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**Research Report**

## Food Prices, Food Price Volatility and the Financialization of Agricultural Futures Markets

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# Food Prices, Food Price Volatility and the Financialization of Agricultural Futures Markets\*

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## The supply and demand background

Over the long term, food prices have tended to decline in real terms, as the result of increased yields. Averaging over the four years 2011-14, the deflated price of grains and vegetable oils are respectively 15% and 14% lower respectively than those over the four years 1969-72; the prices of softs (cocoa, coffee, tea and sugar) are 35% lower. However, prices have tended to rise over the period since 2000. In 2011, grains prices were 92% higher than in 2000, vegetable oil prices 136% higher and softs prices 65% higher. Prices have dropped back slightly from 2012.



.../... Supply and demand factors have both contributed to higher food prices. The food demand curve has shifted right as the result of income growth, particularly in Asia. The food supply curve has shifted up as the result of higher input (particularly fertilizer) prices plus a slow-down in yield growth as the consequence of low levels of agricultural investment.

It is an open question whether the fall in prices over the past two to three years will continue. The OECD-FAO Outlook (OECD, 2015) suggests further modest falls but insufficient to bring back prices to historic levels. By contrast, analysis of long term price movements suggests that in the very long run, food supply is almost perfectly elastic – over the past, demand has had no long run effect on prices. High prices make investment attractive and we have seen the impact of this in particular in major increases in US grains production. However, yields remain obstinately low in Africa. Food price optimists take the view that these incentives will be sufficient to bring supply back in line with demand at historical price levels. Pessimists argue that a higher, and perhaps even a continuously rising, long run price will be necessary to feed the rapidly growing world.

## ► Food price volatility

Food price volatilities show little trend over the long run. Volatility is determined by shocks to production and consumption (notably harvest shocks) and is inversely related to supply and demand elasticities. Stocks attenuate volatilities by increasing the elasticity of net supply. There is an argument that production shocks have increased, possibly in part due to global warming, although there is no clear evidence of this impact, and, in grains, because of the increased importance of the Black Sea region where weather conditions are very variable.

Stock levels, which had fallen to low levels by 2007, have now largely recovered. It seems that shock transmission from the crude oil mar-

kets to grains and vegetable oils has increased but crude oil price volatility remains low – oil prices are prone to large jumps more than month-to-month oscillation. Volatility was more of a problem over the past decade than it is currently. Comparing the 2011-13 with the nineteen nineties (1990-99), grains price volatility is unchanged at 17%, the volatility of vegetable oils has risen from 16% to 18% but softs volatility has jumped from 18% to 24%. 2014 saw an uptick in vegetable oil volatility, and there was also a smaller rise in grains volatility. These rises may be associated with the sharp downward movements in crude oil prices.

In retrospect, the 2007-08 price and volatility episode does appear to have been exceptional. Real price levels and volatilities both rose; the latter have fallen back but prices have only declined partially and remain relatively high. One possibility is that the volatility was associated with the uncertainty generated in the transition from the previous trend of low and declining prices to the current situation in which higher prices are required to stimulate the additional production required to feed the growing and self-enriching population in the developing world.

## ► The financialization of food commodity markets

The term financialization refers to the major increase in the presence of financial agents on food commodity futures markets – see Mayer (2010). Statistics produced by the Bank for International Settlements show the notional value of outstanding commodity derivative positions. The BIS figures show rapid growth in the dollar values of these positions from 2004 to 2008 followed by a subsequent fall back to lower levels from the end of 2008. Even after this fall, the outstanding contract value remains three times that of 2004, prior to the major rise.

Much of the growth in non-commercial activity in commodity futures is attributable to in-

dex-based (“CIT”) investors. These investments generally take the form of swaps contracted with investment banks – the investor pays \$1m to the bank and receives back \$1m times the change in the commodity index specified in the contract less a fee payable to the bank. The investors are typically pension funds and the like plus rich individuals. They tend to think of commodity futures as an additional asset class and diversify a typically small proportion of an equities plus bonds portfolio into commodities. It is claimed that, over the long term, commodity investments of this sort would have generated returns comparable to those on equities at a comparable level of risk. Historically, commodity returns and equity returns were only weakly correlated so diversification into commodities should have reduced risk. However, these claims are based on simulated returns over a period in which these investments were not available. In practice, the tradable commodity indices have a high energy weighting and so have done well when oil prices have risen and poorly when they have fallen. Because oil price movements are correlated with changes in overall activity and hence with equity price movements, the correlation between commodity and equity returns has risen.

Index traders invest to track one or other tradable commodity index or sub-index. They are invariably net long in all markets. They have seen themselves investing in the “commodity asset class” rather than individual commodities. In US Senate testimony, hedge fund manager Michael Masters argued that they were driving commodity prices in 2008: *You have asked the question “Are Institutional Investors contributing to food and energy price inflation?” And my unequivocal answer is “YES.”* He added that they “eat” rather than provide liquidity (Masters, 2008). Irwin and Sanders (2012b) call this view the Masters Hypothesis.

The current academic consensus (Irwin, Sanders, Stoll, Whaley) is that index investors had a negligible impact on agricultural futures

prices – Irwin and Sanders (2011, 2012a,b), Sanders and Irwin (2011a,b), Stoll and Whaley (2010). I have taken a different view. Specifically, Simone Pfuderer and I have demonstrated clear evidence of CIT impacts on prices in the soybeans complex – soybeans, soybean oil and (less strongly) soybean meal. There are also high contemporaneous correlations between changes in index positions and returns on agricultural futures. Using an instrumental variable approach (all instruments lagged) we see impact for a wider range of markets, but not in corn or soft wheat (Gilbert and Pfuderer, 2014a,b).

The overall conclusion is that there is some evidence that index investment moved food prices but that evidence is weak for corn (maize) and wheat, the two most important futures-traded grains, and cannot apply to rice, which is not actively traded on a futures exchange. However, agricultural futures account for only a small share of total CIT investment and it is to energy and metals that one should look to see the real CIT action.

Data on index investment positions in non-agricultural futures markets are only available monthly and from June 2010. They do not cover the major build-up in positions in 2006 and 2008. In a 2010 paper for UNCTAD, I constructed a quantum index (equivalent CBOT wheat contracts) for total index position in US agricultural markets. If the agricultural share in total investment is broadly constant, this will provide a good proxy for total index investment. We can compare this index constructed from the limited sample of CIT traders available from January 2006 with the Special Call data for all US commodity futures which is available monthly since mid-2010. The two series track well except over the initial Special Call observations.

Granger causality testing is the standard method in the literature for investigating whether one factor is causally related to another. Because the claimed causal variable is lagged, any link cannot be from the effect variable to the causal variable. However, it may be that the

structural cause is a third variable which drives the effect and is correlated with the claimed causal variable.

In Gilbert and Pfuderer (2014a), we showed that changes in this index Granger-cause changes in the IMF's major non-food commodity price indices. The results are driven by the large upward movements in index investment through to the summer of 2008, the collapse in 2009 and the revival in 2010. Index investment has moved relatively little since 2011. (If we simply estimate over the 2011-14 period, the results are weaker but mainly because the coefficients are less well determined, not because they are at variance with the earlier estimates).

In summary, there is some evidence that index traders had price impacts. However, this is far from arguing that they caused the 2008 food price spike. (The results are less clear in relation to volatility but there the impact appears to have either been null or volatility-reducing). The puzzle with these results is that they are much stronger than the results obtained on weekly data looking at changes in positions in particular markets (corn, wheat etc.) on the prices in those markets. This leads to the suspicion that there may indeed be a third factor which is driving both index investment and the commodity prices.

My personal view is that the high 2008 and 2011 prices reflected fundamental factors, but that financial actors, and in particular index investors, played an important role in transmitting fundamental information into the market. This can explain why CIT investment predicts overall movements in commodity prices without necessarily causing impacts in any single market. The explanation does not preclude the possibility that financial actors may have exacerbated fundamentally-based price movements.

## ► Food price bubbles?

There is general agreement that the 1998-2000 Nasdaq dot.com boom was a bubble. Caballero Fahri and Gourinchas (2008), echoed by Phillips, Wu and Yu (2011), have suggested that Nasdaq was just the first of a wave of bubbles moving across asset markets over the final decade of the so-called Great Moderation which ended with the 2008 financial crisis. Subsequent bubbles in this alleged sequence are the US housing price boom, attributed to sub-prime lending, house price booms in Spain and Ireland and the 2007-08 crude oil and food price spikes. Grains and oilseed prices are candidates for inclusion in this list.

Some commentators ascribe this alleged bubble wave to overly loose monetary policies, in particular on the part of the Federal Reserve Board. On this view, investors, flush with funds, chased high nominal returns in markets in which, absent inflation, low returns had become the rule. Behavioral economists emphasize return chasing, extrapolation, herding, and over-optimism on the part of retail investors. Investment in commodity futures is dominated by institutions who do not exhibit these features but who may suffer from "short termism". Institutional investors will aim to beat common "benchmark" portfolios but will not deviate far from the implied allocations for fear of underperforming. Even if they are aware that particular price developments are without fundamental support, they lack the freedom to take a contrarian view.

The mainstream (rational) account of bubbles rests on the view that finance theory gives a good account of the relationship between asset returns (Euler equations), but only a weak account of asset values (the transversality condition). The weak form of the transversality condition appears to rule out bubbles since any bubble will eventually diverge from the fundamental by an arbitrarily large amount. Diba and Grossman (1988) considered periodically

collapsing bubbles. They suppose a probability  $\pi_t$  that the bubble collapses back to the fundamental in any period  $t$ . The higher the bubble component, the more likely it is to burst. On this view, bubbles tend to grow increasingly fast prior to bursting.

Bubble processes are non-stationary but subject to structural breaks. Evans (1991) showed that standard test procedures (such as the ADF) will not work and will fail to find bubbles. I use the Phillips, Shi and Yu (PSY, 2013) procedure which has now become standard in this literature. The procedure uses a combination of backward and forward recursive ADF tests. The forward recursions deliver the Generalized Sup ADF (GSADF) statistic which tests for a bubble at some point in the sample. The backward recursions deliver a sequence of Sup ADF (SADF) tests which time stamp bubble start and end dates. The PSY procedure has previously been used on agricultural futures data by Etienne, Irwin and Garcia (2015) and on metals price data by Figuerola-Ferretti, Gilbert and McCrorie (2015).

Using the approach on weekly data, a single bubble is identified in wheat, at the 5% level, from August 2007 through March 2008 (33 weeks with a 2 week “hole”). In corn two bubbles are identified at the 5% level – from November 2006 through March 2007 (9 weeks) and from February 2008 through July 2008 (28 weeks). In soybeans, a bubble is identified from February to May 2004 (14 weeks) plus a second bubble from November 2007 to April 2008 (22 weeks). There is also evidence of a negative bubble in 2000. There is no evidence of bubbles in 2010-12.

Only a single bubble episode is identified in grains and oilseeds over 2000-05 but the years 2006-08 see bubbles in all three markets including simultaneously in February and March 2008. Was this a coincidence?

A crude oil bubble is also identified in 2008 but this came later and after the wheat bubble had terminated. It does not seem possible to blame contagion from the crude oil market. Economists who emphasize fundamentals will

point to low stocks over this period. However, low stocks should lead to high but not explosive prices. Economists who emphasize financialization will note that this was exactly the period that the growth in index investment was fastest. Etienne, Irwin and Garcia (EIG, 2015) analyzed bubbles in agricultural futures markets over the long sample of 1970-2011. They found a substantial number of bubbles but conclude that “bubbles are short-lived” with 65%-80% of episodes concluding within 20 days. EIG use daily data while I use weekly data. My conjecture is that what EIG have identified is futures market froth which is likely to be of little policy concern.

Explosive index investment can account for explosivity in grains and oilseeds prices. The PSY test throws up a bubble for CIT investment in agricultural commodities from October 2007 to June 2008. The coincidence of the explosive periods index investment and in grains futures suggests that index investment was indeed the channel through which impounded their views about market fundamentals into prices. Whether or not one chooses to regard this as a speculative bubble depends on whether one believes that index investors brought new information into the market. This is in effect an inference based on a single episode and so should be treated with caution. Nevertheless, the coincidence is remarkable and reinforces the regression results reported earlier linking index investment to food price movements.

## ► Conclusions

The food commodity price movements in 2007-08 were exceptional. They were also associated with exceptional volatility. The fact that food prices remain high suggests that there was a fundamental driver – I have suggested a rightward shift in the demand curve. However, the volatility was transient. Financial actors, particularly index investors, played a role in impounding the perception of a changed fundamental environment into prices. The end of 2007 and

the first half of 2008 were characterized by euphoria across a range of agricultural and other markets. Index investment in food commodities exhibited the same characteristics and may have been instrumental in generating excessively high prices.



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