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Commodity Price Volatility and Financial Markets

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Abstract

The past decade has seen a sharp increase in the level and volatility of commodity prices. This has been of significant concern for many policymakers around the world, with the G-20 committing to 'work to address excessive commodity price volatility'. In particular, there is a view that the increased presence of financial investors and speculators has been an important source of this volatility. This paper discusses the rise of financial investment in commodities and argues that the evidence does not support the view that the 'financialisation' of commodities has been the key driver of commodity price developments over the past decade or so. Moreover, the paper attempts to place the debate about the role of financial investors in an historical context, in particular the long tradition of associating speculators and middlemen with commodity price volatility.

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COMMODITY PRICE VOLATILITY & FINANCIAL MARKETS

1. Introduction

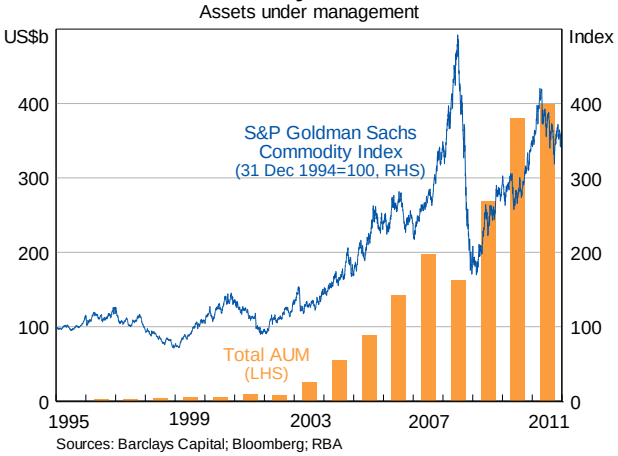
'In years of scarcity…people impute their distress to the avarice of the corn merchant, who becomes the object of their hatred and indignation.'

'whoever should buy any corn or grain with intent to sell it again, should be reputed an unlawful engrosser, and should…be set in pillory, suffer imprisonment during the king's pleasure, and forfeit all his goods and chattels.'

Adam Smith, Wealth of Nations, Book 4, Chapter 5.

The past decade has seen a sharp increase in the level and volatility of commodity prices. While this has occurred alongside a sharp increase in commodity demand from emerging market economies, it has also occurred in parallel with a rapid increase in both commodity derivatives trading and financial investor activity in commodity markets (Graph 1). Commodity markets have seemingly become more like financial markets as they have become recognised as a separate asset class alongside bonds and equities. This has given rise to considerable interest in the factors driving commodity prices in recent years – in particular the extent to which they have reflected fundamental determinants of physical supply and demand versus the growing 'financialisation' of commodity markets.

Graph 1
Commodity Investment
Assets under management



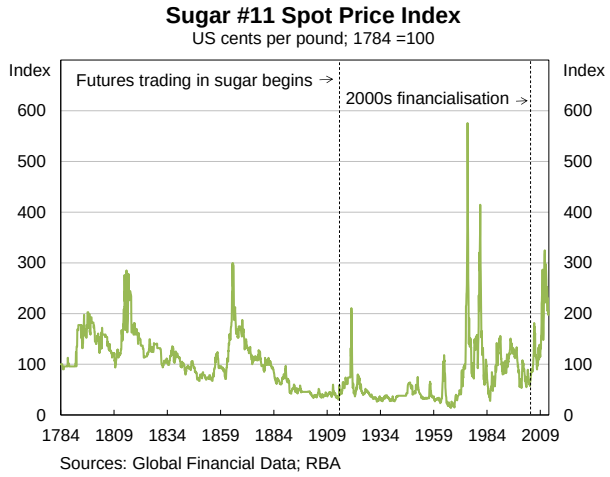
Sources: Barclays Capital; Bloomberg; RBA

If the decisions of financial investors and speculators reflect informed views about fundamentals, financialisation can play a beneficial price discovery role. However, if financial speculators base their decisions on other factors – such as portfolio diversification or 'noise' or 'momentum' trading behaviour – it is argued that it could be destabilising (see, for example, Frankel and Rose (2009)).

Given the nature of food and energy in particular as daily staples, volatile commodity prices are of considerable concern to policymakers. Reflecting this, the G-20 has committed to 'work to address excessive commodity price volatility' and to 'facilitate better functioning of commodity markets', including 'appropriate regulation in financial commodity markets'.

As it happens, there is a long and interesting tradition of blaming commodity price volatility on speculators and middlemen. This is despite the fact that – as demonstrated below by the sugar price – episodes of heightened commodity price volatility not only pre-date the 2000s 'financialisation' period, but also pre-date the introduction of commodity futures markets in the mid-1800s. While there have been many examples where financial speculators have influenced particular commodity prices, there have probably just as many (if not more) occasions when physical market participants have done likewise.

Graph 2



The paper is organised as follows. The next section provides a brief historical overview of commodity price developments. Section 3 outlines the recent rapid growth of financial investor activity in commodity markets and describes the mechanics of the futures market. Section 4 assesses some of the claims that financial investors have driven the recent increase in commodity price volatility

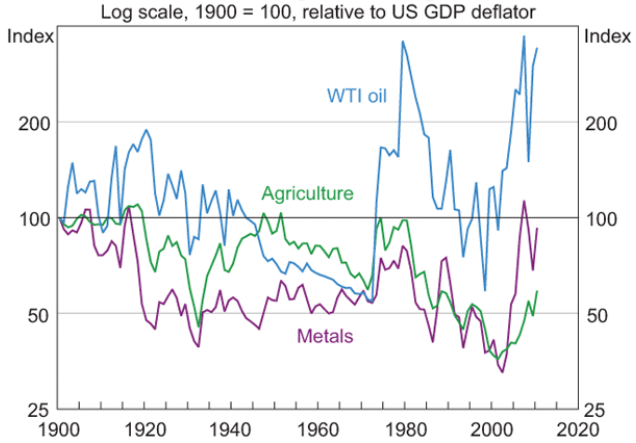
as well as briefly considering the role of some of the alternative fundamental drivers. Section 5 describes the historical development of the futures markets including some of the corresponding regulatory developments, and seeks to place the current debate about the role of speculators in a historical context.

2. Commodity Price Volatility – Brief Overview

The past decade has witnessed a large increase in the prices of many commodities, even with significant falls during the global financial crisis. To place the recent price movements in a historical perspective, such a sharp increase in real commodity prices has not been seen since the 1970s (Graph 3). While oil and metals prices are high in real terms by historical standards, having regained or exceeding their levels of 30–40 years ago, real agricultural prices remain well below their previous peaks.

However, following the 1970s episode, real commodity prices fell for most of the subsequent two decades. This seemed to support the Prebisch-Singer view of a falling long-run trend for real commodity prices.[1] As such, the increase in commodity prices since the early 2000s arguably needs to be seen in the context of the deviation from a declining trend that many had probably expected.

Graph 3
Real Commodity Prices by Sector*
Log scale, 1900 = 100, relative to US GDP deflator

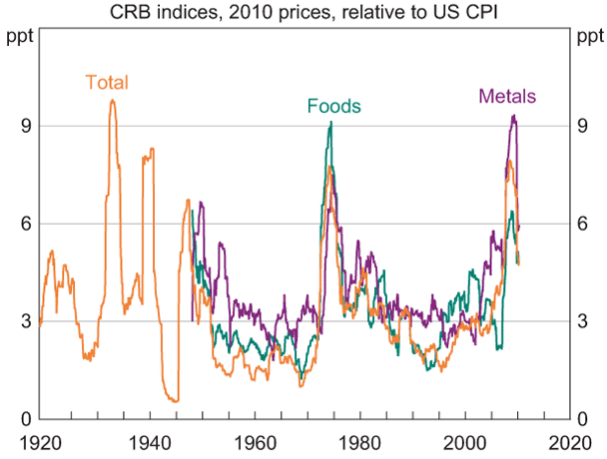


* Equal weighted (geometric) indices, annual
Sources: Bloomberg; Cashin and McDermott (2002); Global Financial Data; Grilli and Yang (1988); IMF; RBA; Thomson Reuters

[1] See Prebisch (1950) and Singer (1950).

The rise in the level of commodity prices over recent years has been accompanied by significantly higher volatility (Graph 4). While price signals play an important role in adjusting future supply and allocating existing supply, excessive price volatility can hinder this process by generating greater uncertainty about future price levels.

Graph 4
Real Commodity Price Volatility*
CRB indices, 2010 prices, relative to US CPI



* Standard deviation of monthly percentage price changes over preceding 2 years
Sources: Global Financial Data; RBA

Commodities prices are often regarded as being particularly volatile owing to both supply and demand being price inelastic, at least in the short run. The higher volatility of some commodity prices is also likely to reflect the fact that many commodities are traded in relatively transparent, continuously priced markets – in contrast to many other goods and services. These commodity prices can thus reflect news and changes in economic conditions more quickly than consumer prices, which manifests as higher average volatility. (Although for an interesting alternative perspective see Arezki, Lederman and Zhao (2011); they argue that in fact individual commodity prices may be less volatile than for many manufactured goods.)

Commodity prices are sometimes considered to be even more volatile than other prices that adjust on a daily basis, such as financial prices. However, this is generally the result of comparing the prices of individual commodities to broad-based indices of certain asset classes. For example, the volatility of prices for broad commodity indices is similar to that of broad equity indices, while that of individual commodities tends to be similar to that of individual share prices (Table 1).

Table 1

Standard deviation of daily returns, percentage points

	Jan 90–Jun 07	Jul 07–May 11
Individual prices		
Natural gas	3.6	3.5
WTI oil	2.3	2.9
Sugar	2.1	2.7
Rice	1.7	1.8
Wheat	1.6	2.6
Copper	1.4	2.2
Soybeans	1.3	1.9
Gold	0.9	1.4
Individual S&P 500 companies (average volatility)	2.4	2.8
Commodity and financial indices		
S&P 500 energy index	1.2	2.3
Goldman Sachs Commodity Index	1.2	1.9
S&P 500 index	1.0	1.7
CRB index	0.9	1.5
US$ per A$	0.6	1.2

Sources: Bloomberg; RBA

3. The Rise of Financial Investment in Commodities

'The history of food took an ominous turn in 1991…the year Goldman Sachs decided our daily bread might make an excellent investment.'

Frederick Kaufman, 'The Food Bubble: How Wall Street Starved Millions & Got Away with it', Harper's Magazine, July 2010

It has been suggested that, in addition to fundamental supply and demand factors, the activity of speculators in financial markets has played a significant role in contributing to the increase in the level and volatility of some commodity prices in recent years. This section describes the growing presence of financial investors in commodity derivative markets, while the next section examines the evidence of

the effect of this growth on observed commodity price dynamics over the past decade.

Financial markets provide a useful complement to physical commodity markets because they allow consumers and producers to hedge their exposures to movements in commodity prices. These markets exist precisely *because* prices can be volatile, and allow uncertainty about future price movements to be managed. For example, a farmer could purchase a forward contract at the time of planting a crop, to give certainty about the price that will be received upon harvest. Financial investors provide additional liquidity to these markets, and can improve price discovery.

3.1 The Motivation

Over the past decade, the development of new financial products have allowed financial investors – who do not have a commercial exposure they need to hedge – greater access to commodity futures markets. Demand from investors has been strong, with the 'search for yield' prevalent in financial markets making commodities an appealing investment option. Additionally, influential research by Gorton and Rouwenhorst (2006), among others, highlighted the diversification benefits of including commodities in a portfolio.[2] In particular, they found that commodity futures were negatively correlated with equities and bonds and strongly positively correlated with inflation. Moreover, commodity futures offered equity-like returns and volatility. Around the same time, investment banks, such as Goldman Sachs, were also highlighting the risk/return benefits from including an allocation to commodities in a traditional equity-bond portfolio (Table 2).

[2] A draft of Gorton and Rouwenhorst's paper was available in 2004.

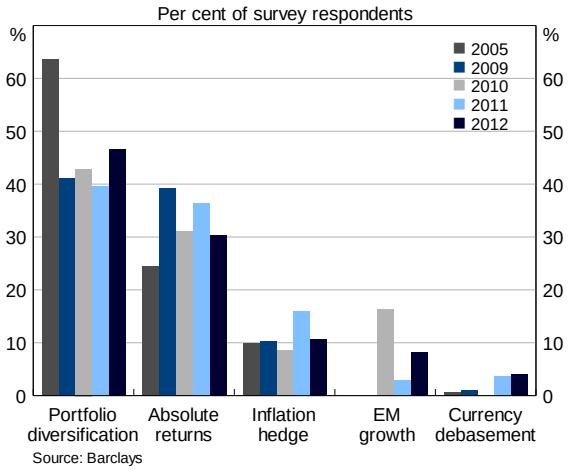
Table 2: Benefits of Diversifying into Commodities

	Return	Volatility	Sharpe Ratio	Correlation with Commodities[(a)]
Gorton & Roeuwenhorst (2004); period 1959-2004				
Commodity Futures	10.7	12.1	0.43	1
Stocks	11.1	14.9	0.38	–0.1
Bonds	7.7	8.5	0.26	–0.3
Goldman Sachs (2004); period 1970-2003				
60-40 Equity-Bonds	10.8	12.1	0.37	
60-30-10 Equity-Bonds-Commodities	11.3	11.2	0.44	

(a) At a 1-year horizon

A recent survey of financial investors in commodities by Barclays Capital confirms that return and diversification remain the two key motivations for commodity investment (Graph 5).

Graph 5
Motivation for Investing in Commodities



3.2 Assets Under Management

As a result, financial investment in commodities has grown rapidly, with around US$400 billion in assets under management in the September quarter of 2012 (Graph 6). This compares with just US$25 billion at the end of 2003. Most of the early investment in commodities was through broad-based commodity index funds, which use derivatives contracts, such as futures, to replicate the return of a specific commodity index, such as the Goldman Sachs Commodity Index (GSCI) or the DJ-UBS Commodity Index. While the GSCI was actually introduced in 1991, and the DJ-UBS index in 1998, there was little investor interest until the early to mid-2000s. While energy commodities – particularly crude oil – account

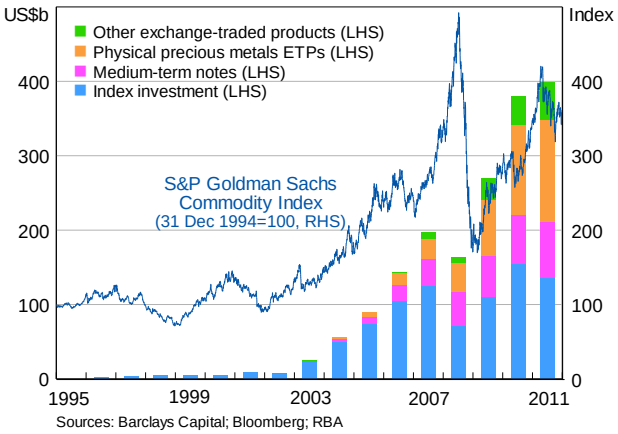
for a large share of the funds invested in commodity index funds, agricultural commodities account for a smaller share (Table 3)

Table 3: Composition of Commodity Investment Indices
By sector; per cent

	GSCI	DJ-UBS
Energy	**68**	**33**
- Crude Oil	48	15
-Natural Gas	3	11
Precious Metals	**3**	**13**
-Gold	3	10
Base Metals	**8**	**19**
-Aluminium	3	6
-Copper	4	7
Agricultural	**21**	**36**
-Corn	5	7
-Soybeans	3	7
-Wheat	4	5

Sources: Dow Jones-UBS, S&P GSCI

Graph 6
Commodity Investment
Assets under management



Sources: Barclays Capital; Bloomberg; RBA

In more recent years, exchange-traded products (ETPs) have overtaken commodity indexes as the largest vehicle for financial investing in commodities.[3]

[3] ETPs track an index, commodity or basket of assets and are traded on an exchange. Their returns can be generated from derivatives or by holding the underlying assets. See Kosev and Williams (2011) for more detail. An alternative way to invest in commodities is through

The first commodity ETP was launched in 2003 with Gold Bullion Securities. Currently, there are more than 100 ETPs tracking commodities with around US$200bn in assets under management. Around 70 per cent of ETP assets under management are accounted for by gold, with silver and the platinum group of metals accounting for around a further 10 per cent – that is, only a relatively small proportion of commodity ETP funds are invested staples such as food and energy. Precious metal ETPs typically buy and store the underlying physical commodity, providing an obvious mechanism for investment to affect prices. Almost all non-precious metal commodity ETPs use derivatives to give investors an exposure to commodities, with only a few holding the physical commodities given the substantial storage and holding costs involved.

A widely used measure of the size of commodity derivatives markets is the value of open positions – or open interest – in major commodity futures contracts, which has increased substantially since 2001 (Graph 7).[4] Much of this growth is due to the increasing presence of financial investors. Open interest represents the total dollar value of futures contracts outstanding that are held by market participants at any point in time (as discussed below, these positions will ultimately be 'closed out', meaning that almost no physical delivery of the commodity actually takes place). Turnover of these derivative contracts has also grown significantly over the same period, although part of this can be attributed to greater ease of access due to the introduction of full electronic trading on commodity futures exchanges (Graph 8).[5]

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medium-term notes, which are debt products that also provide a return that is linked to the price of an underlying commodity, basket of commodities or commodity index, but which is traded off exchange.

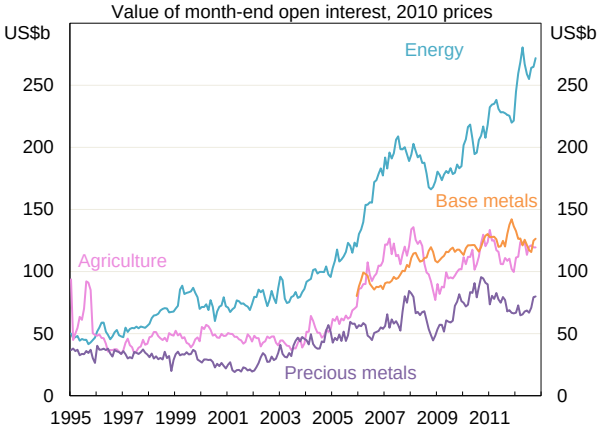
[4] This is consistent with the growth in futures open interest in other asset classes such as equities.

[5] Note that maintaining a particular portfolio composition (or tracking an index) can generate significant turnover volumes, simply to rebalance the portfolio as prices change. This involves selling commodities which have had price rises and buying those for which prices have fallen. Hence turnover related to portfolio rebalancing should *mitigate* price movements rather than exacerbate them, as is sometimes suggested.

Graph 7

Futures Market Size*

Value of month-end open interest, 2010 prices



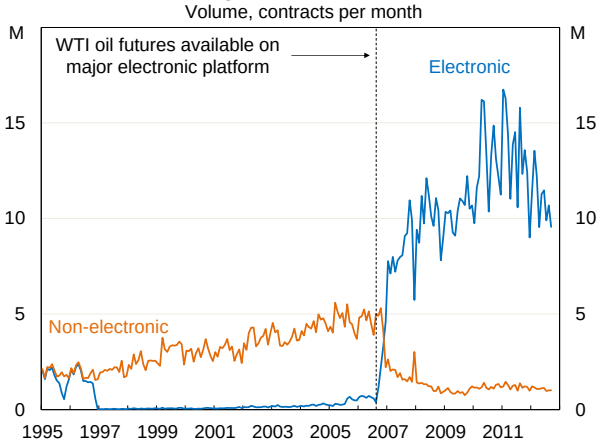
* Includes open interest for all maturities based on the largest contract for each commodity

Sources: Bloomberg; RBA

Graph 8

Trading in WTI Oil Futures

Volume, contracts per month



Source: Bloomberg

Although commodity prices have risen rapidly over recent years as commodities have emerged as an asset class for investors, the size of financial investment still remains modest relative to underlying physical commodity markets (Table 4).[6] Measures of total open interest are generally much smaller than the value of production, but turnover in futures markets can be significantly larger than

[6] Table 4 aggregates turnover and open interest at the major exchanges around the world in order to provide a comparison with global physical markets. This is different to Graph 6, which uses a time series of the open interest in the largest exchange-traded contract for each commodity as an indicative measure of the growth in commodity futures markets.

measures of physical market size.[7] A good deal of this turnover is likely to be related to the rebalancing of positions.

It is frequently stated that the size of the futures market is around 20–30 times that of the physical market (Silvennoinen et al (2010), Domanski and Heath (2007), Sarkozy (2011)). This is potentially misleading in that it relates to turnover rather than open interest and seems to be based on a relatively small sample of commodities (and could be seen as implying that the physical commodity goes directly from the producer to the consumer with no intermediation).

Table 4

Physical and Financial Market Size of Major Commodities

2011

	Value, US$ billion			Ratio to production	
	Annual production[(a)]	Annual turnover	Open interest[(b)]	Annual turnover	Open interest[(b)]
Oil	3067	40194	288	13.1	0.09
Copper[(d)]	175	13436	93	77.0	0.53
Gold[(d)]	143	9362	85	65.7	0.60
Soybeans[(c)]	348	6907	73	19.9	0.21
Corn[(c)]	236	2716	42	11.5	0.18
Natural gas	1271	3160	38	2.5	0.03
Aluminium	107	111	33	1.0	0.31
Sugar[(c)]	93	3304	28	35.4	0.30
Wheat[(c)]	189	1230	23	6.5	0.12
Zinc	29	43	10	1.5	0.34
Coal	1203	40	3	0.0	0.00
Lead	25	14	3	0.6	0.12
Iron ore[(f)]	315	8	1	0.0	0.00
Rice[(c)]	285	41	1	0.1	0.00
Nickel	37	1	0	0.0	0.01
Wool[(e)]	26	0	0	0.0	0.00

Sources: Bloomberg; BP Statistical Review 2012; BREE; RBA; Silver Institute; USDA

(a) RBA estimates based on volumes and indicative world prices

(b) Average of open interest outstanding at the end of each month

(c) These data are for 2011/12

(d) New production only, excludes scrap metal supply

(e) These data are for 2010/11

(f) Includes exchange-traded swaps

[7] Although these measures give a broad sense of the size of financial investment in commodity markets relative to the physical market, the two concepts are not directly comparable. Open interest is a stock at a given point in time, while production, exports and turnover are flows over a period of time.

We will return to discuss the development of futures markets in more detail in Section 5.

3.3 The Mechanics of a Futures Transaction

A futures contract is simply a standardised exchange-traded agreement to purchase or sell a commodity for delivery at a specified future date. Financial investors are generally most active in futures markets, rather than spot markets, as they do not want to take delivery of the physical commodity, which is expensive to store and to finance. Rather than taking delivery, financial investors typically undertake offsetting transactions to close out their positions as the contract nears the delivery date.

The role of financial investors is to act on informed views on the prospects for supply and demand as well as to be paid to take on the commodity price risk that producers, and to a lesser degree consumers, wish to hedge. As is discussed further in Section 5, the development of futures markets was quite a remarkable innovation. The standardisation of contracts, along with the role of the clearing house, ensures that only the price is being determined. The public nature of the trading is extremely helpful for price discovery. And the separation of the ownership of the commodity price risk from that of the physical commodity allows producers and consumers to better manage their commodity price risks. As history shows, futures markets typically do not survive if the underlying hedging demand from producers and/or consumers is not sufficient (see below).

There are two broad channels through which commodity futures markets can affect the production and consumption decisions of participants in spot markets: (i) they allow firms to hedge their exposures to movements in spot prices, thereby smoothing their consumption expenditure and/or production cash flows over time and lowering the cost of capital; and (ii) they provide a potential source of influence over spot prices. If the sole function of futures markets was to provide hedging services to producers and consumers, the welfare implications would be unambiguously positive. But if speculation in futures markets causes futures prices to diverge from physical supply and demand fundamentals, this could have a distortionary effect on spot prices. This is the key issue in the current debate about the influence of financial investment on commodity prices, and indeed has been something of a recurring theme throughout the history of financial markets

for commodities. However, the relationship between futures and spot prices is by no means straightforward – either in theory, or in practice.

The theoretical relationship between futures prices and spot prices is based on a no-arbitrage condition. This says that consumers and producers should remain indifferent between buying and selling the physical commodity at today's spot price, and entering into a futures contract that would allow them to buy and sell the commodity at a specified later date at today's futures price.[8] Assuming that the commodity is storable and that (well-informed) participants are able to freely access both the spot and futures markets (i.e. there are no financing or institutional constraints), then an unexpected increase in the futures price would, all else equal, allow agents to profit from buying the commodity today at the (relatively low) spot price, and selling it in the future at the (relatively high) futures price. This would then place upward pressure on the spot price and/or downward pressure on the futures price until the no-arbitrage condition was restored.

If an increase in the futures price is viewed as revealing genuinely new information about fundamentals, firms that supply the physical commodity to the spot market will have an incentive to build inventories, while firms that demand the physical commodity will have an incentive to stockpile purchases for future use. This should create excess demand for the commodity in the spot market at the current price, thereby pushing the spot price up until the no-arbitrage condition is restored. In this scenario, futures prices would only distort spot prices if there are information failures – that is, if participants in the spot market mistake speculative price developments for genuine price discovery.

However, if an increase in the futures price is not considered to reveal any genuinely new information about fundamentals, the response of firms in the spot market (and well-informed investors in the futures market) will depend on their views about how long the apparent 'bubble-like' conditions will be sustained, and how long they are willing to hold their positions.[9] Such a situation could arise, for

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[8] In practice, financing constraints could limit this process to some extent.

[9] Speculative price movements could also occur in spot markets. However, such instances are likely to be relatively isolated, as uninformed financial investors (who have no underlying physical demand for commodities) are, in general, less likely to participate in spot markets

example, due to the influence of so-called 'noise' or 'momentum' traders, who are either less well-informed than other market participants, or who actively choose to ignore fundamentals (Shleifer and Summers 1990; Reichsfeld and Roache 2011). If the deviation from fundamentals is considered temporary, firms that supply the physical commodity to the spot market will have an incentive to increase their short positions in the futures market (i.e. enter into agreements to sell the commodity at a future date at the relatively high futures price, rather than at the (lower) expected spot price). At the same time, firms that demand the commodity in the futures market will have an incentive to reduce their long positions in the futures market. This should place downward pressure on the futures price, to the point where the no-arbitrage condition is restored.

Alternatively, participants in the spot market may suspect that a rise in the futures price which is not justified by fundamentals could be sustained – for example, due to herding behaviour among 'noise traders'. In this case, producing firms may be tempted to withhold supply to the spot market (in expectation that the higher futures prices will translate into higher spot prices) and reduce their short futures positions (which provide insurance against falls in the spot price). At the same time, consuming firms will have an incentive to stockpile the spot commodity for future use and increase their long futures positions (which provide insurance against increases in the spot price). Other, better-informed, financial speculators may also be encouraged to bet on future price increases in order to book short-term profits. This process could simultaneously drive spot and futures prices higher, and even further from the price implied by fundamentals. While fundamentals would be expected to eventually reassert themselves, so-called 'rational bubbles' might nevertheless act to distort spot and futures prices for a period.

The theoretical relationship between commodity futures and spot prices is therefore not straightforward – importantly, it does not imply that changes in futures prices need necessarily lead to changes in spot prices. In practice, this is supported by the results of Granger causality tests presented in Dwyer et al

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(where they will incur storage and financing costs without an offsetting convenience yield). While market manipulation by informed participants in spot markets may also be possible, this is unrelated to the financialisation of commodity markets.

(2012), which point to substantial variation in the direction of Granger causality across individual commodities.

4. Has Financial Investment Distorted Commodity Prices?

'…the influence of financial markets has systematically transformed these real [commodity] markets into financial markets'

'This impairs the allocation of resources and has negative effects on the real economy'

'Swift political action is required on a global scale'

UNCTAD Policy Brief No 25, September 2012

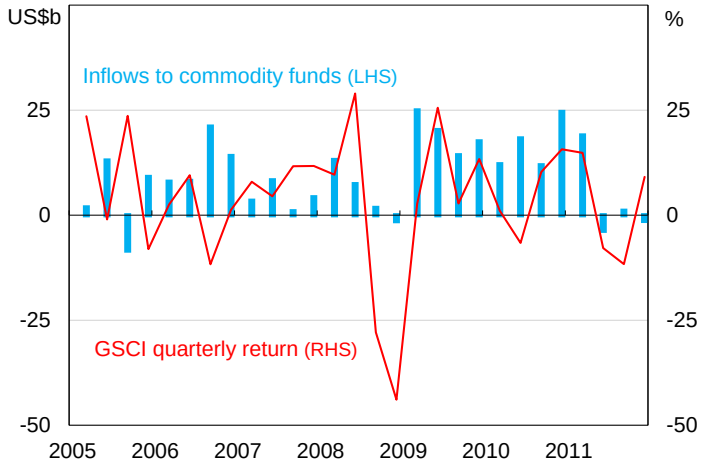
The increased presence of financial investors in commodity markets in recent years has given rise to concerns that this has distorted commodity markets and contributed significantly to the increase in the level and volatility of commodity prices over the period.

Two key pieces of evidence are often cited to support this view. First, that the sharp run up in commodity prices occurred alongside the sharp increase in the amount of assets under management directed to commodities (see, for example, Wray 2008, Masters 2008) (Graph 1). In effect, this view equates demand for financial exposure to commodities with the demand for the underlying physical commodity. Indeed, Masters notes that over the five years to 2008 financial investor demand for oil futures 'increased by 848 million barrels', which is 'almost equal to the increase in demand from China!' Likewise he notes that the 'Wheat futures stockpile of Index Speculators is enough to supply every American citizen with all the bread, pasta and baked goods they can eat for the next two years!'

Two points can be made in response to this line of argument. Firstly, it is the net flow of new funds into financial vehicles that is more relevant rather than the stock. This removes valuation effects whereby higher commodity prices can help to drive up the market value of financial investment. Looked at in this way, the relationship between commodity investment and commodity prices is much weaker (Graph 9).

Graph 9

Commodity Investment and Prices



Sources: Barclays Capital; Bloomberg

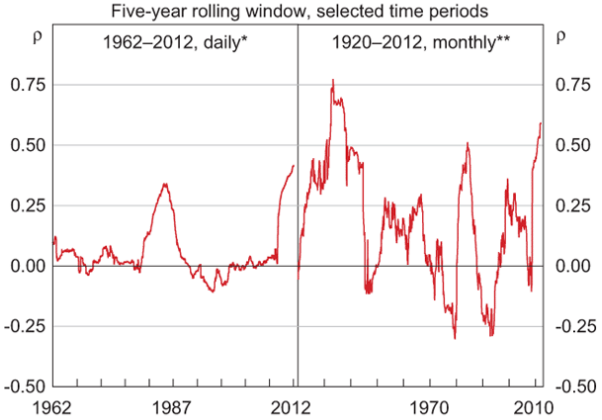
More fundamentally, though, this view seems to misunderstand the nature of futures and other derivative instruments. Because they generally do not involve actual delivery, such instruments can be created at will. That is, increased (decreased) demand for a commodity futures contract faces a much more flexible supply side than is the case for the physical commodity (where especially in the short to medium run, supply is relatively fixed). Investors in commodity derivatives, such as futures, are not actually buying or selling the underlying commodity per se, rather they are taking on the price risk of that commodity. Because investment in futures do not need to be fully funded (as no principal is exchanged), in a fully-collateralised total return commodity index, investors' funds are actually typically placed in US Treasury bills.

The second piece of evidence that financial speculators are affecting prices that is often cited is the increased correlation between commodity and financial asset prices, particularly equity prices. The logic here is that as commodity markets have become financialised they have increasingly followed the prices in other purely financial markets, rather than reflecting physical supply-demand conditions (UNCTAD 2012). Typically such analysis only covers a relatively short period of time – the past 10 or 20 years (see, for example, Inamura et al, UNCTAD). However, the recent increase in the correlation between commodity prices and other financial prices, such as equities, is in fact not especially unusual by longer-run historical standards, with previous episodes of increased correlation occurring prior to the recent influx of financial investors into commodity markets (Graph 10).

Graph 10

Commodity and Equity Price Correlations

Five-year rolling window, selected time periods



* Date labels correspond to the first day of the year; correlation between daily percentage changes in Thomson Reuters/Jefferies CRB and S&P 500 indices

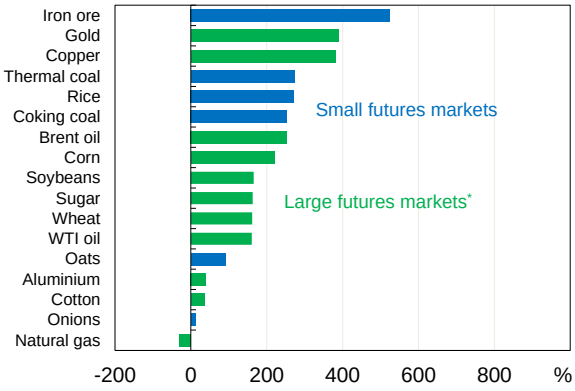
** Date labels correspond to the first month of the year; correlation between monthly percentage changes in Thomson Reuters/Jefferies CRB and S&P 500 indices

Sources: Global Financial Data; RBA

These previous periods are associated with major economic dislocations, rather than being the 'fault' of speculators, such as during the Great Depression period and the late 1970s. The most recent episode is thus not unusual in this regard given the very large global shocks that occurred both in the boom period and then in the global financial crisis.

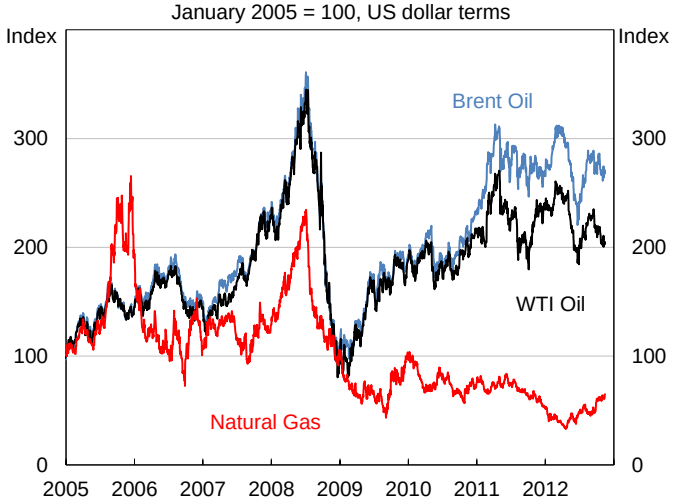
It is also worth noting that price increases have been just as large (if not larger) for some key commodities that do not have well developed financial markets as for those that do (Graph 11). Moreover, the prices of oil and US natural gas have diverged significantly in recent years, particularly since the start of 2009, despite both having significant futures markets that have grown strongly in recent years (Graph 12). There has, however, been a significant increase in the supply of US natural gas in recent years, associated with the technological developments in the shale gas sector, which explains the difference in the pattern of natural gas and oil prices. This suggests that even where there has been a large increase in financial investment, fundamentals remain the key driver.

Graph 11
Commodity Prices
Percentage change between January 2003 and October 2012



* Number of contracts traded in 2011 greater than 25 million
Sources: Bloomberg; Global Financial Data; RBA

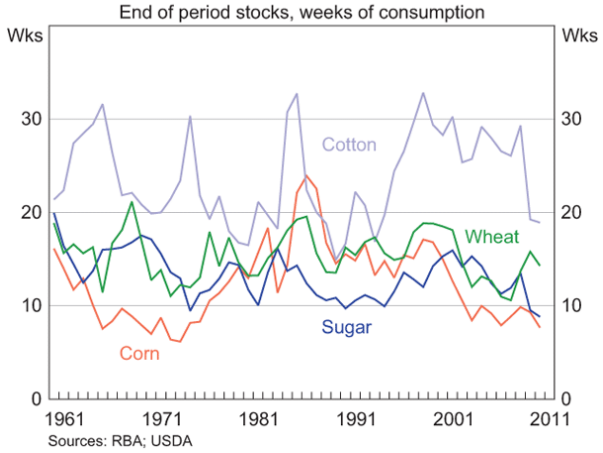
Graph 12
Oil & US Natural Gas
January 2005 = 100, US dollar terms



Nor has there been a large increase in commodity inventories that we would expect to accompany speculation-driven price rises. The available – albeit limited – data show that global inventory levels for a range of commodities have been *declining* and are currently below their long-run averages (Graph 13).[10]

[10] That said, it is possible that the producers of extracted commodities – such as oil – effectively control their 'in the ground' inventories by limiting production. This is difficult to gauge.

Graph 13
Global Inventory Levels
End of period stocks, weeks of consumption



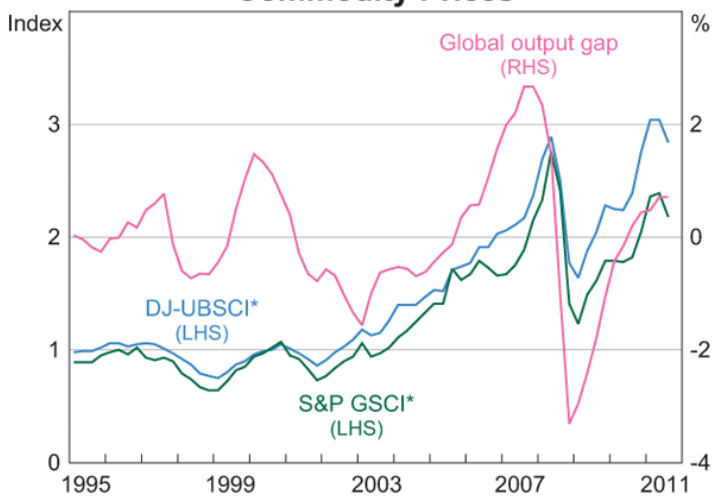
Sources: RBA; USDA

4.1 Commodity Prices and the Global Output Gap

Another argument that has been made in support of the financialisation view relates to the changed relationship between the global output gap and commodity prices over recent years. It has been argued that the global output gap is an important determinant of the cyclical behaviour of commodity prices, since commodities are used as an input to production (and typically it takes some time for commodity supply to respond to changes in demand). As shown in Inamura *et al* (2011), there appears to be some evidence of this, with a broad co-movement over time between the global output gap (measured as the difference between actual and potential global GDP)[11] and various commodity price indices (reproduced from Inamura et al in Graph 14).

[11] While industrial production may be a more relevant measure of global activity for this purpose, we use GDP in order to assess the claims made in Inamura et al. Global GDP is measured using purchasing power parity exchange rates and potential output is calculated using the Hodrick Prescott filter (λ = 1,600). Preliminary analysis using world IP gave broadly similar results.

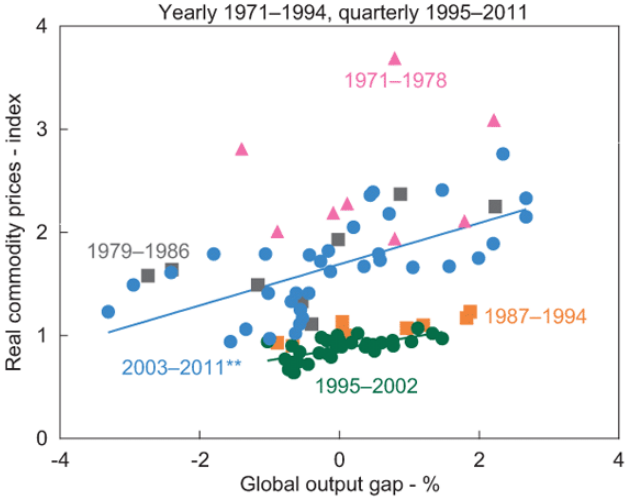
Graph 14
The Global Output Gap and Commodity Prices



* Spot returns measures of the S&P Goldman Sachs Commodity Index (GSCI) and the Dow Jones-UBS Commodity Index (DJ-UBSCI) deflated by the US CPI; 2000 average = 1
Sources: Bloomberg; Global Financial Data; IMF; RBA

Proponents of this view suggest that increased financial investment in commodity markets over the past decade has resulted in an upward shift in the relationship between commodity prices and the global output gap. Abstracting from supply factors, the intuition here is that financialisation constitutes a source of increased demand for commodities which is unrelated to macroeconomic 'fundamentals' (as captured by the output gap). Graph 15 plots the relationship between real commodity prices and the global output gap. There does indeed appear to have been an upward shift in the relationship between real commodity prices and the global output gap between 1995–2002 and 2003–2011, consistent with the financialisation hypothesis. However, taking a longer-run historical perspective, it is evident that the relationship observed over the 2003–2011 period is around average, whereas it is the relationship from 1995–2002 (and also 1987–1994) that looks unusual. That is, it is the period of low and falling real commodity prices during the latter part of the 1980s and the 1990s that looks more unusual, rather than the most recent period.

Graph 15
Commodity Prices* and the Global Output Gap
Yearly 1971–1994, quarterly 1995–2011



* Spot returns measure of the S&P GSCI deflated by the US CPI; 2000 average = 1
** Data to September quarter 2011
Sources: Global Financial Data; IMF; RBA

As noted above, however, this analysis omits supply-side factors, which are clearly also important determinants of commodity prices. In particular, supply conditions were tight in the 1970s – associated with the oil price shocks – but eased in the 1980s in response to the earlier increase in prices.

So, from a longer-run perspective, the relationship between commodity prices and the global output gap in recent years does not look unusual. In any event, the omission of supply-side factors means that any change in this relationship cannot, of itself, be attributed to the financialisation of commodity markets in recent years.

4.2 Principal Component Analysis

An alternative way to examine the extent to which developments in commodity futures prices have been consistent with macroeconomic fundamentals is through principal component analysis. This statistical technique identifies whether there are common factors driving movements in an underlying set of observed variables, and how important they are, without having to specify what those factors might be. Drawing on this analysis, together with broader evidence on the drivers of commodity prices (discussed briefly in the next section), we can infer the extent to which these common factors are related to macroeconomic fundamentals.

This analysis was conducted on quarterly price changes for 20 commodities over two sample periods: the September quarter 1990 to the December quarter 2002 and the March quarter 2003 to the December quarter 2011.[12] By comparing the results from these two periods, we can gain some insights into the effect of financial investment in commodity markets.

The results suggest that, since 2003, one common factor (i.e. the first principal component) has explained 40 per cent of the total variation in our set of 20 commodity prices in change terms (Table 5), with the next most important factor accounting for only 12 per cent.[13] In levels terms, the first principal component explains almost 70 per cent of the variation since 2003. A number of statistical tests indicate that there is only one significant common factor.[14] The results show that the first principal component has become more important over the past decade compared with the 1990s, when it only explained 23 per cent of the variation in commodity prices in change terms (and just under 40 per cent in levels terms). Moreover, across the various commodities, the first factor loadings (i.e. the correlations between changes in the commodity's price and the first principal component) are reasonably uniform within the recent sub-period (Table 6). US natural gas prices are one notable exception, consistent with the large (idiosyncratic) increase in supply associated with the shale gas 'revolution' together with the fact that US natural gas is restricted to the domestic market due to a lack of international transportation infrastructure. Agricultural prices also tend to have somewhat lower loadings on the common factor. This seems likely to reflect the importance of idiosyncratic – particularly weather-related – supply factors in driving futures prices for agricultural commodities.

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[12] The analysis for the latter period was also performed over a slightly longer time period (March quarter 2000 to the December quarter 2011) to test the sensitivity of the results to the use of a relatively short time period. The results from this exercise were very similar to those obtained over the shorter period.

[13] The principal component analysis is performed using percentage changes in quarterly (daily average) front-month futures prices. The exception to this is the use of LME spot prices for base metals from the start of the sample period to July 1997 due to the unavailability of LME futures prices up until this time. The results of the principal component analysis also hold for a (smaller) sample of spot, rather than futures, prices. Iron ore and coal prices were excluded due to the dominance of contract pricing over much of this period.

[14] The standard Scree test and the criterion developed by Otter, Jacobs and den Reijer (2011) show that there is one significant common factor, while the Bai-Ng Panel Information Criteria suggest one or two common factors, depending on which statistic is used (Bai and Ng 2002).

Table 5: Principal Component Analysis of Changes in Commodity Prices

	Share of variation explained (per cent)	
Principal component	2003:Q1–2011:Q4	1990:Q3–2002:Q4
1	40	23
2	12	14
3	9	11
4	7	8
5	6	7
6	5	7
7	4	6
8	3	5
9	3	4
10	3	3
...		
20	0	0

Source: authors' calculations

The dominance of the first principal component shows that there has been one major common driver of developments in commodity prices, particularly in the post-2003 period. This appears likely to be related to known macroeconomic developments over this period – in particular, the combination of an unexpectedly large increase in demand for commodities and sluggish supply growth. For example, the pair-wise correlation between the first principal component and quarterly growth in global industrial production is 0.7 over the recent period. While this does not control for other relevant variables, such as supply factors, it is nevertheless broadly consistent with the results obtained from a more fully specified model in Arbatli and Vasishtha (2012). The alternative hypothesis, which is that financialisation has been by far the most important influence on commodity prices, is a much less plausible explanation, in large part because there is no reason to suspect that this has an element to it that is common across a rather disparate set of commodities, a number of which are not even included in the major commodity indices used by financial investors.

Table 6: First Factor Loadings for Individual Commodity Prices

	Correlation between price change and first principal component	
	2003:Q1–2011:Q4	1990:Q3–2002:Q4
Aluminium	0.82	0.61
Copper	0.79	0.56
Oats	0.77	−0.48
Silver	0.76	−0.12
Brent oil	0.75	0.89
WTI oil	0.72	0.87
Heating oil	0.71	0.82
Corn	0.66	−0.48
Cotton	0.64	0.11
Zinc	0.63	0.31
Soybeans	0.62	−0.21
Lead	0.61	0.24
Coffee	0.55	0.12
Nickel	0.54	0.48
Cocoa	0.51	−0.23
Gold	0.51	0.15
Wheat	0.50	−0.43
Rice	0.46	−0.32
Sugar	0.39	0.09
US natural gas	0.38	0.33

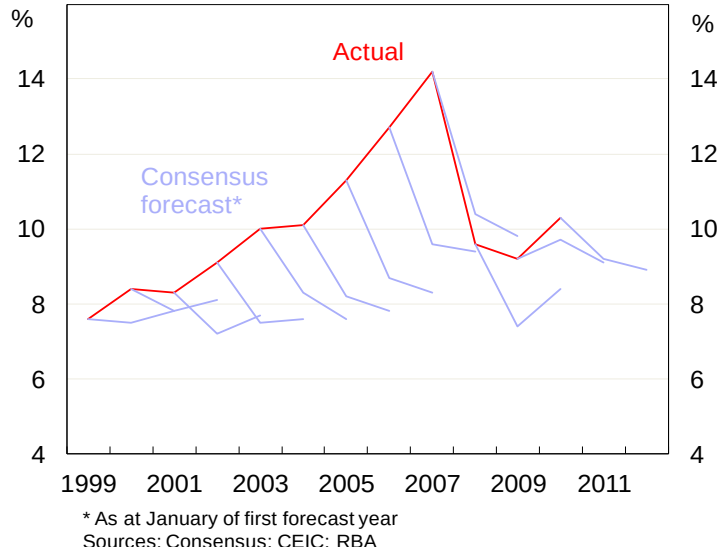
Source: authors' calculations

4.3 Briefly on Emerging Market Demand and Inelastic Supply

While the role of strong growth of the emerging market economies, especially China, in influencing commodity prices is well known (see, for example, Coates and Luu (2012)), we wish to highlight two points: the extent to which demand from China surprised on the upside; and the difficulty the global supply chain had in adjusting to this.

While the potential of China's large domestic market was recognised in the early 2000s (and indeed had been for more than a century),[15] the rapid pace at which it would industrialise through the decade and the implications for commodity prices were not widely anticipated. For instance, Consensus forecasts consistently under-predicted China's growth from 1999 through to 2007; it was not until the second half of the 2000s that analysts began to forecast that the medium-term rate of growth had increased above the Chinese Government's 7–8 per cent targets in their five-year plans (Graph 16). Not only was economic growth in China much stronger than expected, but it also turned out to be much more resource intensive than previously. Chinese steel production, for example, grew at an annual average rate of close to 20 per cent over the decade from 2001, compared with 10 per cent in the 1990s, and around 7 cent in the 1980s. As a result, China's demand for iron ore and coking coal turned out to be dramatically larger than had been expected. It is also worth noting that China's weight in the global economy has increased significantly over time, such that even 'only' 7 per cent growth in 2013 would add more to global GDP than 10 per cent growth in 2003 (Stevens (2012)).

Graph 16
China – GDP Growth
Annual average



Similarly, mining companies took some time to be convinced that the pick-up in commodities demand would be sustained. For example, mining investment as a share of Australian GDP did not rise to above-average levels until the second half

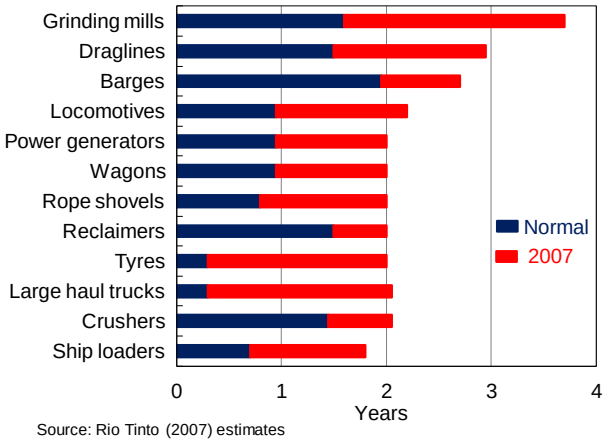
[15] See, for example, Arndt (1972) who cites a Times correspondent from 1858 that 'A London house of famous name sent out a consignment of pianofortes. The speculation was based, probably, on the calculation that China must contain 200,000,000 women, and "now that China was opened up", at least one out of every 200 would wish to learn piano.'

of the 2000s. The slow supply response reflects a number of factors including the long lead times for new investment, labour and equipment shortages, and bottlenecks in the transport network. In short, after a lengthy period of weak commodity prices, and hence investment, up until the start of the decade, the global supply chain was not equipped to respond quickly to the surge in demand from China. As an example of this, Rio Tinto noted in 2007 that the time it took for mining truck tyres ordered to be delivered had increased from three months to two years, while lead times for larger pieces of equipment such as draglines and grinding mills had doubled to more than three years (Graph 17). As an illustration of the tightness of the market, mining companies were forced to retrieve and re-use truck tyres that had previously been discarded.

Graph 17

Capital Equipment Delivery Times

in the Mining Sector



Source: Rio Tinto (2007) estimates

So the combination of a downturn in the commodity sector in the 1990s in response to weak prices and the unexpected strength in demand from China offers a plausible explanation for recent developments in commodity prices even though some have placed considerable focus on the role of financialisation. As the next Section discusses, this type of debate is by no means unprecedented. On the contrary, history offers numerous examples of instances where sharp fluctuations in commodity prices have also been associated with the actions of speculators and investors.

5. A Short History of Futures Markets

"Prices had moved wildly before the [US Civil] war because of weather, economic instability and imperfect crop information, but it appeared that the new volatility was due to maneuvers by speculators with large purses. Thus 'speculator' became more than ever a term of opprobrium…The mysterious and remote commodity speculator seemed more of a parasite to the farmers than the local physician who was holding land for appreciation."

Cowing, C (1895) *Populists, Plungers, and Progressives: A Social History of Stock and Commodity Speculation. 1890-1936*

Futures trading has a long history, with historians tracing early contracts for the future delivery of commodities (essentially forward contracts) back to ancient Mesopotamia, Egypt and the Roman Empire (Peery (2012)). The very first futures markets were for commodities, and were established to facilitate physical trade in goods by providing hedging facilities to producers and consumers of commodities.

Modern commodity futures began to take shape in the mid-to-late 1800s, with the Chicago Board of Trade (CBOT) trading standardised futures contracts in grains (wheat, corn and oats) by 1865, and the London Metal Exchange (LME) commencing trading in copper and tin futures in 1877. In Australia, the Sydney Futures Exchange (now part of the Australian Stock Exchange) began trading in 1960 as the Sydney Greasy Wool Futures Exchange. By contrast, futures trading in financial market instruments did not commence until much later, even though these markets are now much larger than commodity futures markets. The first foreign exchange contracts were introduced by the Chicago Mercantile Exchange in 1972[16] following the breakdown of the Bretton Woods system of fixed exchange rates, while interest rate futures did not begin trading until the mid

[16] This was the first successful currency future. A currency future was actually listed in 1970 at the International Currency Exchange – but being in the Bretton-Woods fixed exchange rate era it quickly died due to a lack of interest.

1970s and equity index futures did not begin trading until the early 1980s (Table 7).

Table 7

US Futures Market Development

Abridged Timeline

Year Introduced	Commodity	Exchange
1865	Corn, Oats, Wheat	Chicago Board of Trade
1869	Rye	Chicago Board of Trade
1870	Cotton	New York Cotton Exchange
1872	Butter, Cheese	Butter and Cheese Exchange of New York
1882	Coffee, Sugar, Cocoa	Coffee Sugar and Cocoa Exchange
1885	Barley	Chicago Board of Trade
1936	Soybeans	Chicago Board of Trade
1940s	Onions	Chicago Board of Trade
1961	Frozen pork bellies	Chicago Mercantile Exchange
1964	Live cattle	Chicago Mercantile Exchange
1972	Currencies	Chicago Mercantile Exchange
1974	Gold	COMEX
1975	Interest Rates	Chicago Board of Trade
1976	US Treasury Bills	Chicago Mercantile Exchange
1977	US Treasury Bonds	Chicago Board of Trade
1981	Eurodollar	Chicago Mercantile Exchange
1983	Crude Oil	NYMEX
1990	Natural Gas	NYMEX

Sources: Various commodity exchanges

The popularity of futures contracts for different commodities has varied significantly over time, and provides some useful insights into the fundamental purpose of these markets. In summary, participation in individual commodity futures markets has tended to be highest when demand for hedging price fluctuations in the underlying deliverable commodity has been strongest. For example, it is unsurprising that the first modern-day futures markets were exclusively for agricultural commodities given that agriculture accounted for

around a third of the US economy in 1880s. It is equally unsurprising that financial futures markets – in particular interest rate and foreign exchange markets – are today much larger than agricultural futures markets, given both the growth in the financial services industry over recent decades and the increased volatility in financial prices that accompanied financial sector deregulation and the shift from fixed to floating exchange rate regimes (see footnote 16).

Further underscoring the close relationship between the strength of hedging demand and the size of futures markets, history also provides a number of examples of futures markets that have disappeared as hedging demand has waned. For example, futures markets for barley and rye were both closed down as the economic importance of these commodities declined, while the demise of the futures market for storage eggs was linked to advances in technology which removed seasonality from the supply of eggs, and therefore, from the price.[17]

Even from their early stages, modern commodity futures markets have been subject to intense scrutiny during episodes of high and volatile commodity prices. US markets in the late 1800s and early 1900s provide some noteworthy examples of debates about the role of financial investors during episodes of heightened commodity price volatility and subsequent regulatory responses. The big issue at the time was market manipulation – in particular, attempts to 'corner' the market. For example, Markham (1987) reports that in 1868 there were 3 corners in wheat, 2 in corn, 1 in oats, plus an attempted corner in rye and a 'threatened' corner in pork. And on September 24, 1869 – or 'Black Friday' – an attempt by two speculators to corner the US gold market collapsed, resulting in the price of gold falling from around $US160/oz to $US130/oz within minutes.[18]

By the 1890s, popular sentiment was firmly against the CBOT, with farmers asserting that the exchange was responsible for excess price volatility. Interestingly, these arguments were most often put forward in an environment of falling commodity prices, which is in clear contrast to today's debate. The

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[17] Carlton (1984) finds that 79 different types of commodities have been listed in the Wall Street Journal from 1921 to 1983, with 42 different types of commodities existing in 1983. He calculates that the median existence of a commodities futures contract over the period was 7 years, with 20–30 per cent of contracts ceasing to trade within 2 years.

[18] See Ackerman (1988) for a detailed account of the 'Black Friday' episode.

reputation of the CBOT was not helped at this time by the emergence of so-called 'bucket shops', which functioned as off-exchange gambling houses by allowing wagers to be placed on commodity prices.[19] These bets were 'thrown into the bucket' (i.e. placed on the bucket shop's books) rather than being executed on exchange, which meant that in contrast to commodity futures, positions at bucket shops were not physically deliverable. In essence then, bucket shop business model relied on their customers losing money – and if they did not, bucket shop operators would often simply close down and refuse to pay out. The CBOT itself was firmly opposed to the emergence of bucket shops, not only because they provided an off-exchange exposure to commodity prices but also because they were seen to be tarnishing the reputation of legitimate, physically-deliverable commodity futures trading.

Around 200 bills were introduced to curb futures and options trading in the US between 1880 and 1920, culminating in the Grain Futures Act, which was eventually adopted by Congress in 1922. The Act was designed to affect derivatives trading only – spot activity was deliberately and specifically excluded. The central feature of this legislation was the establishment of a licensing system which required commodity exchanges to meet certain criteria, including self-regulation, in order to be permitted to conduct trading – a requirement which still exists in the US today.[20] In addition, the Grain Futures Administration, which was established to administer the Grain Futures Act, also introduced a 'large trader reporting system' in a bid to curb market manipulation. Under the large trader reporting system, the daily market positions of individual participants were required to be reported if they exceeded a designated size – this system also continues to exist in the US today, in the form of Commitment of Traders reports.

However, the Grain Futures Administration argued that surveillance alone was insufficient to prevent instances of heavily concentrated speculative trading from unduly influencing prices and petitioned Congress to be given the power to impose binding position limits. Legislation to give effect to this was adopted in 1936 with the enactment of the Commodity Exchange Act, which continues to

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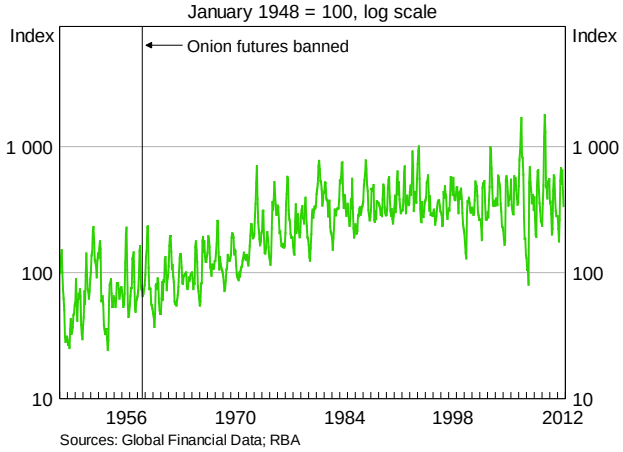
[19] Hochfelder (2006) is a standard reference.

[20] A key motivation of this licensing system was to eliminate bucket shops (which were not designated exchanges).

regulate commodity futures trading activity in the US today. The Act originally applied to a specific list of commodities, which included grains, butter, eggs, potatoes, rice, cotton and mill feeds – in order to add other commodities, the statute itself was required to be amended.[21] In 1958, the Commodity Exchange Act was amended by Congress to ban futures trading in onions altogether, in response to price volatility. Interestingly, although the ban remains in place today onion prices have continued to exhibit volatility (Graph 18).

Graph 18
Onion Price Index
January 1948 = 100, log scale



Sources: Global Financial Data; RBA

Over the following years, position limits were extended beyond the grains to various other commodities. Exchanges also voluntarily imposed their own position limits on some commodities, again essentially on an ad hoc basis. When the Commodity Futures Trading Commission (CFTC) was established in 1975, various exchanges had placed speculative position limits on the trading of 17 commodities.[22] Altogether, limits were in place for nearly all actively traded commodities, with around half of these specified by government regulation and half by the exchanges.

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[21] In addition to providing for position limits, the Commodity Exchange Act also prohibited options trading for commodities in which futures trading was already being conducted. This ban remained in effect until 1981.

[22] The CFTC was established by the Commodity Futures Trading Commission Act (1974), which extended the Commodity Exchange Act (1936) in part due to record high grain prices and concerns about the role of speculators.

In 2011, under the direction of the Dodd-Frank Act, the CFTC has proposed stricter position limits for futures and options contracts for specified commodities. Under the proposed rules: the number of commodities with federal position limits will be expanded; swap contracts that are 'economically equivalent' to futures contracts will also be covered; and swap dealers will no longer receive exemptions for entering into positions to hedge their clients' speculative positions. Although the proposed rules were scheduled to come into effect on 12 October 2012, they have since been delayed by a US district court, which ruled that the CFTC had failed to establish that the proposed position limits were 'necessary to diminish, eliminate or prevent excessive speculation'. [23]

It is clear then that the current debate about the relationship between financial investment in commodities has also been played out on numerous occasions through history. Indeed, much of today's regulatory framework for commodity futures markets originated in response to episodes of 'excessive' price volatility, for which financial investors – or speculators – received much of the blame.[24] However, it is also worth noting that history reveals numerous instances of attempts by commercial interests – for example, commodity producers – to manipulate prices. For example, the Cargill Grain Company was prohibited from trading in the CBOT's market for 'privileges' (or options) in 1937 for allegedly attempting to corner the corn market, and after subsequently rejoining the exchange, was banned from trading oat futures in the early 1950s (Markham, 1987). And in 1988, Kraft – a major purchaser of cheese – was accused of selling relatively large quantities of cheese on the National Cheese Exchange in order to lower the price it paid for the cheese it purchased under contract off-exchange (which was linked to the exchange price).[25]

To conclude then, the common element in these historical episodes has been some form of market failure (most often asymmetric information) rather than

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23 ISDA et al v. CFTC (2012)

24 Johnson (2012) defines speculation and investment thus: '"Speculation", a word often used derisively, means to voluntarily take a risk on the outcome of events over which one has no effective control, hoping to gain if correct. "Investment", a word commonly associated with prudence and caution, means to voluntarily take a risk on the outcome of events over which one has no effective control, hoping to gain if correct.'

25 See Marion and Mueller (1996) for a summary report on cheese pricing and the National Cheese Exchange.

necessarily the nature of the participants involved – for example, whether they are financial investors or participants in the physical market. Indeed, it is not clear that these market failures are more likely to occur in futures, rather than physical markets. History, then, would appear to suggest that the most successful policy responses to episodes of ‘excessive’ commodity price volatility are likely to be those that come closest to addressing these underlying market failures.

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