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Hedging, arbitrage and the financialization of commodities markets

D. Tropeano

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Abstract

The paper provides an overview of the unfolding of the financialization of commodities in the 2000-2014 time frame. Different phases are described according to the positioning of the group of traders, their motivations, and the type of financial assets used to take a position in commodities. The main theme is the failure of arbitrage to level prices of similar financial assets traded in different markets. However, this failure does not depend on financing constraints suffered by arbitrageurs. Following Mirowski (2010) it is shown that arbitrage becomes a form of financial innovation rather than an equilibrating mechanism in contemporary financial markets. Historical accidents and changes in policy affect the positions of groups in the financial market game. The various strategies used are explained by creating a set of T accounts for the various groups that highlight the winners and the losers in the various phases.

Domenica Tropeano, Università degli Studi di Macerata.
E-mail: tropeano@unimc.it

1 Introduction

The paper reconstructs the evolution of commodities markets in the decade and a half between 2000 and 2014. This period was characterized by financialization which proceeded at an increasingly accelerated pace. Often, speculation is blamed for the harm caused by financialization or, more simply, by financial investment in commodities. The paper describes what happened in the various phases of increased investment in commodities by highlighting the strategies of the various trading groups and pointing out the results of their interaction. Rather than to financialization per se or simply to speculation alone, the harm caused by excessive fluctuations in prices is attributed to both hedging and speculative strategies, which are closely intertwined and co-dependent. The purpose of the paper is to describe how actually-existing markets work, instead of taking their functioning for granted according to a widely accepted theory (Chester 2013). In this particular case, the events displayed in the reconstruction are witness to the failure of arbitrage mechanisms in complex markets.

The work is structured as follows. In the second section arbitrage theory is reviewed. In the third section the hedging attempts and arbitrage failures of the first period of financialization are analyzed, and in the fourth, the new forms of arbitrage and price instability in the 2008-2014 time period are discussed. Conclusions are drawn in the last section.

2 Hedging and arbitrage theories

Hedging is an important part of the neoclassical vision of how financial markets work. The definition of hedging is: making "an investment to reduce the risk of adverse price movements in an asset. Normally, a hedge consists of taking an offsetting position in a related security, such as a futures contract" (Investopedia).

Intuitively, if an investor buys an asset and, at the same time, sells another asset with the same characteristics, his/her exposure to price movements, both favorable and unfavorable, should cancel out. The hidden assumption behind this risk mitigation strategy is that price variations in similar commodities match perfectly. The reason why they should match perfectly is that, if the prices of similar commodities were different, arbitrageurs would intervene to correct this distortion and the discrepancy would cease. Thus, hedging and arbitrage are closely linked in the explanation of how markets work. This is also relevant for policy purposes, as many hedging techniques have been recognized as risk mitigators in the regulation of banks.

If arbitrage does not happen as described in this theory, then hedging rests upon shaky ground. If an investor is long on a commodity and sells the same exposition to a similar commodity, it is because he/she trusts that their prices will move in the same way, thus bringing his/her total exposure down to near zero. If the prices of the two similar commodities do not converge, hedging would not free the investor from potential losses or gains. Arbitrage is essential for hedging to be a useful tool for mitigating risk. Arbitrage theory is grounded on the idea that all markets are alike, that they all work in the same way, and that any discrepancy in price between similar commodities will be wiped away by profit-seeking economic agents.

Thus, the essential homogeneity of markets and the existence of profit-seeking economic agents ensure that arbitrage theory works, which in turn ensures that markets remain in equilibrium. In this vision traders are important because, through their intervention, they allow this mechanism to function.

Many modifications have been made to the theory regarding the behavior of agents and how their diversity can hinder the arbitrage process from taking place and can affect the prices realized for the commodities. In particular, one of the equilibrium market hypothesis-based streams of literature has introduced various types of irrational or partially rational agents whose interaction in the market place causes the realization of prices that are different from the fundamental values and may even lead to the occurrence of destabilizing dynamics. The classic example for the stock market is the

presence of irrational noise traders who interact with speculators whose actions are motivated by different models, i.e., the chartists and the fundamentalists. The weights attached to the different groups may produce different price dynamics.

Schleifer and Vishny (1997) assume that there are different types of traders and they add two more features: a three-period trading and financing horizon constraint for the fundamentalists. The authors acknowledge that the classic theory of arbitrage is based on the presence of a great number of identical traders who, given their small demand and supply, cannot affect the market price; they realize, too, that the current configuration of markets with big investment funds does not fit into this picture. This notwithstanding, they retain the assumption of price-taker traders and add financing constraints. The perfect information assumption is retained, as well. The fundamentalists know that in the end, in period three, the right price (based on fundamentals) will prevail, but they cannot finance the purchases of the asset to the extent that would be needed to counteract chartists' investment. Thus, the limits to arbitrage are attributed to the presence of different agents and the existence of financing constraints. The imperfections are to be found in the agents' camp, because the agents are not identical and they need money to speculate. Since they speculate on behalf of big investment funds whose managers are focused on immediate results, the time-consuming arbitrage process cannot be carried out. So, big investors do exist but they are outside the model.

In the current environment, the opportunities for hedging have been greatly enhanced by financial innovation. There is the widespread idea that it is very easy to invent a new asset that can perfectly replicate the exposure to a particular commodity or security. That process usually involves the creation of derivatives. Another assumption is that size does not matter, as the same operation can be performed for a single commodity, a big portfolio, or the financial market as a whole. In the case of a derivative and the underlying asset, it is argued that their prices must converge at some point and that arbitrageurs will intervene to clear any divergences.

The assumption is that the derivative price will converge to that of the underlying asset and not vice versa if a divergence materializes. As Frenk and Masters (2010) write, since underlying prices are

efficient (according to the Efficient Market Hypothesis), the prices of derivatives must be derived from the prices of the underlying goods; otherwise, arbitrageurs would exploit the dichotomy. However, for the theory of arbitrage to work, all that is needed is that the two prices converge, while the direction is not specified. This means that either the derivative will converge to the price of the underlying asset or the opposite (Frenk and Masters 2010: 25). The specific structure of the market, as Frenk and Masters write, will determine the direction of the resolution.

The arbitrageurs could do their job, but the result would not be a price that corresponds to the efficient market hypothesis, in other words, an equilibrium price with respect to demand and supply in the underlying market. It might be a price that destabilizes that market, instead. So, instead of providing liquidity to producers and consumers, speculation would create price trends of its own.

Mirowski (2010) offers a more radical criticism of the neoclassical theory of arbitrage and hedging. His criticism is based on the evolution of markets and financial innovation. He posits that if markets are different, they will not be working the same way. The most obvious difference is the way in which trading is organized. Trading may differ as to the venue, the format (auction, posted price, type of auction), or the rules assigned to participants. These details - that are insignificant to the neoclassical theory - make the process of prices convergence harder and arbitrage rather unsuccessful. If arbitrage is unsuccessful, so is hedging.

Arbitrage could be seen as a form of market innovation. Whenever traders try to exploit profit opportunities by selling high and buying low, they link two markets, creating a new one. However, they do not correct a flaw in the system but rather, make it more complex. Sometimes the arbitrageurs do not use either of the two markets to correct the price divergence but trade in a third market. For example, a ‘futures’ market based on the mechanisms of a version of the double-sided auction may be used to link various spot dealer-mediated markets in a designated commodity, or an over-the-counter ‘derivatives’ market may be built over an existing auction market (Mirowski 2010:423)

Furthermore, if two different market formats are linked by arbitrage operations, the price that will come out will not necessarily converge either to the first or to the second market price. Mirowski (2010) does not just challenge the direction of convergence. He believes a hybrid price that can reflect the characteristics of both markets cannot exist: *"There is by definition no unity of correct price that can be restored through arbitrage between two suitably distinct markets.(Mirowski 2010:423)"* New tools created to redistribute risk have a life of their own, in some way autonomous from their components. The novelty touches both the definition of the new composite financial instrument and the institutional rules under which it is traded.

The creation of new markets and new securities that are piled up on top of those already existing may have significant consequences. The whole structure could eventually collapse. Markets would start resembling algorithms that are based upon simple functions to produce results. Algorithms must stop at a certain point. There is, however, a taxonomy of algorithms in which they have to be related to each other in a particular order. It is not possible to impose a simpler algorithm over a complex one. If this is attempted, the whole system collapses. The crux of the problem is that the calculation process cannot stop; it would continue forever if human intervention did not stop it. Mirowski (2010) argues that market forms start out isolated and operate at very low levels of complexity; it is innovation that turns them into ever more elaborate markomata (a type of automata). Market innovation would put something new on top of existing markets, generally in the form of structures of higher computational complexity, in order to encompass and integrate operation of the diverse component markets. While some risks may be diverted to other markets, the pyramid of increased complexity may fall apart. The reason for this failure is the computational incapacity of the market network, considered as a group of automata, to mirror what is going on in its component markets. For example, the prices of derivative instruments may become detached from the prices of the underlying assets (Mirowski 2010: 435). To repair the system it would be necessary to change its structure by decreasing the velocity of financial innovation and closing

some markets. In the end, the system would become less complex. Therefore, the computational problems could be resolved.

In the following section, I will discuss a case in which the evolutionary, institutionalist, and Minskyian approach to the problems of complexity in the financial system can be useful for interpreting events and suggesting policy options. The case study deals with the increase in the volatility of commodities prices in the presence of an extraordinary increase in financial investment in that asset class. The new investment was made by using new tools and creating new markets. In the period spanning 2000-2014, many actors entered the scene at different times and even exchanged roles. Understanding how such instability occurred requires reconstructing not only the change in the population of traders but the change in their motivations for trading, as well. In fact, the fluctuations in prices originated from various patterns of interaction among traders. Those interactions, in turn, were affected by events that occurred during that time period, such as the big financial crisis and the changes in regulations and monetary policy. These circumstances, which would have been considered exogenous in the neoclassical narrative, were indeed engines of transformation and change.

3 Hedging, the missing arbitrage, and the rise in the price of commodities in the 2000-07 time period.

3.1 Hedging, commodities index investment, and arbitrage.

From 2000 onwards, there has been growing financial investment in commodities. According to many studies (Tang and Xiong 2012; Basu and Gavin 2011), this has caused a rising trend in their prices.

At the beginning of the whole story there was a huge attempt at hedging by institutional investors. Big institutional investors, such as pension funds, municipal entities, university funds, increased their investment in commodities in order to protect themselves from changes in the price of shares.

The hedging was justified by the fact that the returns on these two classes of assets were inversely correlated.

This behavior would not be rational if viewed through the lenses of neoclassical theory:

> "Even if the observed correlation between equity and commodity futures returns were reliably negative, it is likely that this negative correlation would be an equilibrium arbitrage phenomenon that should be expected in a world where no unexploited hedging profit opportunity exists. The rise in commodity derivative trading thus poses a challenge to asset-pricing theorists to explain in a well-articulated rational asset pricing model. " (Basu and Gavin 2011:46).

Though the strategy would offer diversification it would be in contrast with the rational expectations theory. It would be as if a dollar bill was left on the road or a free lunch was offered, according to the theory of rational expectations.

That notwithstanding, institutional investors invested heavily in commodities between 2000 and 2007, retreating only after the financial crisis of 2007-8 (Basu and Gavin 2011). Their diversification strategy had far-reaching consequences in the market they entered.

First of all, they were demanding neither spot nor futures, but index futures. The index was an artificial construction in which a basket of commodities were bundled with different weights and different proportions. The investor in the index should have received the same revenue as the investor in the same basket of commodities held for the same time as the maturity of the index. The index should have perfectly replicated the performance of the commodities that it contained. The investment in the index was made through the creation of another contractual relation with an intermediary, usually a Wall Street bank. The investors were using futures index swaps to reap the benefits of their diversification strategy. They were transferring the cash amount to be invested in commodities to the bank that would buy government bonds and receive interest on them. The bank would, in turn, swap the yield of the government bonds with the return on the commodities index. The banks thus had to pay the return on the commodities index to the institutional investors. In

order to hedge the exposures to commodities indexes arising from these contractual obligations, the bank used futures; as the futures were of shorter maturity than the swaps, the banks had to roll over the futures for the nearest dates and buy the futures for later dates. The roll-over was thus executed the same way on the same days of certain months. Even the quantity to be rolled over was fixed; on each day, a quarter of the total index exposures were to be rolled over.

New patterns of trading in the market for futures emerged in which the demand for hedging and also for speculation depended on different factors. As a consequence of these new behaviors, which were neither rational nor irrational but simply justified by the positions of agents in the trades, the arbitrage between the spot and future market was not pursued and futures prices rose at a constant rate.

Theoretically, the price of a future should be equal to the spot price of the underlying asset plus the spot price multiplied by the difference between the interest rate and the yield of the asset over the same period. The rationale behind this equation is the assumption of arbitrage. In fact, if the future price were higher than the one satisfying the equation, it would be convenient to borrow money, buy the underlying asset, sell the future, and earn a profit after having repaid the loan and its interest (Fabozzi *et al.* 2002). This arbitrage, in turn, would lower the future's price and let the asset's price rise, up to the point at which the equation is satisfied again. The gain would be obtained independently of the level of the spot price on the date when the future expires. For a commodity, the same equation must take into account the cost of storage and the convenience yield of holding it (usually related to the level of inventories).

This example assumes that the market for the futures and that for the underlying asset are similar in their structure and in the behavior of agents. If they were not then the law of one price would not hold. On this Mirowski writes:

> ".. it is known that if the 'same' commodity were to be offered for sale under the auspices of two different market formats, then it is highly unlikely that the price and quantity consequences will always and everywhere be identical between them. Imbalances of supply and demand therefore need not lead in general to identical prices and quantities sold, in this view.(Mirowski 2010:422)"

For example, if the market for futures were simply much bigger than the market for the assets, the arbitrage would not be sufficient to restore the equation. There would simply not be enough assets to buy. In fact, the growth of financial futures on commodities was much higher than that of underlying commodities.

Moreover, in this example of how the equilibrium price would be determined, it is assumed that the future will be settled when it expires. The future can be settled by delivery or taking delivery of the commodities sold or bought but most of time the delivery does not take place. The buyer of the future can get rid of the obligation to take delivery by selling a future with the same characteristics as the one bought and the seller by buying another one.

The rise of index investment and other forms of institutional investors' positions in commodities required rolling over of the futures which means that the future was sold before the expiry date relieving thus the buyer from the obligation to take delivery. Rolling over means closing the long positions in the maturing contracts and initiating new long positions in contracts that have later maturity dates. The shape of the futures curve will determine the gains or losses from the rollover. The curve may be either upward- or downward-sloping if futures prices increase/decrease with the maturity of the underlying contract. Because the curve since the early 2000s has been positively inclined for most commodities (Mou 2010), this has meant a rollover gain for sellers and a rollover loss for buyers. The buyers were the banks on behalf of the institutional investors in index funds and their counterparts in the deal, the sellers, were mainly money managers, hedge funds, and banks.

The amount gained or lost by rolling over a unit of the commodity is defined as the spread between the price of the maturing contract and the price of the deferred contract within a certain unit of time. Without price impact, the spread should be almost constant in a short time period. If the actions by index funds, instead, affect the price, the spread will fall during the rollover period as the maturing contract falls in price, while the deferred contract rises. Knowing this, speculators prepare

themselves to exploit the narrowing of the spread by taking the same positions as the index swap dealers some days in advance. Then, the speculators create short positions in the maturing contracts and long positions in the deferred contracts. At the time of the rollover, they close their positions and realize the gain. The gain does not depend in any way on the evolution of the spot price of commodities but only on the spread in the prices of two futures contracts expiring at different rates registered within a certain time window.

The only risk is that the expected narrowing of the spread at the rollover time does not occur. This could happen if a large number of investors suddenly withdrew from index funds.

So, the textbook way of determining the future's equilibrium price as the price that ensures no arbitrage between spot and future markets, did not apply for the futures prices of the commodities included in the most important indexes (agricultural commodities, metals, energy).

3.2 Finance constraints or too many overlapping markets?

Many scholars believe that behind the detachment of derivatives prices from fundamentals lies the missing arbitrage problem (Schleifer and Vishny 1997; Vayanos and Gromb 2010a; Vayanos and Gromb 2010b; Acharyia, Loechster and Ramadorai 2013). The question they try to answer is: Why did speculators not intervene to clear up this excess demand for futures since it was profitable to do so? Though divergences arise in the way they represent the positioning of the main groups of traders, their answer is that the failure of arbitrage was due to financing constraints. Paradoxically, then, the solution would be to grant speculators more means to speculate.

Acharyia, Loechster and Ramadorai (2013) describe and test a model of interaction between hedgers, identified as the producers of commodities, and speculators, defined as the buyers of futures on the other side of the deal. The authors' main thesis is that the excess demand for hedging by producers, which depends on their default risk, causes futures prices to fall. So, the basis would be negative. The price slump would, in turn, increase the cost of hedging for producers who sell futures. Therefore, they would decide to hold fewer inventories and dump commodities on the

market, making their price fall. The reason why the excess demand exists can be found in financing constraints for speculators. The authors propose a policy designed to relieve such constraints.

Acharyia, Loechster and Ramadorai (2013) introduce assumptions that are in contrast with the consensus view on who the speculators were. So with reference to the situation mentioned above the consensus view is that the producers were the speculators and the buyers of futures were the hedgers. So, the problem was the excess demand for futures by banks that had the swaps of commodity index investors which was partially accommodated by various groups of producers, trading firms, and financial entities all selling futures. Some of them were actually hedging stocks of physical inventories but to the extent that their demand was higher than their stock, they were just speculating on the shape of the forward curve.

The future and the spot price were both on the rise. The latter could have risen because of rational valuation expectations of the shape of the forward curve for futures. Another reason why the spot price did rise was the profitable inventories accumulation by those who were speculating on the slope of the forward curve for commodities futures.

Hedgers and speculators had changed their role with respect to the classical representation entailed in the theory of backwardation. The theory of backwardation assumed that the most common situation was that of demand for hedging by producers (selling futures) being higher than demand for hedging by consumers (buying futures). The futures price would thus tend to be lower than the spot price (positive basis). In fact, in the 2000-2007 time period, there was no backwardation, but contango and the basis was negative. So, the cost for producers willing to hedge decreased. They then had reason to accumulate inventories instead of dumping them on the market.

Brunetti and Reiffen (2012), instead, accept this consensus view. They acknowledge that the problem was the excess demand of buyers rather than that of sellers of futures. They also find evidence for the calendar spread speculation hypothesis. They test the hypothesis that the spread between the first deferred and the nearby futures contract depends on both the relative size of commodity index traders' positions on the two maturities and on the aggregate size of commodity

index traders' positions. They find that the relative prices of futures with different maturities vary predictably with commodities index traders' positions. An important conclusion from their work is that the producers were not damaged by the rise in the price of futures. As markets moved into contango, after the introduction of commodity index trading, the equilibrium discount changed into an equilibrium premium, becoming a bonus to producers. However, they believe, as do many scholars, that the reason behind all this is the shortage of capital coming from speculators. No reason is given why speculators should be scarce on capital, given that buying and selling futures does not require capital except for very low initial margins.

I argue instead, in line with Mirowski's view, that the creation of another market, i.e., the commodity index, which should mimic the performance of the spot markets for many commodities, is what led to a divergence between future and spot prices.[1] The higher prices of futures did not induce investors to buy on the spot market. No arbitrage mechanism was available.

3.3 Winners and losers: an accounting scheme.

If this reconstruction finds consensus, then the logical conclusion is that the losers in the game were those consumers who did not hedge and the institutional investors; the winners were the speculators and the producers-hedgers (see Table 1). Those producers-hedgers actually were trading companies that distribute the products rather than growing or producing them; they began behaving like financial investors, too (Newman 2008; Cheng and Xiong 2014).

We can track the positions of the various actors in the game by looking at the stylized T accounts presented in the Appendix. The accounts show assets and record flows on the left, and liabilities on the right. The households have, on the assets side, their wages and pension entitlements, and on the liabilities side, the loans they have to repay and other expenses. The institutional investors, pension funds, and other long-run investors, have Treasuries and the index commodities swaps on the assets side, while they have the pensions they have to pay to savers as liabilities. The banks in this phase act as intermediaries between institutional investors and other financial investors; so, on the assets

side they have the futures that they buy on behalf of institutional investors and on the liability side they have the commodity index swaps.

The speculators are, in fact, other financial investors such as money managers, hedge funds, individuals that sell futures and might carry out calendar spread speculation. This type of speculation may also be carried out by trading firms that have commodities on the assets side the loans and the futures sold on the liability side.

Therefore, before the great financial crisis erupted in 2007, the losers were the institutional investors and the households, while the winners were the speculators, i.e., the money managers, hedge funds, and the like.

The reason why the institutional investors were losing is evident if one looks at the performance of the total return on commodities investment. The GSCI (Goldman Sachs Commodity Index) futures index total return through the period spanning 2000-2014 grew at a negative rate (see Kaminska 2014). The Dow Jones- UBS total return index grew until the second half of 2007 though less than the Dow Jones UBS spot index and during the crisis declined more than the spot index; then recovered but to a much smaller extent than the latter (Mooney 2011).

Instead, speculators were making gains on the calendar spread positions without risking anything, as long as the trading habits of commodity index trader hedgers were known. The institutional investors in index funds were quite conservative long run investors and the index funds were not traded so often, though the inflow and outflow might have affected the size of the rolling. Like CDOs, index funds were simply held till maturity.

Those who argue that the new speculators in commodities transfer money from producers and consumers to financial market participants (Frenk and Masters 2010; Acharyia, Loechster and Ramadorai 2013) do not consider the following point. In particular, Frenk and Masters (2010) write that speculation causes an increase in price volatility, leading in turn to higher costs for bona fide hedgers. In their opinion, speculators do not make money from facilitating economically

advantageous transactions that would not take place without their intermediary action, but rather, they gain from widening spreads due to unpredictable price fluctuations.

Most of the literature blames speculation for generating social costs through the supposed increase in the cost of hedging for producers and consumers. The institutional perspective adopted in this paper is rather different. Speculators are not seen as the sole designated culprits; hedgers may be guilty as well. Hedging and speculation are two sides of the same coin. At first, it was the enormous increase in the demand for hedging by swap traders to require a corresponding increase in supply. Then, the speculators intervened by exploiting the profit opportunities arising from the institutional details of the market. Hedging and arbitrage, carried out in a complex financial structure, introduced instability with large fluctuations in the prices of commodities. Dumb money was as responsible as speculation itself (Kaminska 2014).

4 Hedging and arbitrage as a form of financial innovation: the evolution of commodities markets in 2008-14.

The 2007-08 crisis did not stop the financialization of commodities (Henderson, Pearson and Wang 2014; Kaminska 2014). During that time the inflow into commodity index funds decreased (Mohammadian-Molina 2012), but after that, new forms of investment in commodities emerged with new financial instruments and new trading techniques.

Total assets under management grew from 160 billion in 2008 to 424 billion dollars at the end of 2012. Precious metals went from 49 to 148, energy from 62 to 122, agricultural products from 38 to 65, base metals from 9.9 to 28.3 (Barclays 2013, Figure 28, 19). The composition of commodity assets under management changed, as well. Indexes roughly doubled, going from 65 to 133 billion dollars in 2012, as did medium term notes (MTN) swelling from 46.8 to 81.1 (see Barclays 2013: 19). The biggest increase, however, was in exchange traded products (ETFs) which more than quadrupled, shooting up from 48 to 210 billion dollars.

Along with this change, new attempts at arbitraging and hedging by the actors involved were implemented. Rather than a steady rise in the price of commodities, the result was a fluctuating pattern with cyclical swings. The new exchange traded products, by their own design, increased the problems with arbitrage and thus, the effectiveness of hedging.

4.1 Changes in investment patterns after the 2007-08 financial crisis.

ETFs backed by futures required rolling over the futures in the same way as index fund investments did. Investors in ETFs were in part institutional investors but also other types of investors like money managers or hedge funds that pursued an active strategy, in contrast to the passive approach favored by institutional investors and individuals. The inflow and outflows in ETFs were more volatile than those in commodity index funds. This was obvious, as the new tool was created to allow investors to switch quickly from one security to another at any moment during the day, rather than only once a day (mutual funds redemptions), and it claimed to be cheaper than investment in funds because the fees were lower. Thus, while there continued to be a tendency for prices of futures with a more distant expiry date to increase compared to those with the closest expiry date, the prices of both futures and spot commodities experienced a greater volatility than in the previous period. Price fluctuations were more pronounced and so was contango.

Banks changed their role from being agents that acted on behalf of institutional investors to being principals that owned and stored commodities. [2]They were long on commodities and short on futures (see Appendix). Before the crisis, the banks had futures on the right hand of the T-account, the asset side. They bought them, though, on behalf of the investors. On the liabilities side, they had the index fund swaps, as they were committed to give investors the difference between the return on Treasuries and the yield on the commodities index fund designated in the contract (see Appendix: The banks, first row). After the crisis, physical commodities appeared on the asset side and futures ended up on the liabilities side as banks sold futures (see Appendix: The Banks, last row). The popular narrative is that banks were selling futures and buying spot commodities, storing them, and

gaining from the difference between the price of the future sold and that of the physical commodity bought. The gain was positively related to the intensity of contango, of the negative basis, and negatively related to the cost of taking a loan to buy the commodities and storing them. After the crisis, however, many investment banks in the U.S. were handed over a commercial banking charter so they could grant loans - to buy and store commodities - to the commodities firms they owned. In addition, big banks began buying or renting storage facilities, thus lowering the cost of storing. Another perhaps more plausible explanation is that banks were selling futures to profit from the shape of the curve and then used inventories of commodities they already had to hedge their futures position. While this strategy may have been carried out by big banks that owned storage facilities and trading firms, an easier way to make gains was just to bet on the shape of the forward curve for futures. Since there were many new financial assets linked to commodities and all of them were using futures, then there was a higher number of rollover dates than in the past, thus creating more opportunities for calendar spread speculation. Even without calendar spread speculation, it was easy to sell a future expiring at a later date and then get rid of that position by buying the identical future before its expiry date at a lower price. According to some financial observers, commodities became a hedge for futures sold, rather than the other way around.

The gains by the banks were the mirror image of the losses by investors in commodities. So, the condition that allowed this to continue was the loose monetary policy and the willingness of investors to accumulate losses. If at any time this willingness were to disappear, the strategy would be discontinued, leading to a massive sell-off of commodities on the spot market. Actually, as long as the contango was increasing in intensity and spot prices were rising, the banks were gaining on both the future and spot positions (Kaminska 2010). The zero interest policy and the availability of central bank refinancing at zero costs made this strategy highly profitable for big banks.

Initially, large trading companies played the same game, but it was less profitable for trading companies as they had to take out loans from banks to buy commodities. Obviously, they had commodity assets and sold futures, as well, but they were depending on bank credit for their

operations. There were also more complex arrangements between banks and trading companies that allowed trading companies to buy not-yet-produced or extracted commodities. This is the reason why in the accounting scheme loans also appear on the assets side of trading firms after 2007.Hence, banks were not directly lending to producers but instead, to trading firms that were signing pre-payment contracts with producers. In this way, banks succeeded in transferring the credit risk to others. The commodities were the collateral for the loans by banks to trading firms and also for the loans by trading firms to producers.[3] So, a higher price for commodities meant more loans and more loans allowed a higher rate of extraction. It was a self-enforcing cycle. The pattern on the supply side would reinforce the contango in prices. The excess supply caused by loans that financed even not very profitable firms caused the spot prices to fall with respect to the future price pushed by the financial investment in commodities. This was more evident in the energy sector, e.g. in shale gas extraction in the U.S.

Between 2008 and 2011 the futures and spot commodities price differential was rising (heavy contango). Later, contango was less pronounced and, for some commodities, there was even a feeble backwardation. Starting from 2014, spot prices began to fall (Unctad 2015), particularly that of oil, and commodities firms received fewer loans because of the lower value of the collateral. At the beginning of this downward slide, there was a withdrawal from commodities index funds and ETFs. The data on assets under management show the biggest decline in Etfs while the decline in commodities index funds was smaller and happened more slowly . Starting from 2011 there is a steady but slow decline in index investment accompanied by an increase in Etfs. In the end of 2013, however, Etfs investment dropped sharply by about 100 billion in a few months. Renewed index funds withdrawal followed later in 2014 e 2015 (Unctad 2015, Chart 1a1: 22). The decline in investment in one product feeds back on itself through declines in the prices of other products having as underlying the same security or belonging to the same security class.

The banks, however, were in a better position to protect themselves from the fall in prices. They had sold exchange-traded funds and medium term notes, over-the-counter products, linked to

commodities (Mohammadian-Molina 2012). In our accounting scheme, ETFs and MTNs are on the right hand side, in the liabilities column, as they had to provide investors with the yield of commodities or commodities indexes. Because in this right column they also had both physical commodities and loans made to commodities producers and commodities trading firms, this worked as a natural ex-post hedge. In fact, at the time of writing, with commodities prices in free fall, banks have withdrawn quite easily, while trading firms are suffering heavy losses.

Thus, the winners in the second period were banks and, in particular, the big banks that owned commodities firms. The losers were institutional investors, some hedge funds pursuing active strategies, and, in the last two years, trading firms, as well. Trading companies are still suffering losses because they depend on bank credit that may be cut as their profits fall and because they themselves are creditors of precarious firms that suffer the most from falling spot prices.

In the next section, there follows an explanation of how the modalities of trading may have affected the behavior of prices, in both the boom and the bust. The withdrawal of investors from one market, for exchange-traded funds for instance, may have brought about the decline of prices in other markets. This would depend on the way the ETFs are designed and could also be due to an arbitrage failure.

4.2 ETFs and arbitrage.

In the ETF market banks, as authorized participants, should act as market-makers for the sponsors, which may be banks as well. This process is described as follows:

> " When an ETF sponsor wants to create more ETF shares to be traded on an exchange, it hands the shares to APs who then deliver a basket of the ETF's underlying securities to a trust held on behalf of the sponsor. Small discrepancies between the price of the underlying securities and the ETF shares draw APs into making markets, providing an opportunity to make money by "arbitraging" the difference." (Alloway and Massoudi 2013)

Whenever the ETF price diverges from the price of the underlying security, the banks should intervene in order to level them, thus earning arbitrage profits. This requires the arbitrage to work in

the way described by theory. Yet, if it does not, it may result in price instability. More specifically, this missing arbitrage could exacerbate the tendency for prices to fall during the bust phase of the cycle. If the price of ETFs falls below that of the underlying security, the Authorized Participant (AP) should satisfy the demand for redemptions by the final investors. In order to satisfy this demand in cash, however, it should sell the underlying assets. In theory, the authorized participants should gain from selling the latter at a higher price and paying back at the lower ETF price. In fact though, if redemptions are heavy, selling by the authorized participant lowers the price of the underlying asset; so, in the end, the authorized participant could even lose. The assumption that arbitrageurs are price takers is not satisfied. Furthermore, this attempt at arbitrage would not reconcile the two prices, while it could, instead, trigger self-sustaining increases or decreases.
This arbitrage failure can be interpreted through Mirowski's and Minsky's insights (Mirowski 2010; Minsky 1993). After the crisis, the financial structure was not simplified; on the contrary, new layers were added to existing markets. Consequently the computational problems of markets-automata worsened. Not only was arbitrage limited by the market structure and the willingness of traders to exploit it, but price movements also spilled over from one security to a similar one. This was complicated by the new electronic trading rules and significant jumps, within minutes, in prices of the same commodities were not a rare event.

4.3 New modalities of trading.

The introduction of new avenues for trading with the multiplication of electronic trading platforms, each with its own rules, and the use of automated trading machines has complicated the picture. The more trading places and modalities there are in which securities are traded, the more difficult arbitrage among them will be.

Biccheri and Maystre (2013) found that from 2008 to 2013, the intraday correlations between the returns on the US stock market, for which the E-mini S&P 500 Future is a proxy, and the returns on selected commodities (various highly traded futures contracts on crude oil, corn, soybeans, live

cattle, other agricultural commodities) increased from a zero value to a positive one. The increase in correlations is calculated from high frequency data that records trades in very short intervals like five minutes and ten seconds. This supports the idea that commodity price volatility depends more on financial factors than on changes in fundamentals because changes in fundamentals do not happen in just a few seconds.

Another characteristic of the post-crisis environment was the diffusion of new trading systems; the trading avenues increased in number, but most of that trading happened in the dark. The dark area includes the so-called dark pools, where disclosure of bid-ask spreads is not made public before the trade, but also internalized trades among departments of the same financial institution, and over-the counter trades (see Degryse, de Jong and Kerviel 2011).

Degryse, de Jong and Kerviel (2011) find that the increase in the share of trades conducted in the dark area does indeed decrease liquidity in the lit area, as measured through various metrics (price impact, bid-ask spreads, depth).

Therefore, the assumption that any agent can become an arbitrageur, provided s/he has the necessary funding for his/her strategy, is very difficult to see proven in practice. In those fragmented trade avenues any significant selling would cause a price impact. Practitioners themselves say that is is now almost impossible to sell a financial asset under a limit order at the same price prevailing when the limit order was placed. Automates discover the orders a mere instant after they have been displayed, buy the demanded assets at the current price, and then resell them to the investors at a slightly higher price, pocketing the difference (see Rose 2010: 13).

5 Conclusions

I have provided an overview of the unfolding of the financialization of commodities in the 2000-2014 time frame. Different phases were described as envisaged according to the positioning of the

group of traders, their motivations, and the type of financial assets used to take a position in commodities.

The main conclusion that emerges from this reconstruction is that the simple arbitrage formula that should be used, in theory, to derive the price of futures does not apply for most futures on commodities. So, the equilibrium price is not determined by the "no arbitrage" clause. Since the inception of commodity index investment by institutional investors, other profitable strategies have been used; the most common one is calendar spread speculation, though any strategy aiming at profiting on the shape of the forward curve for futures would do. The higher price of futures then passed to the spot price, either through the rational expectations theory of the term structure applied to the future's forward curve or simply through hoarding by producers as well as financial institutions.

The arbitrage failure was not due to the the lack of financial resources by speculators, as

argued by most scholars. Arbitrage between future and spot prices was simply not always profitable because of the price impact. The size of index investment meant that whatever attempt was made to exploit the difference in price by arbitraging would cause a price impact. This contradicts the neoclassical assumption of an atomistic speculator as a price-taker. In the second phase, 2008-14, the price impact was also caused by the increasing share of trades conducted in the dark with no limit order book and often within the same institution. The higher the incidence of dark trading was, the lower the liquidity (and the higher the price impact) in the lit avenues for trading was.

Financial innovation introduced new products to be hedged by using futures. The rolling over of index funds, ETFs, and MTNs was scheduled at different dates, thus multiplying the price impacts and the occasions for profitable speculation. To put it simply, speculation that was profitable was carried out, but it did not level the prices of similar assets traded in different markets.

Arbitrage across several financial asset markets, all related to the same commodity, was very difficult for the simple reason - as Mirowski writes - that there is no one price that can reconcile them. This means that after 2007 it was a hard task to reconcile the price of a commodity included in an index with the price of its future, and those two prices with the price of the ETF, then those three prices with that of the MTN, all having the same commodity as the underlying security. Any change in the price of one of those assets could start a movement in the same direction in the others, thus giving rise to different phases of the cycle.

Notes

[1] In the period 2005-10 the prices of many agricultural commodities futures contracts settled much higher than the corresponding delivery market cash prices (Ademijan, Garcia, Irwin, Smith 2013).
[2] The involvement of banks in the commodities business has been object of an investigation by the Senate of the United States (United States Senate 2014).
[3] On the collateralization of commodities see Kaminska (2012) and UNCTAD (2015).

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Appendix: Accounting scheme.

1 Institutional Investors

Assets	Liabilities
Shares and Treasuries	Pensions
Swaps on Index funds	
MTN	
ETF	

2 Banks

Assets	Liabilities
Futures	Swaps on index funds
Loans	**MTN**
Treasuries	**ETF**
Other assets	Other liabilities
Commodities inventories	**Futures**

3 Trading companies

Assets	Liabilities
Commodities inventories	Futures
Loans to producing firms	Loans

4 Money managers, Hedge Funds.

Assets	Liabilities
Futures	Futures
Commodity Index Funds	Loans
ETF	

5 **Households.**

Assets	Liabilities
Wages	Expenses for goods commodities services
Pension entitlements	Loans

Note: The items in bold characters are those that have been added in the second period 2008-14.