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The Financialization of Agricultural Futures Markets

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1. Introduction

Pricing

- There are active futures markets for most major internationally traded commodities – wheat (hard and soft), maize (corn), soybeans, soybean oil, palm oil, oil seed rape.
- There is no active futures market for rice.
- Where there are active futures markets, the futures price (generally a nearby more than the delivery contract) provides a reference price for commercial transactions worldwide. Forward contracts, e.g. between farmers and grain elevators, define pricing options against (“basis”) a nearby futures price plus/minus a negotiated premium/discount reflecting quality, location and bargaining power.
- Price discovery therefore takes place on the futures markets which can be seen as information aggregators.

Hedging and speculation

- Traditional discussions of commodity futures distinguish between “commercials”, generally identified as hedgers, and “non-commercials”, identified as speculators.
- Commercials have exposure to the price of the physical commodity – long in the case of producers and stockholders; short in the case of consumers.
- The commercial/non-commercial distinction is based on type of economic activity while the hedger-speculator distinction is based on the motivation of the transaction. Commercials may speculate and non-commercials may sometimes hedge.
- Futures markets transfer price exposure from these hedgers to speculators who voluntarily take this on in the hope of capital gain. They stand to earn a risk premium.
- Stockholders (long physical, slender margins) are the principal group of commercials. Hedgers are thus net short futures implying that non-commercials must be net long futures. Keynes noted that if non-commercials are to make a profit, futures prices must, on average, be lower than subsequent spot prices implying a downward futures bias.
- Given the likely hedging imbalance, non-commercials act as counterparties to commercials. If a market is unattractive to speculators, commercials will find it difficult to undertake hedge transactions. Non-commercials are therefore liquidity providers.

The non-commercial actors

CTAs and CPOs: CTAs are Commodity Trade Advisors. CPOs are Commodity Pool Operators. CTAs and CPOs are regulated in the USA by the CFTC under the CEA (the Commodity Exchanges Act) which governs all futures trading activity. CTAs place retail investor funds in CPO funds.

Hedge funds: They are currently unregulated and are not required to report. They invest on behalf of rich individuals (> \$1m available) and institutions, such as pension funds.

Swap providers: Typically investment banks who sell over-the-counter (OTC) commodity swaps to other investors, often retail investors but also large institutions. A “plain vanilla” floating-for-fixed swap gives the long (the retail purchaser) the value of a specified commodity future, or a basket of futures, at the contract expiry date in exchange for a pre-specified sum of money, either at the swap initiation or expiry date. Index swaps relate the floating payment to a tradable commodity futures index. The swap provider offsets positions on the futures markets.

Others: This group invests directly in the futures markets for their own interest.

Financialization

- What has changed? Nothing I have said to this point is new.
- Over the past two decades, the commodity industries (producers, stockholders, processors) have complained that the futures markets have come to be dominated by non-commercial players (sometimes loosely referred to as “the funds”) with no knowledge or interest of the industries in question. The fundamentals of stocks and production are dominated by the “fund”-amentals of momentum and trends.
- In a 1994 paper for the LCE (now part of NYSE-LIFFE) I wrote that “the funds are the new fundamentals”.
- This is associated with the emergence of commodities as a distinct asset class, competing with equities, bonds and real estate for a place in investor portfolios.

What are the issues?

Can markets distort? Are prices the result (sometimes?, always?) of the way prices are formed as well as the information that goes into their formation?

1.Bubbles: CTAs are required to declare their investment strategies. The vast majority (probably over 90%) declare that they follow non-discretionary “technical” strategies. There is a concern that this may result in herd following behaviour leading to bubbles.

2.High prices and volatility: Some commentators have argued that index-based commodity investment, which has become increasingly important over the past decade, adds to demand and so raises prices and/or reduces market liquidity and hence increases hedging costs and market volatility.

3.Market manipulation: It sometimes happens that hedge funds or large producers take large positions in commodity futures markets. There is a danger that they slide from speculating on a future price development into trading in such a way that this outcome materializes, i.e. market manipulation. This is illegal in all jurisdictions. Most current futures regulation is aimed at curbing manipulation.

- In this talk, I consider recent work on bubbles and index investment.

2. Trends and bubbles

The Dutch tulip bubble, 1636-37

This is the first recorded commodity price bubble.

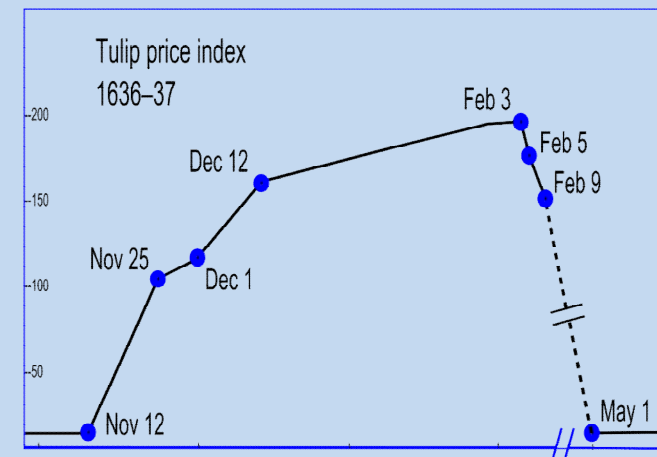
Tulips were a phenomenon in C17 Netherlands, already a rich country. Importantly, bulbs take a long time (7-10 years) to grow from seed so a rise in demand can lead to a sharp rise in prices before new supplies become available.



The Dutch placed particular value on tulips with streaky petals – resulting from the presence of a virus and impossible to predict until the plant flowers.

A large but informal paper market in bulbs grew up over the winter months in anticipation of the next spring's bulbs.

The bubble occurred in the winter of 1636 – prices rose sharply to collapse in spring 1637.



Behavioural accounts of bubbles

Laibson(2009) and others have emphasized non-rational behavioural explanations of bubbles. These explanations have five features

- Extrapolation
- Return chasing
- Herding (rational and irrational)
- Overconfidence
- Over-optimism

These discussions are generally at the level of the individual retail investor. Investment in commodity futures is dominated by institutions. It is unclear to what extent the behavioural account relates to institutional investors.

Behaviour of institutional investors

- Investors delegate asset allocation decisions to advisors either because they are legally required to do so (some pension schemes), because they regard the advisors as more qualified and/or better informed, or because they lack the time and resources to make their own allocations.
- To that extent, investor psychology is relevant only in so far as it relates to choice of advisors. What matters is how investment advisors make investment decisions.
- Investment advisors may be more sophisticated than retail investors –see Alevy *et al*(2007) who compare the experimental responses of students and CBOT traders.
- Incentives are important. Institutional incentives depend on relative, not absolute, returns despite the fact that investors are interested in absolute returns.
- Scharfstein and Stein (1990) argued that this can result in institutional herding – investment institutions benchmark themselves against common indices and each aims not to underperform relative to those indices. The consequence is that asset allocations usually differ only marginally from those in the benchmark.
- Implications: Institutional incentives are likely to result in herding more than extrapolative or over-confident behaviour. However, it is possible that there is interaction between institutional herding and small investor extrapolation.

Trend-following behaviour

- Commodity Trade Advisors (CTAs) take positions in commodity futures on behalf of retail investors. They are regulated by the Commodity Futures Trading Commission (CFTC) under the US Commodity Exchanges Act (CEA). It is possible that they exhibit extrapolative expectation formation.
- The CEA requires CTAs to declare their investment strategies. The vast majority (probably over 90%) declare that they follow non-discretionary “technical” strategies. Much smaller proportions follow contrarian, fundamental or mixed strategies.
- Trend spotting methodologies differ and CTAs effectively compete on their trend-spotting methodologies. A common strategy involves short and long moving averages. If the short average crosses the long average from below, this is a buy signal; when it crosses from above, the signal is “sell”.
- It is difficult to construct trading rules which generate positive risk-adjusted post-sample excess returns. Nevertheless, there is a concern that CTAs collectively generate extrapolative behaviour which may result in bubbles (De Long *et al*, 1990).

Informed and uninformed traders

- Finance theory distinguishes between informed and uninformed traders. Informed trading is the channel through which private information becomes impounded in publically-quoted prices. However, a market cannot consist entirely of informed traders since otherwise trades would be completely revealing (Grossman and Stiglitz, 1980). Markets therefore need uninformed traders if they are to function.
- Uninformed traders may attempt to guess the informed traders' information from price movements – if a price rises, someone may have possessed bullish information. Seeing a price rise, uninformed traders attach a probability to the move being informed and hence raise their bid and ask prices (Kyle, 1985). This can amplify chance price movements.
- Will informed traders, knowing the fundamental, sell into the price rise. De Long *et al* (1990) show that, if the number of informed traders is small relative to the uninformed and if the informed traders have short deadlines, e.g. because of reporting constraints or because they may be fired if they fail to produce returns, they may prefer to speculate on the bubble continuing, hoping to get out before it eventually bursts.

Bubble econometrics

- Standard econometric methods analyze stationary processes – i.e. processes with time-invariant means and variances. These methods become more complicated when non-stationarity is allowed. Explosive processes are, by definition, non-stationary.
- The standard intuition is that explosions are easy to detect and cannot persist. A process can only be explosive for a finite, quite short period of time.
- To test for bubbles, one needs to adapt standard econometric methods to allow the price series to be stationary most of the time but non-stationary (i.e. explosive) for a short period of time.
- In conjunction with his students Wu and Yu, Phillips and his students have focussed attention on “weakly explosive” processes where the departure from the unit root (random walk) is small, of order $o(T^{-1})$ for sample size T . The result is to slow down the explosion (Phillips *et al*, 2011; Phillips and Yu, 2011).

The Phillips and Yu (2011) test

- The Phillips and Yu (2011) model is

$$\begin{aligned} p_t &= p_{t-1} + \varepsilon_t & 1 \leq t < \tau_e \text{ and } \tau_f \leq t \leq T \\ p_t &= (1 + \alpha)p_{t-1} + \varepsilon_t & \tau_e \leq t < \tau_f \end{aligned} \quad \alpha > 0$$

- They aim to “date” the bubble by estimating τ_e and τ_f .
- The explosive section of the process is defined by a Dickey-Fuller regression in which we are only interested in a positive value for α . The standard Dickey-Fuller problem is that the least squares estimate is poorly determined and downwardly biased if the true value $\alpha < 0$. However, if $\alpha > 0$, the estimate is relatively precise.
- Phillips and Yu adopt a recursive estimation procedure in which the Dickey-Fuller regression is performed sequentially over samples as τ increases from an initial value τ_0 to the full sample size T . They estimate τ_e as the first sample end date in which the statistic exceeds its critical value and τ_f as the next subsequent date that it is less than its critical value. The theoretical problem is to define the critical value function.

Evidence on commodity bubbles

- Phillips and Yu state that there was a bubble in crude oil prices in the spring and early summer of 2008. Figuerola-Ferretti *et al* (2012) show that the evidence for this is weak – it depends on looking at prices in levels and not logs and is using data at weekly frequency and not daily or monthly.
- By contrast Figuerola-Ferretti *et al* (2012) find strong evidence for bubbles in the LME copper market in 2004 and 2006. Gilbert (2010) made the same claim.
- So there are bubbles in some commodity markets some of the time but there may be a tendency for them to be “fuzzy” – if they were clear, countervailing action might be expected.

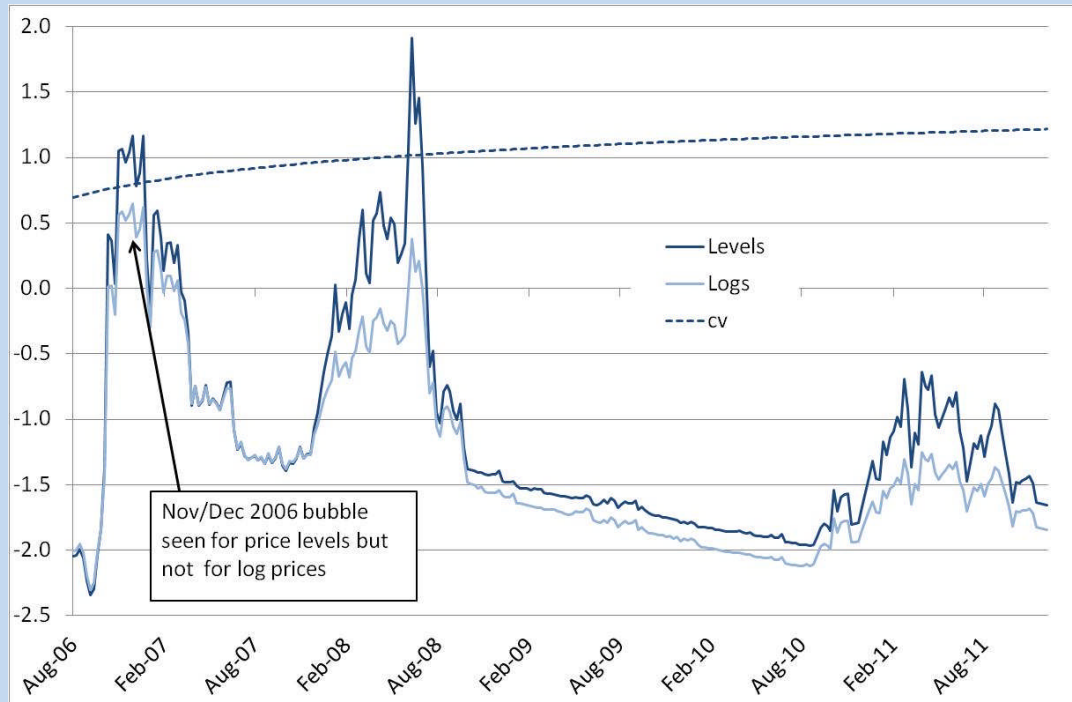
Corn 2006-11

The test uses weekly data from 2006-2011.

A bubble is identified if the test statistic exceeds the critical value.

The evidence is weak.

No bubble is identified for log prices.

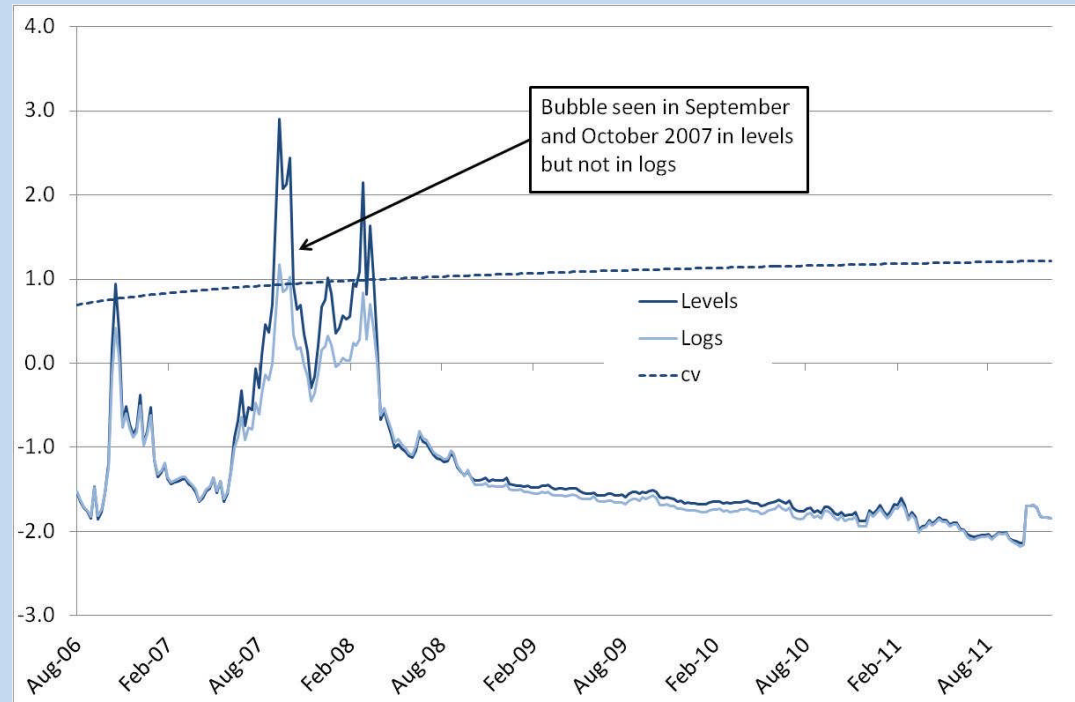


For price levels, the statistic exceeds the critical value for 5 weeks in November and early December 2006.

I get essentially the same results using daily data.

Wheat 2006-11

The wheat story is similar. The test uses weekly data for CBOT wheat. A bubble is found for four weeks in September – October 2007, but is not registered in logs.



My instinct is to measure prices in logs, as is standard in finance. In that case, I do not find grains (or oil) price bubbles.

This work is joint with Isabel Figuerola-Ferretti (Carlos III, Madrid) and Rod McCrorie (St. Andrews)

Bubbles summary

- Finance theory suggests mechanisms by which bubbles can occur, distorting prices away from fundamentals, at least for a time.
- There is no reason to suppose that agricultural futures markets will be immune to bubbles.
- On the other hand, the evidence gives only weak support to the claim that there were bubbles in the important wheat and corn markets in 2006-08, and no evidence for bubbles since that time.
- In part, the weak evidence relates to methodological issues on which there is yet to be an academic consensus. But there may also be a suspicion that bubble tests will always give only weak support to bubble hypotheses since if a bubble were clear in an important market, countervailing action would be taken.

3. Index-based investment

Index-based commodity investment

- The past two decades have seen the emergence of commodity investors as an important group of market participants. Index investors set out to replicate an index – usually the S&P GSCI or the Dow Jones UBS index – or a sub-index of one of these. The declared objective is portfolio diversification into the “commodity asset class”.
- Many investors take these positions through purchase of floating-for-fixed swaps - the investor swaps the invested sum for the value of the index. Some institutions, particularly pension funds, replicate the indices directly.
- The investor is long the index so the index provider (typically an investment bank) is short. The index provider will invest in commodity futures to offset his risk exposure.
- Net index positions can be large – up to 40% of total open interest.
- George Soros accused these funds of having driven up oil prices in 2008. Another hedge fund manager, Michael Masters, accused them of “eating liquidity” and hence increasing price volatility.

Why add commodities to an investment portfolio?

Following Markowitz (1952), standard investment theory looks at financial assets in terms of how they impact the risk-returns profile of an overall investment portfolio, not the individual risk-returns characteristics. Through asset diversification, an investor can increase the expected return holding risk constant, or equivalently reduce risk holding expected return constant.

	Equities	Bonds	Commodity Futures
Average	5.6%	2.2%	5.2%
s.d.	14.9%	8.5%	12.1%
Sharpe ratio	0.38	0.26	0.43

Annualized monthly excess returns , July 1957 – December 2004

Gorton and Rouwenhorst (2004) argued that total commodity returns on the S&P-GSCI compare favourably with equity returns, although they are slightly more risky. The Sharpe ratio is comparable with that on equities and better than the Sharpe ratio for bonds.

The commodity asset class

- “There is a broad consensus among academics and practitioners that commodities compared to other alternative assets can be considered – in a portfolio context – as an asset class of their own”. (Frank J. Fabozzi , 2008).
- This contrasts with an older view that different sorts of commodities – grains, meats, metals, energy) have little in common, with the prices of each being driven by idiosyncratic market-specific factors.

What justifies seeing commodities as an asset class instead of a rag-bag?

- Economists might look for common factors driving commodity prices but which are unimportant or less important for other assets. Examples might be common demand factors (emerging market demand?), and the oil price (more important given the role of biofuel demand). There may also be a self-fulfilling component – prices move together because commodities are seen as an asset class
- Finance theorists would argue that an asset class is defined in terms of having a distinct risk factor but I have not seen a clear empirical demonstration that this exists.

Index funds can account for a large share of total market open interest

Index fund shares, June 2008, (CFTC)					
	\$bn	Share		\$bn	Share
Crude oil	51.0	26.6%	Cocoa	0.8	14.1%
Gasoline	8.0	23.9%	Coffee	3.1	25.6%
Heating oil	10.0	34.5%	Cotton	2.9	21.5%
Natural gas	17.0	14.7%	Sugar	4.9	31.1%
Copper	4.4	41.7%	Feeder cattle	0.6	30.7%
Gold	9.0	22.7%	Live cattle	6.5	41.8%
Silver	2.3	20.1%	Lean hogs	3.2	40.6%
Corn	13.1	27.4%	Other U.S. markets	1.4	
Soybeans	10.9	20.8%	Total (U.S. markets)	161.5	25.8%
Soybean oil	2.6	21.7%	Non-U.S. markets	38.4	
Wheat	9.7	41.9%	Overall total	199.9	

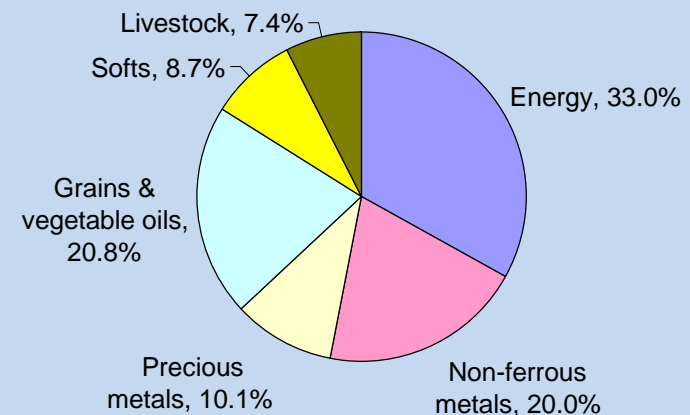
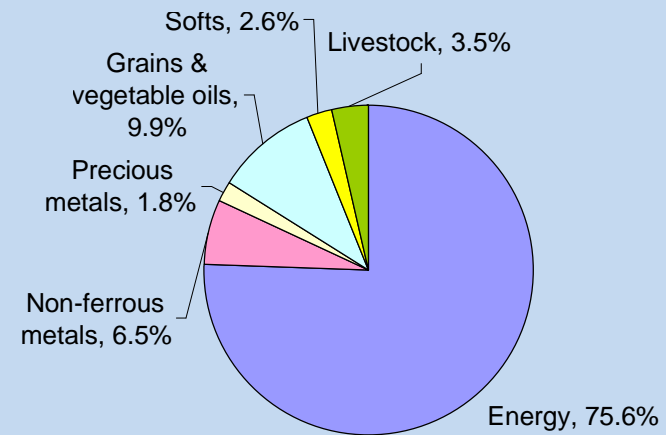
Index composition

The two major tradable indices are the S&P GSCI and the Dow Jones UBS indices.

The S&P GSCI (top) has a very high energy weighting. The DJ-UBS index (bottom) caps sector weights at one third and gives a larger weight to agriculturals.

Overall agricultural weights are small relative to energy and metals so any effects should be comparably small.

Figures are for September 2008.



Investable indices

The S&P GSCI and the DJ UBS indices are both “investable”, i.e. it is possible to devise an investment strategy that will exactly replicate the index returns.

Investable indices are defined in terms of

- A basket of commodity futures contracts. These are invariably the front contracts.
- A rule for rolling an expiring contract into the next contract, i.e. selling the expiring contract and buying the new contract at the close price on a specific day.

There are three return elements on a commodity futures investment:

- i)The holding return on the commodity futures contract itself. If futures markets are unbiased, this will have expected value of zero.
- ii)The roll return – positive if the market is in backwardation (sell high, buy low), negative if in contango.
- iii)The interest free rate, earned on the margin collateral held against the futures contracts. This return disappears from the “excess return”.

Index investment returns depend crucially on roll returns. Returns are high when markets are tight but low when they are flat.

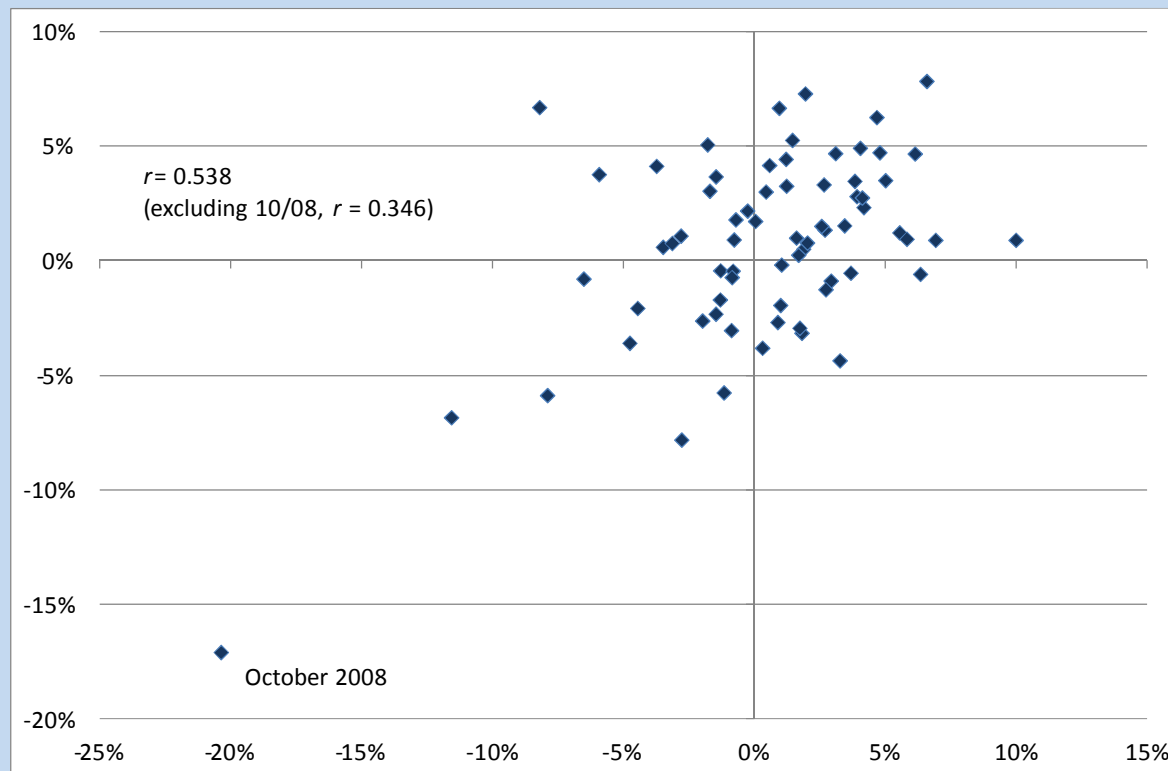
An index investment quantum index

We can use the index investment figures from the CFTC's *Supplemental Commitment of Traders* reports to construct an index of total (net) index investment in US agricultural markets. Gilbert and Pfuderer (2012) use base period (January 2006) prices to weight positions figures to give an index in terms of equivalent CBOT wheat contracts.

Positions rise steeply in the first half of 2006 and again in late 2007 and early 2008. They fall in the summer of 2008 to a low in spring 2009, then rise back and have been broadly stable with a slight negative trend since 2010.



These movements correlate well with price developments.



The chart plots monthly changes in the IMF's food price index against changes in the investment index (February 2006 – October 2011).

The correlation is heavily influenced by the post-Lehman October 2008 observation. Excluding this, $r = 0.346$

Granger-causality analysis

- Correlations do not provide conclusive evidence about causal impact. We can go beyond the correlation evidence by performing Granger-causality tests. A single lag is almost always sufficient. In this case, the test (two sided) is the t statistic on the β in the price return equation

$$r_t = \kappa + \alpha r_{t-1} + \beta \Delta Index_{t-1} + u_t$$

- *Index* can either be the change in the CFTC commodity-specific positions measure or that of the aggregate index and can either be in terms of the number of contracts or be divided by open interest (includes spread positions) or total long positions (excludes spread positions).
- Low test power can be a problem with Granger-causality tests using financial data. The Efficient Markets Hypothesis implies that price returns should not be predictable from the lagged information set. Failure to reject lack of Granger-causality does not imply that position changes do not cause price changes, but only that the evidence is insufficient to establish whether or not this is the case.

Granger-causality test results		
	Commodity-specific	Index
CBOT Wheat	-0.769 (0.90)	0.167 (1.21)
KCBT Wheat	1.541 (0.62)	0.147 (1.19)
CBOT Corn	-0.544 (1.59)	-0.008 (0.06)
CBOT Soybeans	1.062 (1.53)	0.128 (1.26)
CBOT Soybean Oil	1.368 (1.49)	0.293 (2.87)
Grains average	-	0.137 (1.35)
<i>t</i> –statistics in parentheses. Sample: 17/01/06 – 11/10/11. Positions are in contracts. Source: Gilbert and Pfuderer (2012)		

Using data from 2004, which is not publicly available, Sanders and Irwin (2011) fail to find any price impact from index investment.

Gilbert and Pfuderer (2012) repeat these tests on publicly available data from 2006 and confirm the Sanders and Irwin findings.

They also consider soybean oil, a less liquid market not considered by Sanders and Irwin, where they do find an impact.

They also find evidence that index investment impacts cross-grain spreads.

Index investment – summary

- The Gilbert and Pfuderer (2012) results make it clear that index investment does affect the volatility of agricultural futures prices and is very probably volatility-reducing. It seems likely that this is also true of non-agricultural commodities but currently available data are insufficient to allow this to be tested.
- The effects of index investment on price levels are less clear. Gilbert (2010a) saw this as an important driver of grains prices in 2007-08; Gilbert (2010b) made the same claim for crude oil, aluminium and copper over the same period. Sanders and Irwin (2011) and Irwin and Sanders (2011) deny that there is any such effect either for agriculturals or for energy.
- Most commentators use Granger-causality methodology. However, the EMH indicates that such tests are likely to have low power in liquid markets. Gilbert and Pfuderer (2012) argue that the effects are more evident if one looks at spreads or illiquid markets.
- This discussion leaves open the issue of how important index-based investment was as a driver of food and other commodity price movements in 2007-08.

4. Conclusions

Overall conclusions

- Financialization has transformed the way that commodity futures markets function, but has not necessarily had a big impact on outcomes.
- Bubbles can occur but generally do not persist for long. This is not a new phenomenon – trend following behaviour has been around for decades.
- Index-based investment is relatively new. It is a major source of business for the exchanges. Because index investors are always net long, they provide valuable counterparties for commercial hedgers who are typically net short.
- My belief is that index investment did contribute to the grains price boom of 2007-08 but there is no consensus on this.

The Trader's Song ("Supply and Demand"), updated

*Weiß ich was ein Reis ist?
Weiß, ich, wer das weiß?
Ich weiß nicht was ein Reis ist.
Ich kenne nur seinen Preis.*

By the way, what is rice?
Don't ask me what rice is.
Don't ask advice.
I've no idea what rice is.
All I know is price.

Bertolt Brecht, *Die Maßnahme*
(1930)

Wheat, beans, oats and maize!
These things leave me in a daze.
Delta, gamma, vega, rho:
that's the sort of thing I know!
Contangos, backs, whatever
tracks.
In the end, the trend's your
friend.
Ag' research never pays.

Thank you for your attention