Food prices, food price volatility and the financialization of agricultural futures markets

Christopher L. Gilbert

SAIS Bologna Center, Johns Hopkins University

christopher.gilbert@jhu.edu

FERDI Workshop, "Commodity market instability and asymmetries in developing countries: Development impacts and policies", Clermont-Ferrand, 24-25 June 2015

Plan of this talk

1. The food price background
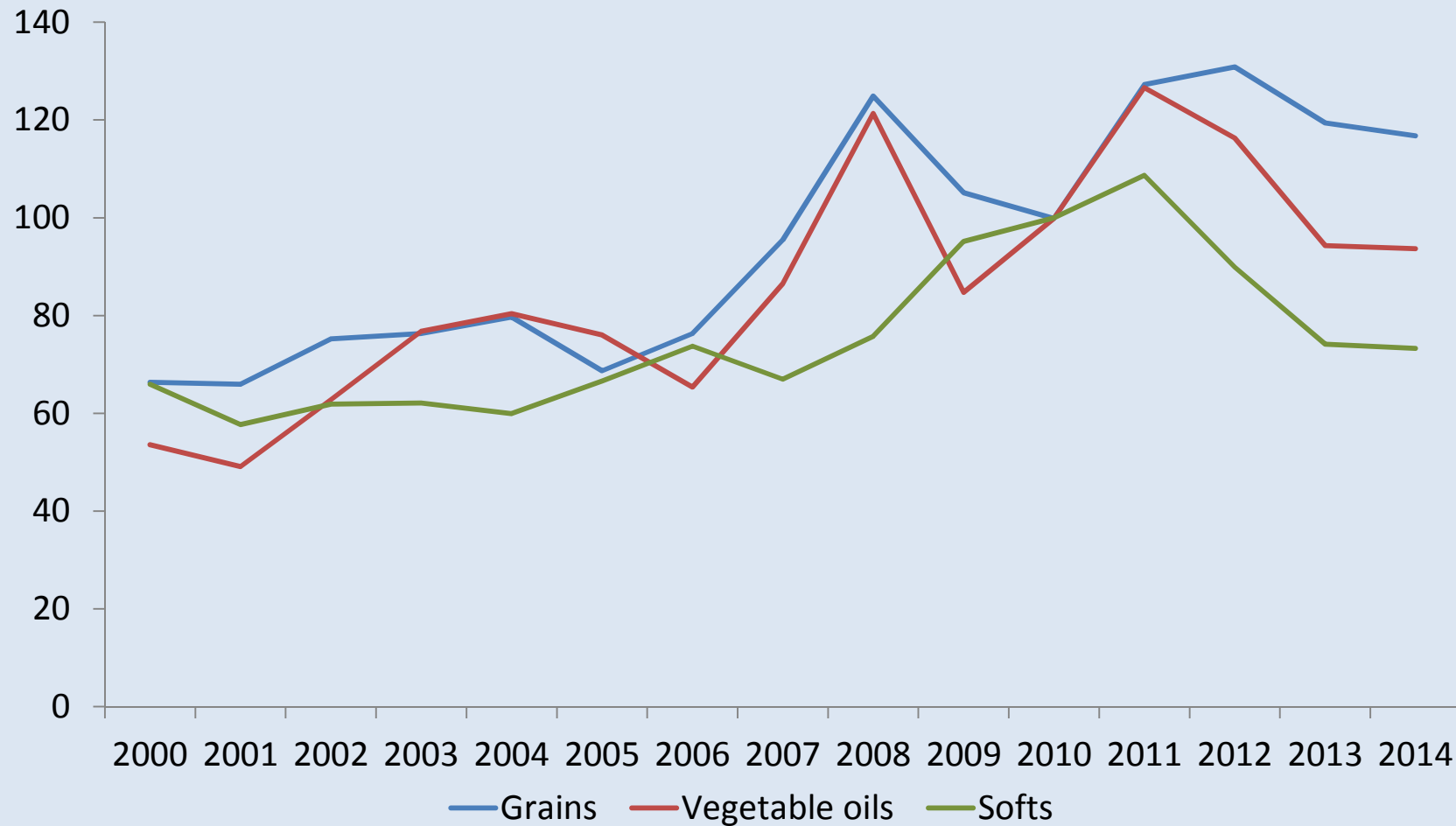2. Financialization
3. Bubbles

1. The food price background

In real terms, food prices have tended to decline as the result of increased yields.

(2010 = 100)

Legend: Grains — Vegetable oils — Softs
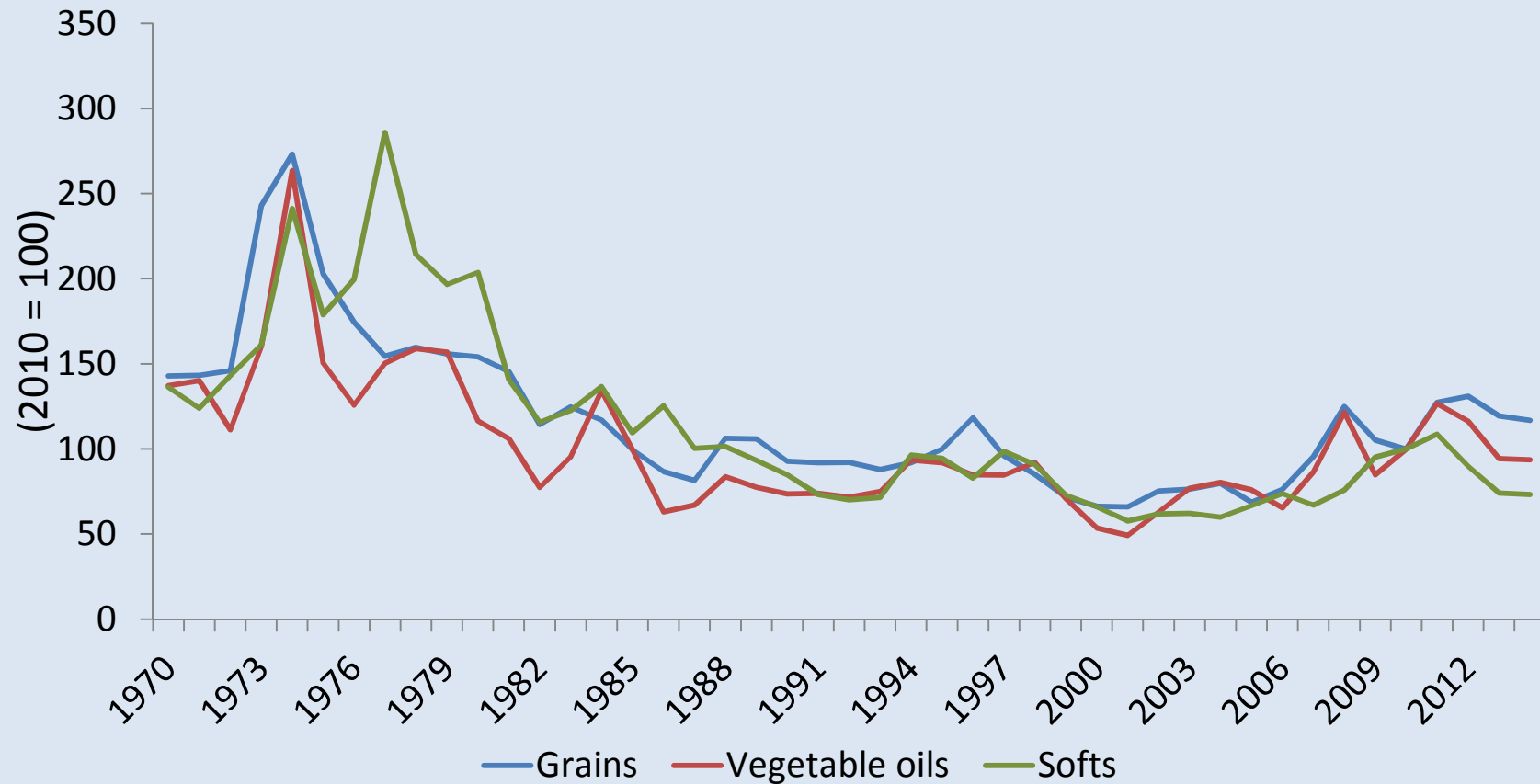
Deflation by the US PPI (all items). Source: IMF, *International Financial Statistics*.

However, prices have tended to rise over the period since 2000, dropping back slightly from 2012.

**Supply and demand factors have both contributed to higher food prices.**

- Demand has shifted right from D to D' as the result of income growth, particularly in Asia.

- Supply has shifted up from S to S' as the result of higher input (particularly fertilizer) prices plus a slowdown in yield growth as the consequence of low levels of agricultural investment.

- The price rises from p to p'.
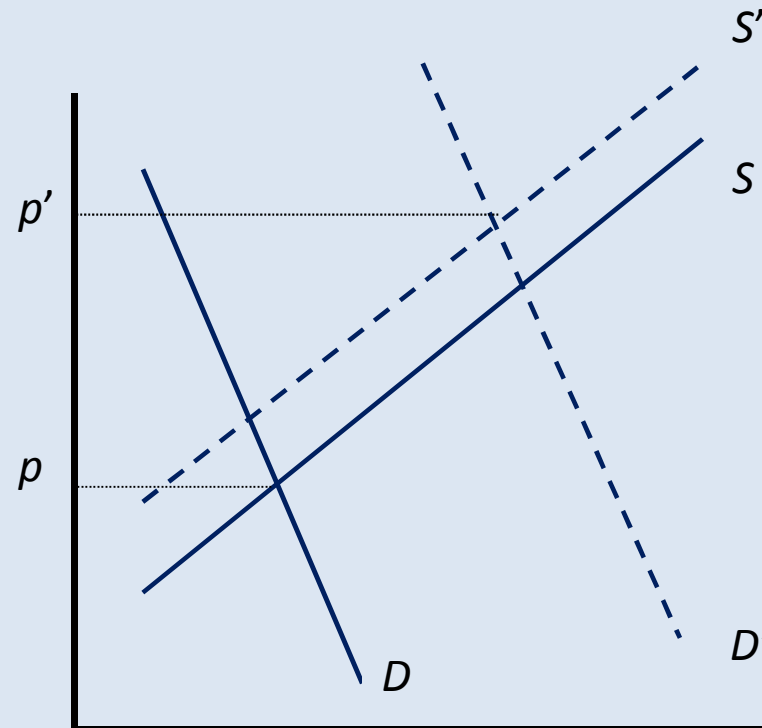
OECD-FAO price forecasts, 2014-23 versus 2004-13
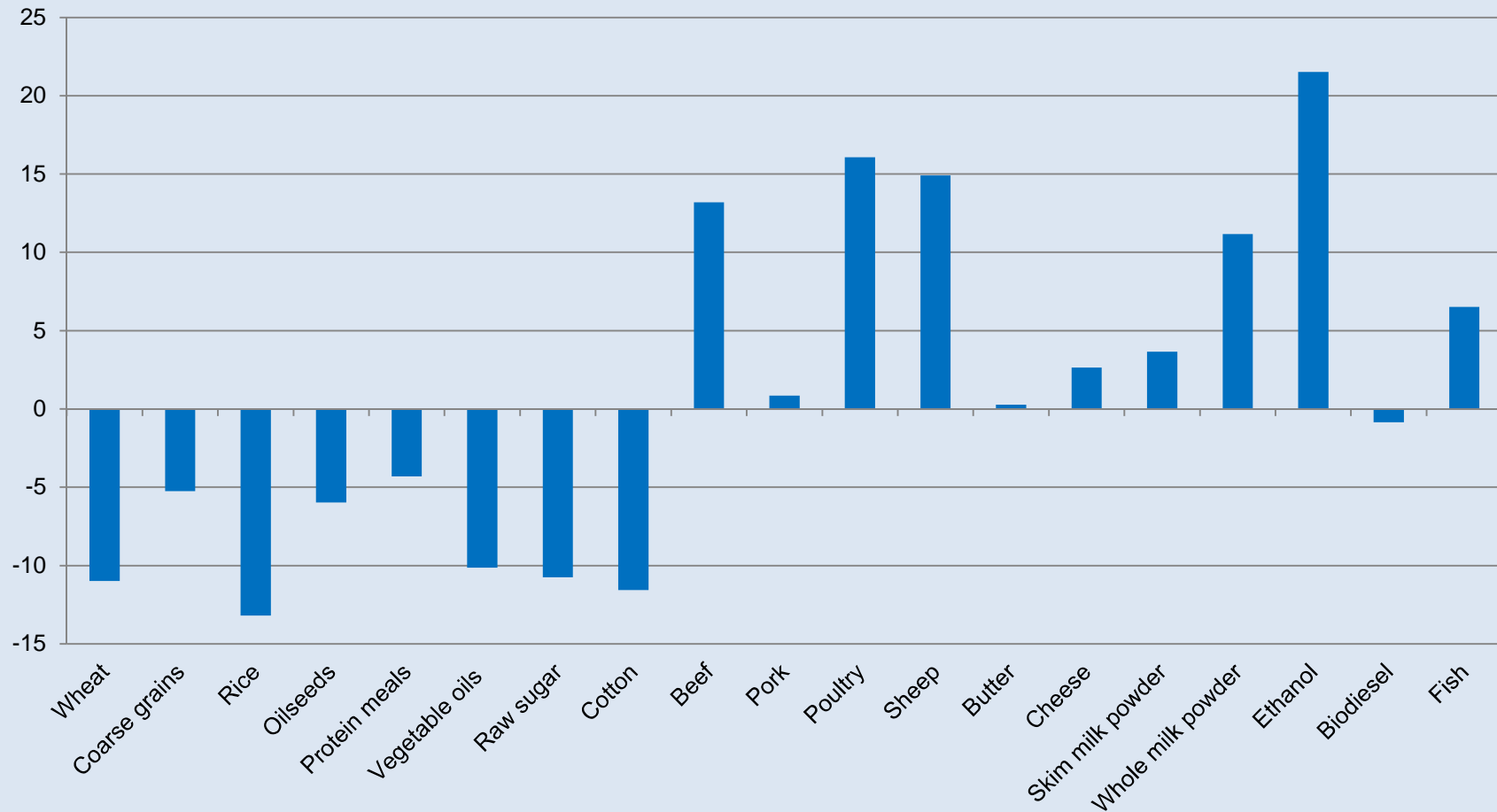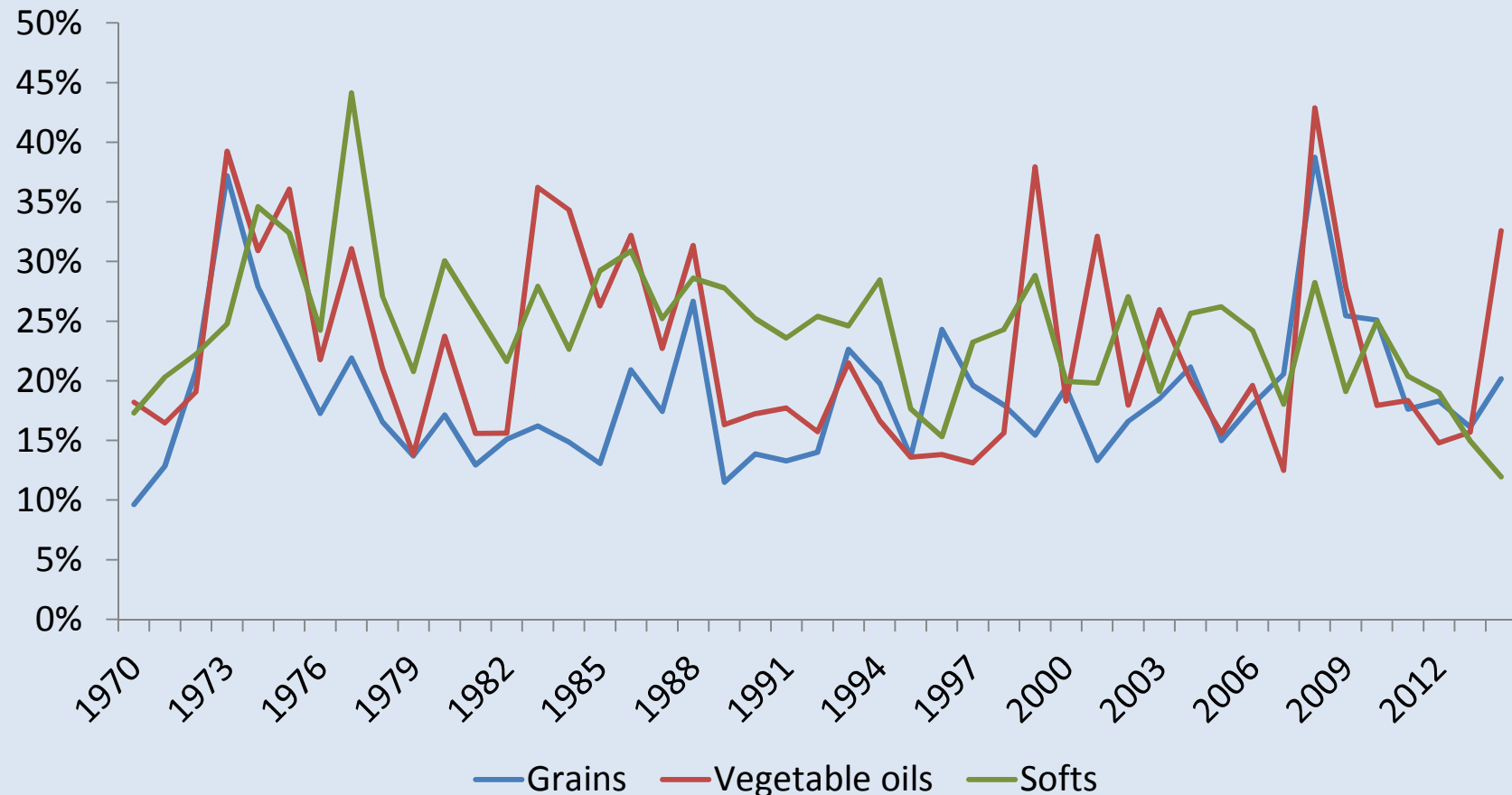

Source: OECD-FAO Agricultural Outlook 2014-2023

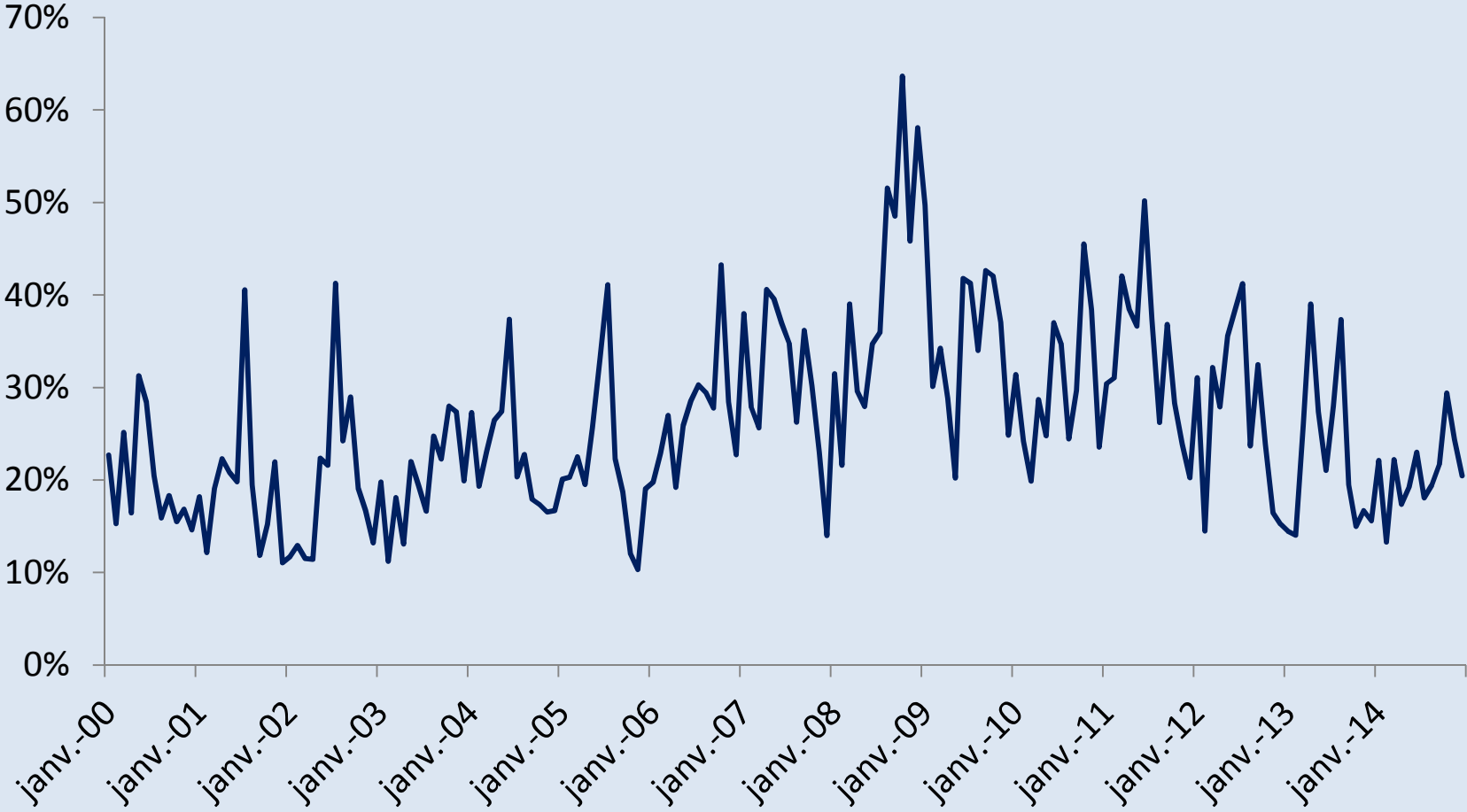# Food price volatilities show little trend over the long run.

Volatilities are calculated as the annualized intrayear standard deviation of month-on-month returns.

Focusing on the most recent period, we see the sharp jump in volatility in 2008 continuing into 2009-10.

CBOT corn volatility

2. Financialization

Financialization: the major increase in the presence of financial agents on food commodity futures markets.

Total Commodity Futures and Swap Positions		
$bn	Nominal	2005 values
1998	137.8	246.6
2000	159.3	234.1
2002	271.5	438.4
2004	480.7	580.5
2006	2153.4	1709.7
2008	**7474.2**	**3626.4**
2010	1470.1	1015.6
2012	1595.9	942.1

Source: Gilbert and Pfuderer (2014, Table 1) based on BIS statistics.

Figures relate to the end of June. The reported figures are for total forwards and swaps and exclude gold and other precious metals. Column 2 deflates by the average of the IMF non-fuel commodity price and energy price indices (2005 = 100.)

12

Index investors and the commodity asset class

- Index-based investors aim to track the returns on one or other major tradable commodity futures price index.
- They claim to be motivated by portfolio diversification concerns and regard commodity futures as an asset class similar to equities, bonds and real estate.
- They trade in a very different way from traditional non-commercials ("speculators").

Index investors	Traditional speculators
Hold all commodities in the index	Hold selected commodities
Almost always long	May be long or short
Long holding periods	Short holding periods
Roll as contracts approach expiration	Seldom roll

Did index trading move commodity futures prices?

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 suggesting that they would tend to increase volatility.

MICHAEL MASTERS

The current academic consensus (Irwin, Sanders, Stoll , Whaley), is index investors had a negligible impact on agricultural futures prices. I have taken a different view.

Index weights

Pie chart (top): Softs, 2.6%; Livestock, 3.5%; Grains & vegetable oils, 9.9%; Precious metals, 1.8%; Non-ferrous metals, 6.5%; Energy, 75.6%

Pie chart (bottom): Livestock, 7.4%; Softs, 8.7%; Grains & vegetable oils, 20.8%; Precious metals, 10.1%; Non-ferrous metals, 20.0%; Energy, 33.0%
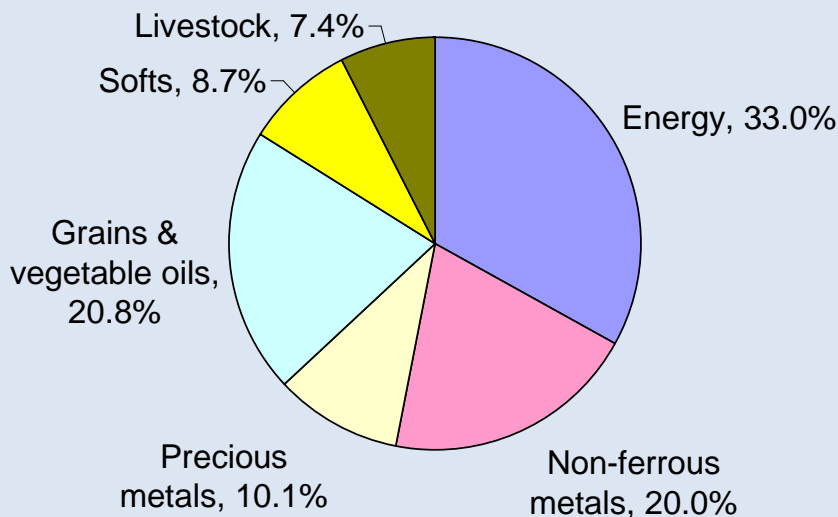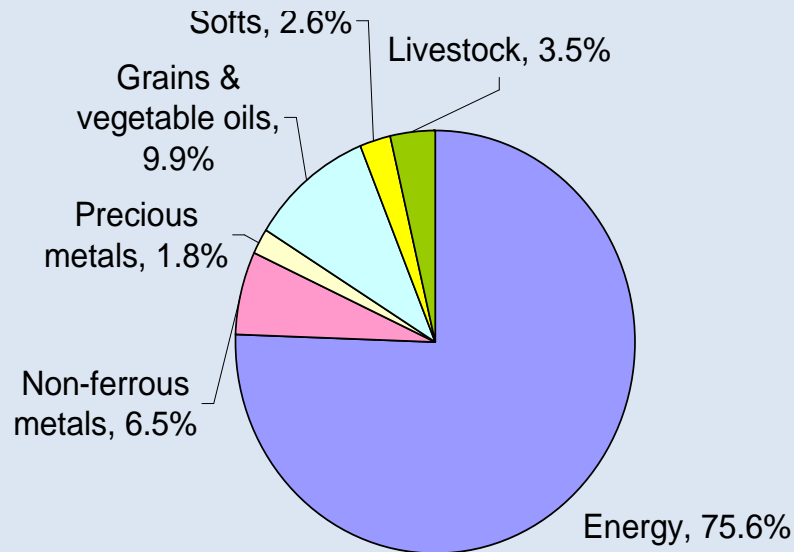
The two major tradable commodity price indices give a relatively low weight to agricultural futures.

These weights change over time:

- In September 2008, the S&P GSCI index (top) gave grains and oilseeds a 10% weight;

- the Dow Jones UBS index gave them a 21% weight.

This suggests that the impact of index trading is likely to be more apparent in energy futures (76% and 33% respectively).

15

The period of most rapid growth in index investment predates the Special Call data

January 2006 = 100

— COT US agricultural futures contracts   ▲ Special call, all U.S. futures
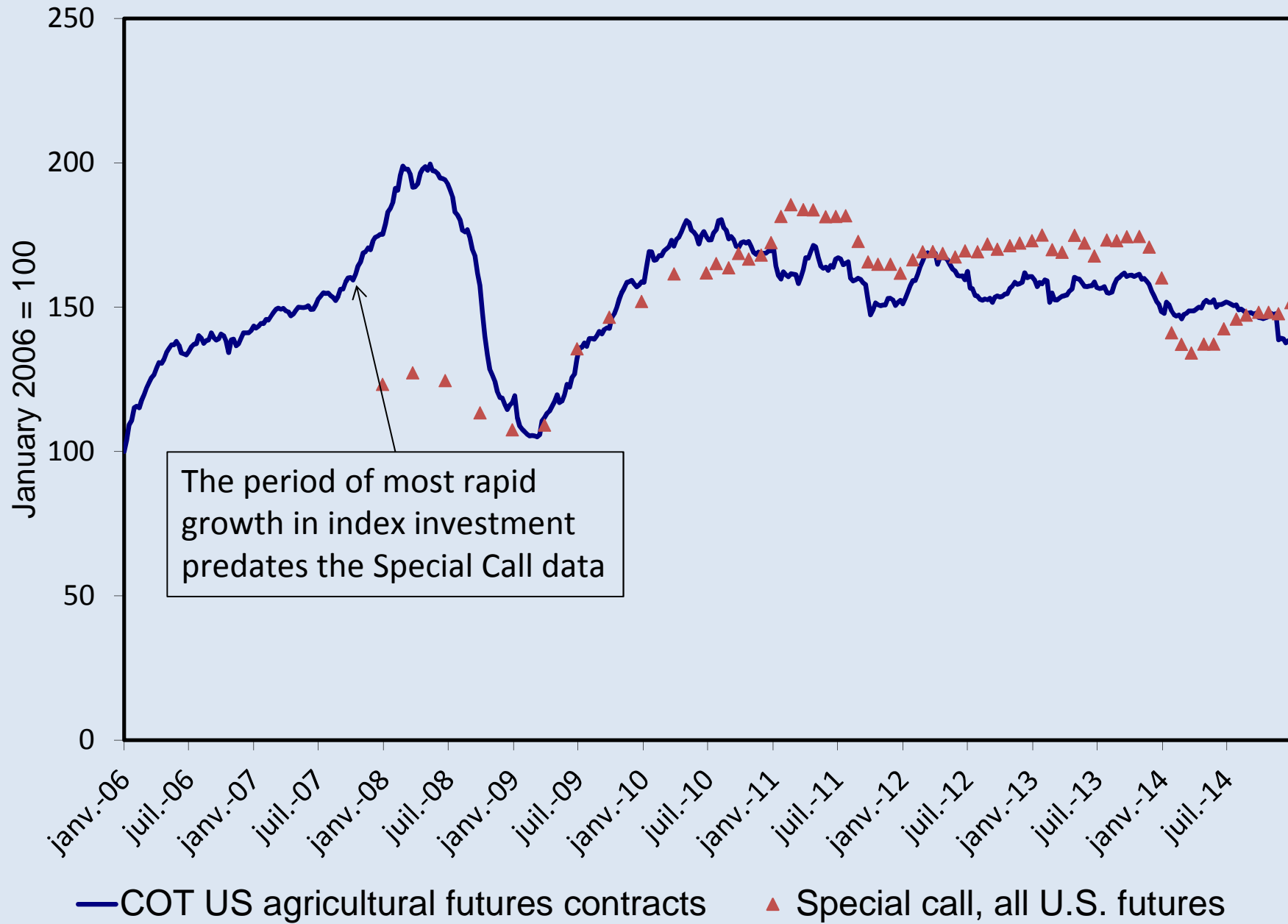
Granger-causality tests demonstrate a causal link from the index investment to commodity prices

	lags	test statistic	
Food	1	t_{103}	2.87***
Beverages	1	t_{103}	1.46
Agricultural raw materials	2	$F_{2,100}$	15.29***
Metals and minerals	2	$F_{2,100}$	8.69***
Non-energy index	1	t_{103}	3.93***
Brent crude oil	2	$F_{2,100}$	6.21***
Monthly data, April 2006 – December 2014. *, **, *** : significantly different from zero at the 10%, 5% and 1% levels, respectively.			

I conclude that
a) The high 2008 and 2011 prices reflected fundamental factors,
b) financial actors, and in particular index investors, played an important role in transmitting fundamental information into the market;
c) In so doing, they may have exacerbated the movements.

3. Bubbles

Were grains and oilseeds prices on a bubble trajectory in 2007-08 (and 2010-12)?

Legend:
- Soft wheat (red)
- Corn (yellow)
- Soybeans (green)

y-axis: (January - March 2006 = 100), values 0, 50, 100, 150, 200, 250, 300, 350, 400

x-axis: Jan-06, Jul-06, Jan-07, Jul-07, Jan-08, Jul-08, Jan-09, Jul-09, Jan-10, Jul-10, Jan-11, Jul-11, Jan-12, Jul-12, Jan-13, Jul-13

Callout box: It is very difficult to find an explanation of the rapid rise in all three prices in 2007-08.
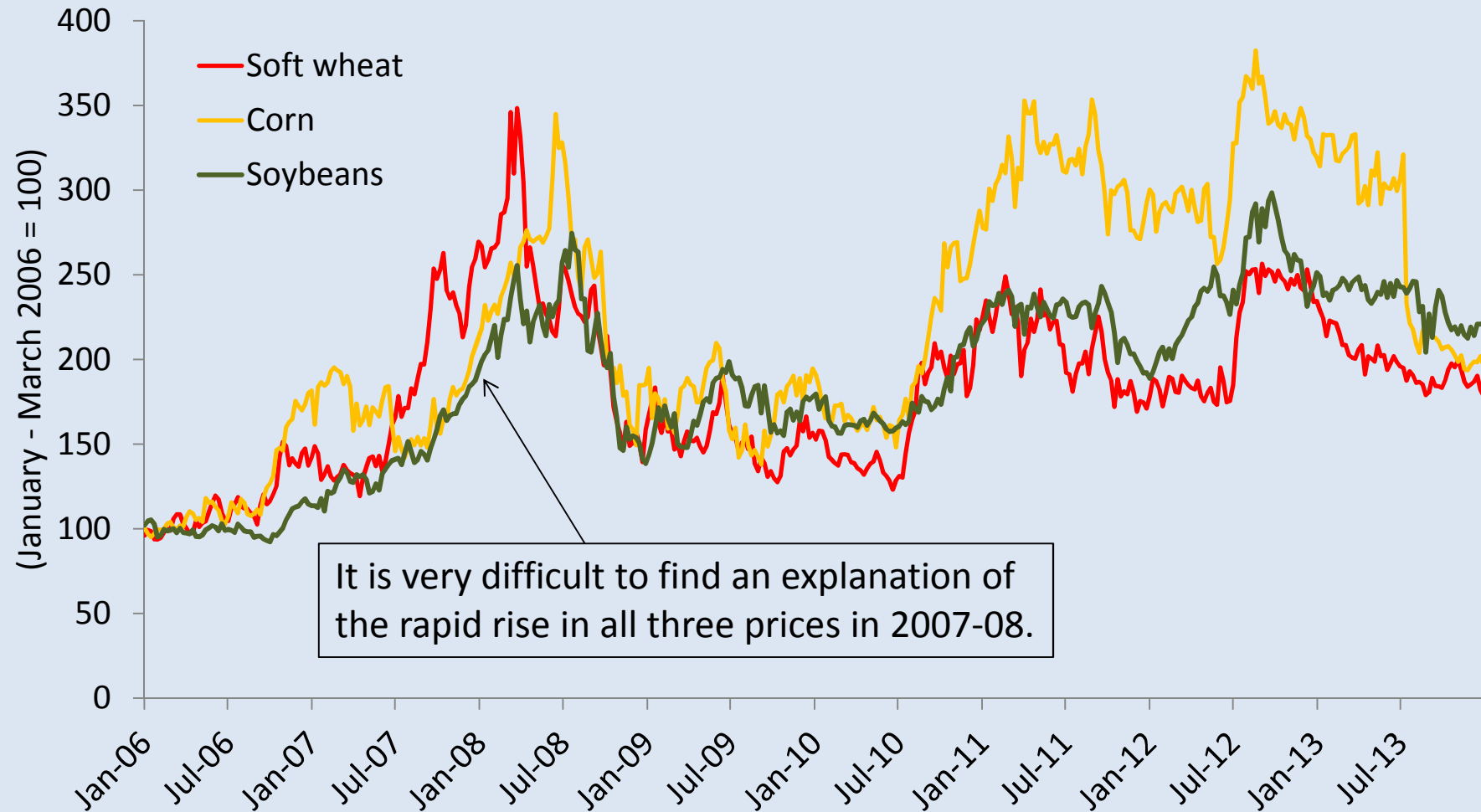
Note: Front Chicago futures price, Tuesdays, rolled first day of the month and rebased at 2006q1 = 100.

19

Behavioral and rational bubble theory

- Behavioral economists emphasize *return chasing, herding, extrapolation 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.

- 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).

- Rational theory implies that, so long as an asset is earning the appropriate (risk adjusted) return, its price can be away from its fundamental value. There are an infinite number of potential bubble paths.

- Behavioral theory has broadly the same implication since herding can sustain any price path.

Testing for 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 (2013) and metals price data by Figuerola-Ferretti, Gilbert and McCrorie (2015).

PSY test results

	GSADF	Date maximum attained
Wheat	4.61***	26-Feb-2008
Corn	4.40***	17-Jun-2008
Soybeans	3.04***	06-Apri-2004

PSY tests are applied to data on the rolled front contracts for Chicago soft wheat, corn and soybeans using weekly data from 2000-13. (Lagged prices are roll-adjusted).*** Significant at 1%.

The GSADF statistics reject the hypothesis of no bubbles in each of the three commodities analyzed.

2007-08: bubbles in all three markets including simultaneously in February and March 2008
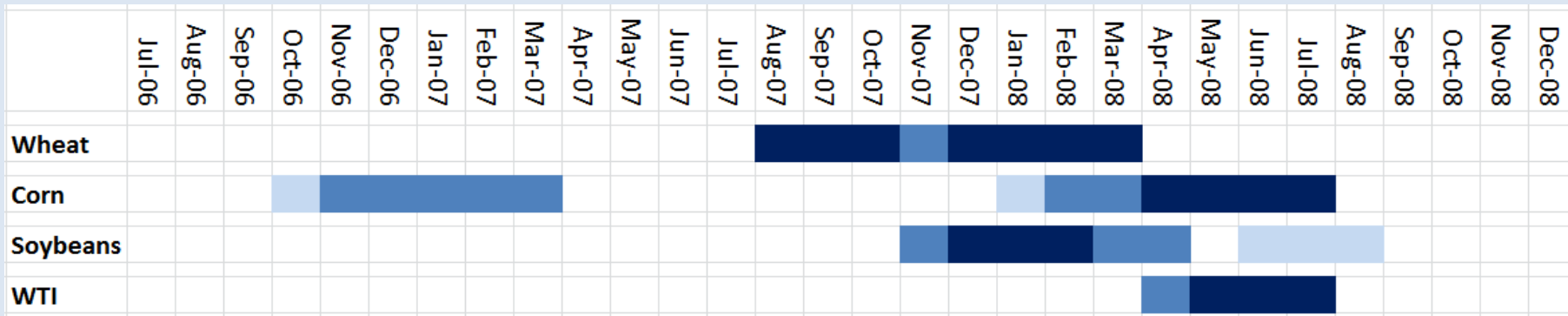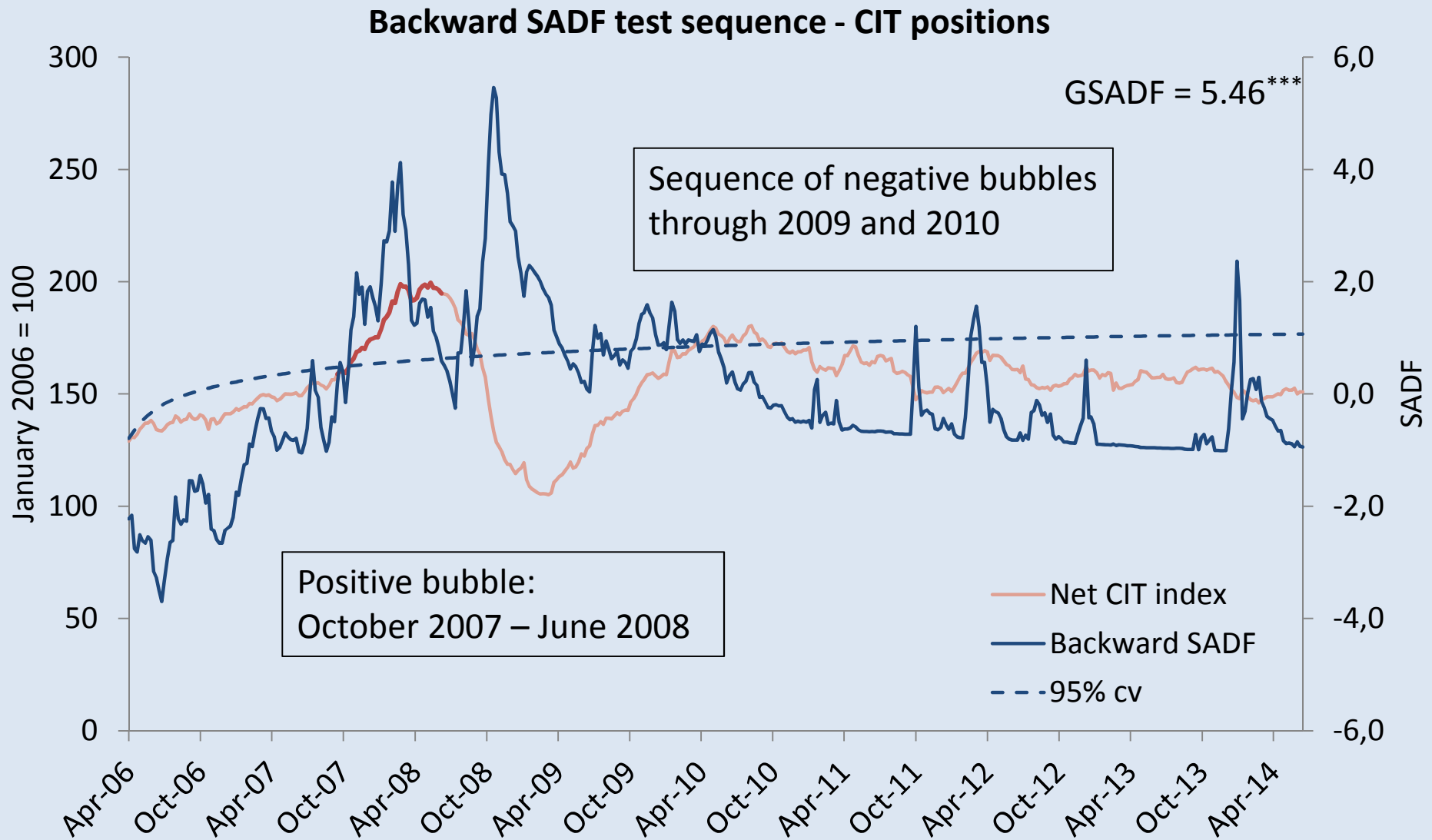

Note: dark blue significant at 1%, mid-blue at 5%, light blue at 10%.

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.

2007-08 saw a bubble in index investment

Backward SADF test sequence - CIT positions

GSADF = 5.46***

Sequence of negative bubbles
through 2009 and 2010

Positive bubble:
October 2007 – June 2008

—— Net CIT index

—— Backward SADF

----- 95% cv

Explosive index investment can account for explosivity in grains and oilseeds prices

	Jul-07	Aug-07	Sep-07	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08
Wheat		■	■	■	▨	■	■	■	■						
Corn							░	▨	■	■	■	■	■		
Soybeans					▨	■	■	■	▨	▨		░	░	░	
Index investment				■	■	■	■	■	■	■	■	▨	▨		
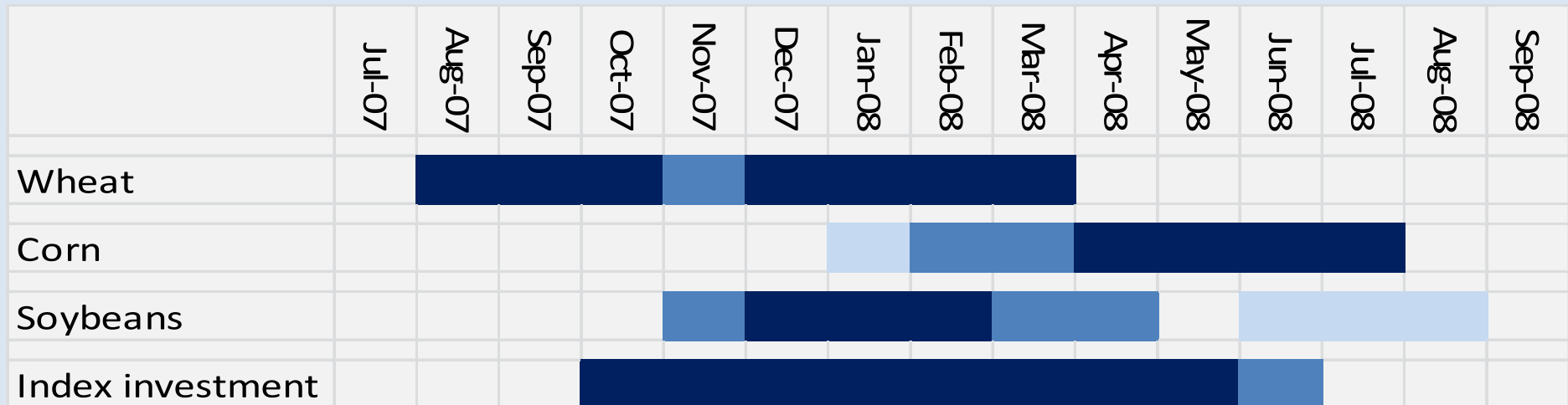
Note: dark blue significant at 1%, mid-blue at 5%, light blue at 10%.

- 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.

Etienne, Irwin and Garcia

- Etienne, Irwin and Garcia *(AJAE,* 2015) analyzed bubbles in agricultural futures markets over the long sample of 1970-2011 treating each contract separately. They found a substantial number of bubbles but conclude that "bubbles are short-lived" with 65%-80% of episodes concluding within 20 days.

- Data frequency and sample length matter. EIG use short samples (around 100 observations) of daily data while I use weekly data.

- Looking at a long series of corn prices over the sample 2000-14, I find clear evidence at the 95% level for a bubble using end-month prices (November 2006 – May 2007), Using weekly data, this bubble is identified only at the 90% level.

- The issue is one of focus. Low frequency data gives a focus on long bubbles; high frequency data on market froth. The Etienne et al conclusion follows directly from their choice of data.

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 was 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.

Thank you for your attention