_1 to CD_2 , due to an unexpected jump in GDP or some other development. This causes the total demand curve to shift outward as well, from TD_1 to TD_2 , and the market price to rise from P_1 to P_2 . At the higher P_2 price, investors now on balance are reducing their stocks by the quantity IQ_2 per year.

In Fig. 3c, the rise in consumer demand and expectations of rising prices produce an outward shift in the investor demand curve from ID_1 to ID_3 . This in turn causes the total demand curve to shift from TD_2 to TD_3 . The market price, which rose from P_1 to P_2 due to the shift in consumer demand, now rises further to P_3 due to the increase in investor demand. The shift in the investor demand curve pushes the price at which this curve intersects the vertical (price) axis from P_1^* to P_3^* . However, this latter price (P_3^*) is still below the new market price (P_3), and so investor demand remains negative and investors continue on balance to deplete their stocks.

Conclusions and an agenda for research

Efforts to assess the influence of investor demand on spot commodity prices are hampered by serious shortcomings of the available data. For this and possibly other reasons, empirical research on the subject has produced conflicting results and conclusions. Some of the available studies suggest that investor demand is relatively unimportant and that fundamentals are largely responsible for movements in spot prices. Other endeavors come to the opposite conclusion.

This study pursues a different approach. Rather than trying to analyze the limited data available, it focuses on a conceptual examination of the key mechanisms by which investor demand on futures markets influences spot prices.

The analysis leads to two important insights that to our knowledge have not been brought out in the literature on the subject. The first is that prices in futures and spot markets are closely linked when these markets are in strong contango, as is typically the case when spot markets are depressed. In such circumstances, investors play a useful role in financing inventories by buying spot and simultaneously selling futures to take advantage of the arbitrage. The result is an increase in stocks and a reduction in the spread between futures and spot prices. In contrast, when commodity markets are in weak contango or backwardation, spot prices are mostly governed by current rather than future conditions. Changes in futures prices may have some influence on spot prices by altering the convenience demand of consumers for stocks and hence the spot consumer demand curve. However, their influence is much looser than during period of strong contango.

The second insight, contrary to what many economists and others believe, is that investor demand can push commodity prices higher even though the physical stocks that they and others hold are falling. This is because the investor demand curve at some price intersects the vertical price axis. At prices above this point, investors on balance will draw down their holdings, augmenting the market supply coming from producers. An increase in investor demand that shifts the investor demand curve outward will push the market price up. At the new price, the annual amount of the commodity that investors are destocking will decrease but investors may nevertheless continue to destock.

These insights have some important implications. First, rising investor demand on futures markets cannot explain dramatic jumps in commodity spot prices that take place while markets are

in backwardation, as for example occurred in copper during the 2004–2006 period. This is because spot markets are largely independent of movements on futures markets during periods of weak contango and backwardation. Similarly, it follows that a dramatic decline in the spot price need not occur when investors reduce their long positions on futures markets, as long as a strong contango does not arise.

Second, economists and other market analysts cannot conclude, whenever physical stocks are stable or falling, that trends in spot prices are necessarily the result of fundamentals.

Third, the shortcomings of the available data and the conflicting conclusions reached by the empirical analyses of these data suggest that strong public policies to rein in investor activity are premature. Such policies could well lead to unintended consequences impairing the way markets function, for example, by constraining market liquidity. Rather, strong policy action should be preceded by additional efforts to perfect the available data, to collect additional information on investor activity, and to conduct further empirical work on the influence of investor demand on commodity prices.

Fourth, the conceptual analysis presented here suggests a number of opportunities for further research of an empirical nature. This research agenda, however, depends in large part on widening and improving the needed data. It is essential, first of all, to identify and properly define the different categories of investors and speculators, along with their objectives and behavioral patterns. More complete data are also needed on the activities of each category of investors in the major commodity markets over time, by supplementing what is known for the U.S. and the OECD with information for the rest of the world. A closely related data issue is the quantification of inventories held by different actors. The resolution of these data problems probably requires a combined effort by academics and governmental officials, particularly those regulating the commodity markets.

With better data, the present study suggests several hypotheses for empirical testing. For example, the analysis here anticipates a much higher correlation between movements in forward and spot commodity prices during periods of strong contango than during periods of weak contango or backwardation.

Similarly, during periods of rapidly growing investor demand on the futures markets, the analysis anticipates a strong positive correlation between the spot price and physical inventories when markets are in strong contango. This is because a rise in futures prices encourages investors to sell short in futures markets and to buy spot holding the acquired physical stocks to cover their future commitments. However, when markets are in weak contango or backwardation, investors do not have the same incentives to engage in this type of inter-temporal arbitrage, weakening the relationship and making the inventory build-up more ambiguous.

Another issue worthy of attention is the relationship between price and investor demand. In particular, do the available data support the expectation that the investor demand curve, though it may have a positive slope over a range of prices, above some price level possesses a negative slope and as a result at some (higher) price investor demand becomes negative as investors on balance reduce their inventories?

Finally, and of particular interest, further research is clearly needed to explain the puzzle as to why investors hold stocks at all during periods of backwardation.

References

- CFTC, 2011. Index investment data, U.S. Commodity Futures Trading Commission, Washington, DC, available at <http://www.cftc.gov/MarketReports/IndexInvestmentData/index.htm>.
- Economist, 2007. Oil is Not Well, 11 January.

- Financial Times, 2008a. Soros Blasts Commodity Bubble, 4 June.
- Financial Times, 2008b. Commodity Speculation Must be Curbed, 25 July.
- Financial Times, 2010. EU to Rein In Commodity Speculation, 20 September.
- Gilbert, Christopher L., 2008. Commodity Speculation and Commodity Investment, October 2008. The original version of this paper was prepared for the conference "The Globalization of Primary Commodity Markets," Stockholm, 22–23 October 2007.
- Gilbert, Christopher L., 2010. Speculative influences on commodity futures prices 2006–2008, UNCTAD Discussion Paper No. 197, March.
- Gorton, Gary, Rouwenhorst, K. Geert, 2006. Facts and fantasies about commodity futures. *Financial Analyst Journal*, March.
- HM Treasury, 2008. *Global Commodities: A Long Term Vision for Stable, Secure and Sustainable Global Markets*. HM Treasury, London June.
- Hollands, Peter, 2010a. Investment in copper futures as a new, yet still readily understood, fundamental force in the market, Bloomsbury Minerals Economics. In: *Proceedings of Presentation for International Copper Study Group September Meeting*, Antofagasta, Chile.
- Hollands, Peter, 2010b. Private communication with authors, 3 December 2010.
- IMF, 2006. *World economic outlook*, International Monetary Fund, Washington, DC, Ch. 5.
- IMF, 2010. *Global prospects and policies*, International Monetary Fund, Washington, DC, Chapter 1, Appendix 1.
- Irwin, Scott H., Sanders, Dwight R., 2010. *Speculation and financial fund activity: draft report, annex 1*. In: *Proceedings of OECD Working Party on Agricultural Policies and Markets*, 17–20 May.
- Kaufman, F., 2010. The food bubble. *Harper's Magazine*, July.
- Kemp, J., 2010. Exchange-traded commodities double in 2009. *Reuters News*, January 15.
- Krugman, Paul, 2008. The oil nonbubble. *New York Times*, May 12. Available at <<http://www.nytimes.com/2008/05/12/opinion/12krugman>>.
- Masters, Michael W., 2009. Testimony before the Commodities Futures Trading Commission, Washington, DC, 5 August.
- UNCTAD, 2009. The financialization of commodity markets. In: *Proceedings of The United Nations Conference on Trade and Development*, Geneva, Switzerland.
- U.S. Interagency Task Force on Commodity Markets, 2008. *Interim Report on Crude Oil*, Washington, DC, July. Available at <<http://www.cftc.gov/ucm/groups/public/@newsroom/documents/file/itfinterimreportoncrudeoil0708.pdf>>.
- Verleger, Philip, K., 2007. How Wall Street controls oil. *The International Economy*, Winter.