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El Niño – What is it and what does it mean? – JUNE 2014

There has been much chatter in recent weeks about a developing El Niño in 2014 and market commentators are getting excited about the potential for increased volatility across financial markets. But what exactly is El Niño and what does it mean for commodity markets? This brief paper will hopefully answer both questions.

"Climate is what we expect, weather is what we get".
Mark Twain, 1887

What is El Niño?

The term El Niño—Spanish for "the Christ Child"—was originally used by fishermen to refer to the Pacific Ocean warm currents near the coasts of Peru and Ecuador that appeared periodically around Christmas time and lasted for a few months. Due to those currents, fish were much less abundant than usual and their businesses suffered. Today we use the term for the large-scale warming of the Pacific Ocean.

El Niño were observed as early as the 1600s. More systematic study began at the end of the 19th century when Peruvian geographers noted unusual oceanic and climatic phenomena occurring periodically along the Peru coast. They noticed that from time to time the Eastern Pacific waters would warm, and sometimes substantially. In the 1920s, the British scientist Sir Gilbert Walker identified that some climate anomalies—specifically changes in atmospheric pressure and circulation—happen around the world every few years. He referred to this as "the Southern Oscillation." While stationed in India studying monsoons, Sir Gilbert observed pressure differences in the equatorial Pacific Ocean. He noticed "a seesaw" of atmospheric pressure measured at two sites: Darwin in Australia and in Tahiti, an island in the South Pacific. When atmospheric pressure rises at Darwin it falls in Tahiti, and vice versa.

In the 1950s, it was observed that these climate anomalies (the Southern Oscillation) coincided in general with El Niño occurrences. In the ensuing decades, scientists realised that the warming of the eastern Pacific was just one part of a large-scale interaction between the ocean and the atmosphere.
Since the 1970s scientists have been researching El Niño and the Southern Oscillation phenomena together. Today we know that El Niño is a part of a climate oscillation called the El Niño Southern Oscillation (ENSO) event. El Niño is the warm phase of ENSO; the cold phase of the event is called La Niña, or La NiNiñoa.

What happens?

"The answer, my friend, is blowin' in the wind".
Blowin' in the Wind, Bob Dylan, 1962

There are two key parts to Pacific weather and they are directly related;

1. Water temperature; clearly a result of the sun heating the ocean, but note that the key element is the difference in temperature between the warmer surface water and the cooler undercurrents (to about 300m).
2. Air pressure; which in turn drives the trade winds. In the tropical Pacific these generally blow from East to West.

In normal conditions (ie non-El Niño), these two factors play out as follows;

1. *Water Temperature;*

As the trade winds blow from East to West, they drag the surface waters with them. This surface water is heated from the sun and pools in the Western Pacific as it runs into the land masses of Australia and Indonesia. Meanwhile in the Eastern Pacific there is an "upwelling" as the colder, deeper water runs into the land mass of South America (see. Fig.1 below);

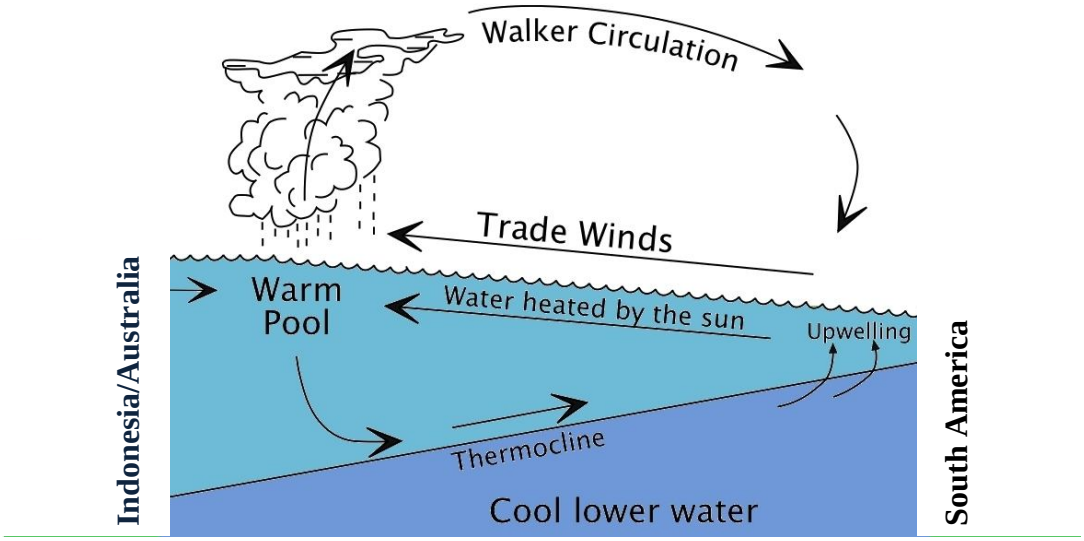

Fig.1 – Pacific Water and Air Currents, Normal Conditions

2. *Air Pressure;*

Because the water is warm in the Western Pacific, a lot of evaporation takes place and the warm, moist air rises. This creates an area of low air pressure at sea-level. Conversely, because the water is cooler in the Eastern Pacific, cool, dry air falls in that region creating an area of high air pressure at sea-level. The trade winds blow from the area with high pressure to the area with low pressure (from East to West). This air pressure "loop" is known as the Walker Circulation (after Sir Gilbert Walker).

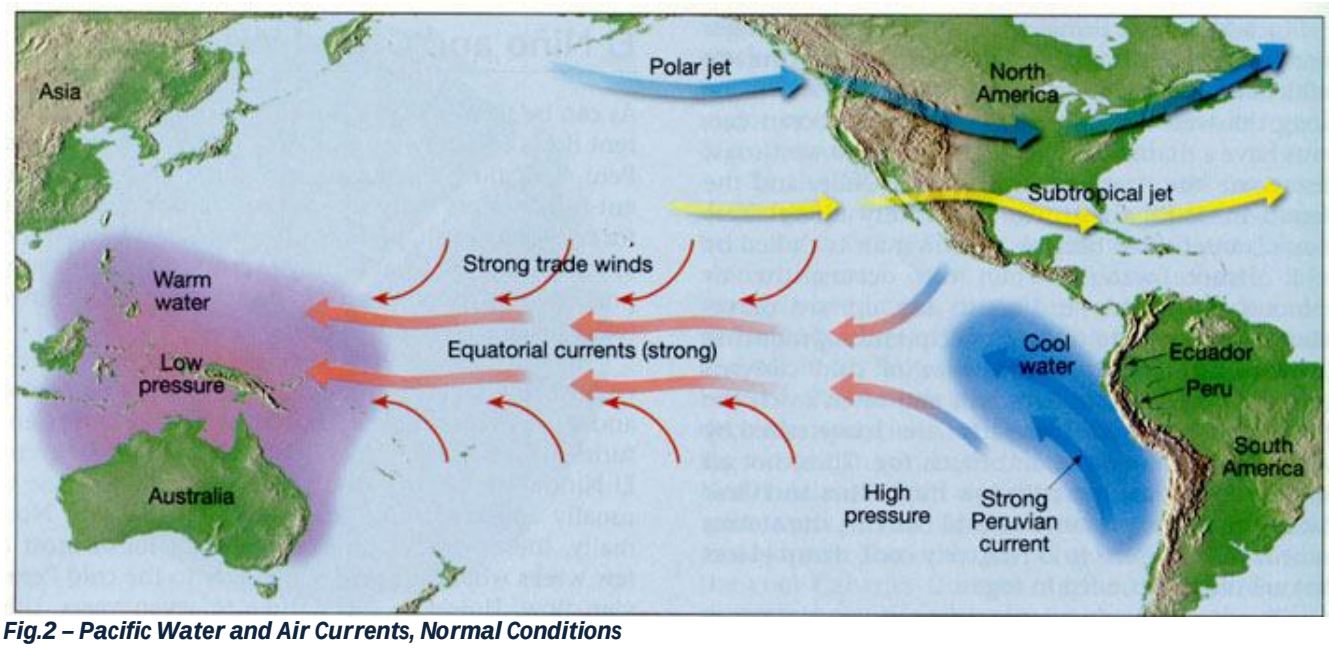

Fig.2 – Pacific Water and Air Currents, Normal Conditions

This “normal” pattern explains local climates. Indonesia is particularly susceptible to heavy rain storms and this weather system is also a key part of the South-East Asian monsoon season. Conversely the Atacama Desert in Peru/Chile is widely recognised as the driest place on earth, while the nutrient-rich water is responsible for supporting the large fish population. Indeed the waters off Peru are one of the five richest fishing grounds in the world

The temperature difference between the warm pool of water in the West and the cooler water in the East is critical. In “normal” conditions the cool water in the East is approximately 20-22^{0}C while the warmer pool in the West is around 8-10^{0}C hotter at around 29^{0}C.

The water temperature and the air pressure are directly linked, with the East-West temperature difference driving the trade winds and the trade winds keeping the temperature difference constant. With a little give or take here and there, everything is in a state of balance. This situation can be maintained indefinitely until some “weather event” throws everything out of balance.

La Niña (also known as La NiNiñoa) Conditions

In a La Niña event, the temperature in the Eastern Pacific drops by approximately 3-5^{0}C. This increase in the volume of cool water then starts to spread across the Western Pacific – see Fig.3 below;

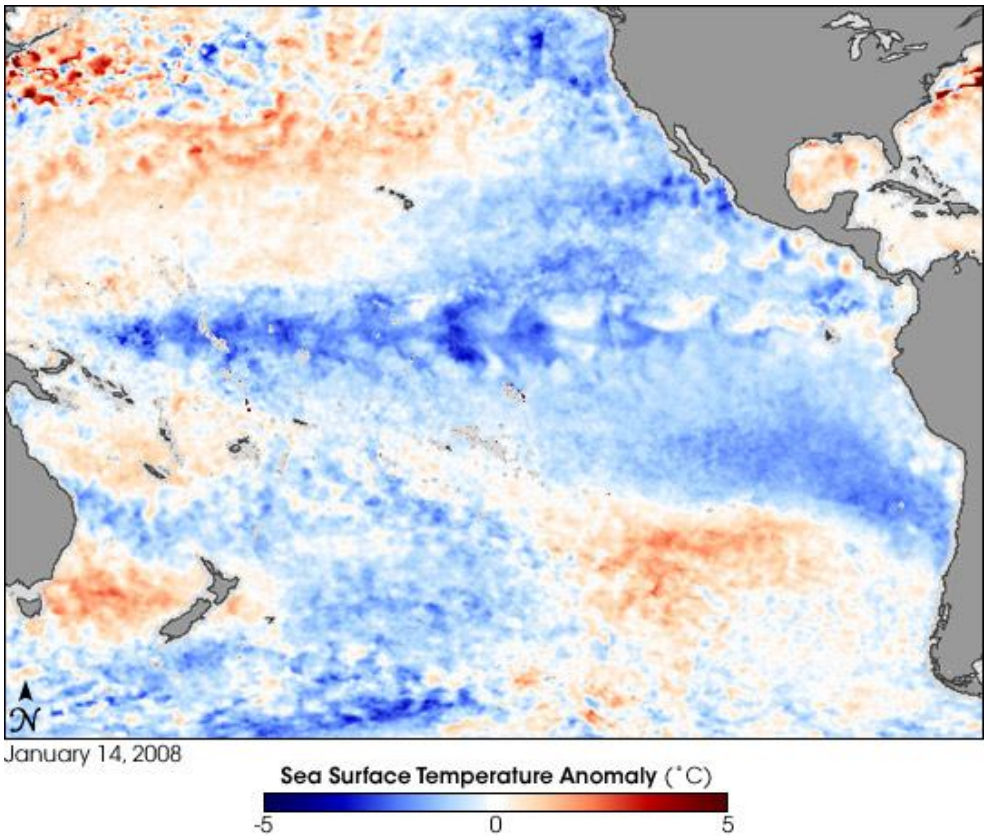

Fig.3 – Pacific water temperatures – La Niña

In this instance the normal situation is magnified. The trade winds blow harder, the rain storms in Indonesia and the monsoon season are longer and wetter, and the West coast of South America suffers prolonged periods of dry weather. Broadly speaking however, local geographies experience exaggerated but similar climates and because of this a La Niña event is deemed far less newsworthy than its El Niño counterpart – unless of course you happen to live in one of the affected habitats.

El Niño Conditions

The key factor in an El Niño event will already have been spotted by more eagle-eyed readers from Fig.1 on the second page of this paper. It is not an error that the diagram shows the sea-level at the Western warm pool as being substantially higher than the sea-level at the cooler South American coast. The difference in the sea-level in "normal" conditions is approximately 0.5m and is a result of all that cool water being dragged from the Eastern Pacific and pooled in the Western Pacific by the trade winds. Gravity of course would like the sea-level in the West to equal that in the East, but the trade winds are stronger and all the time they are maintained as such then the status quo continues.

In an El Niño event the trade winds relax, or sometimes even reverse. As a result gravity starts to win and the large volume of warm water that has been pooling in the Western Pacific sloshes back to the East, ie the "normal" situation is reversed. Sometimes the warm water may only reach the middle of the ocean in which case it is known as a Central Pacific El Niño, but in extreme cases it can reach the coast of South America in which case it is known as an Eastern Pacific El Niño. The further East it reaches, the more severe the outcome. An Eastern Pacific El Niño is a major event with major and potentially catastrophic consequences;

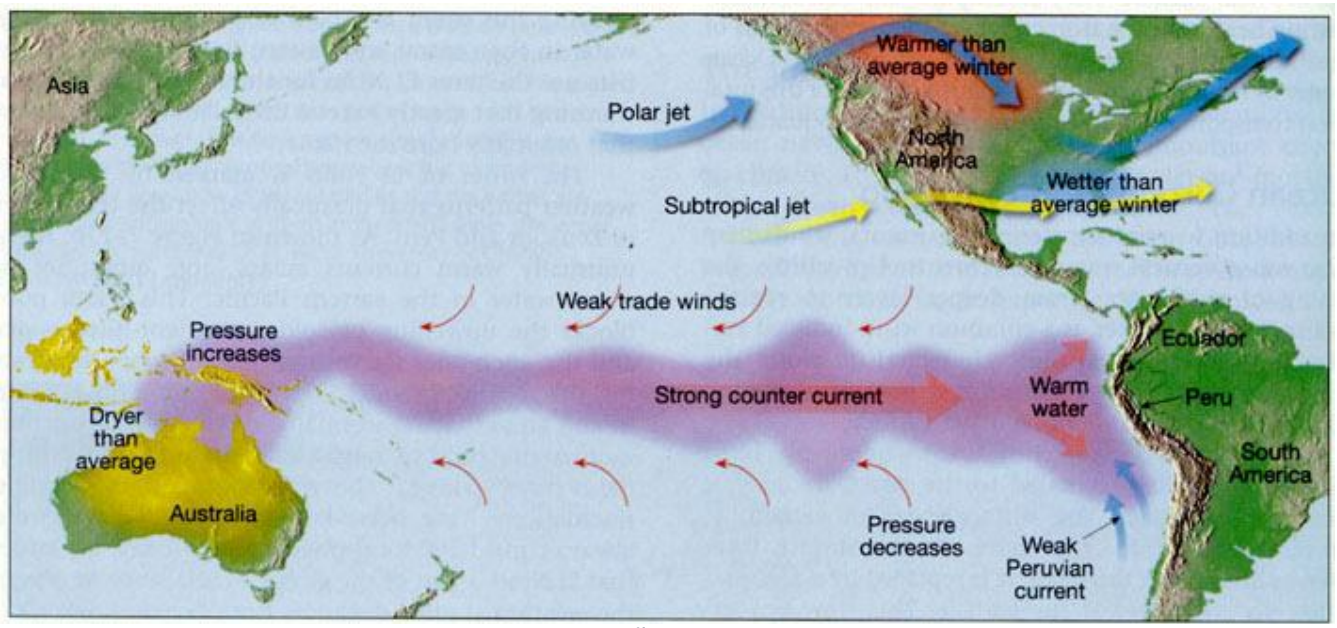

Fig.4 – Pacific Water and Air Currents, Eastern Pacific El Niño Conditions

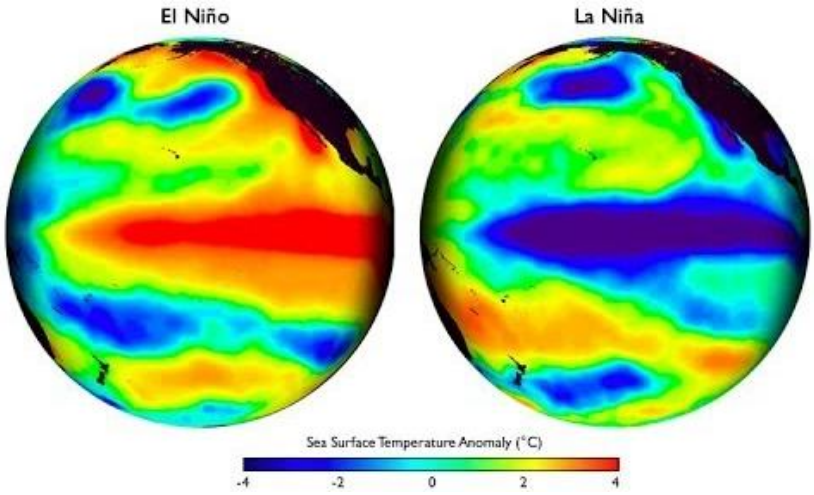

Fig.5 – Pacific water temperatures relative to the mean

When does El Niño occur?

El Niño events happen irregularly and are hard to predict. But because the phenomenon dramatically affects the weather in so many parts of the world, today there are various climate models, seasonal forecasting models, ocean-atmosphere coupled models, and statistical models that attempt to predict El Niño. This has only been possible since the 1980s, when the power of computers became sufficient to cover very complicated large-scale ocean-atmosphere interactions.

Generally, an El Niño event occurs every 3-6 years and usually lasts for 9-12 months – but on occasion the have lasted for up to 18 months. Importantly they are classified by strength, with their strength being estimated by surface atmospheric pressure anomalies and anomalies of land and sea surface temperatures.

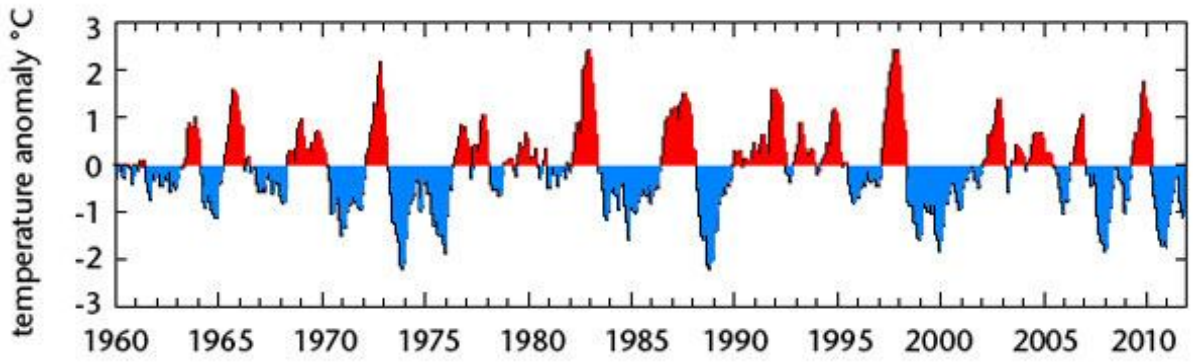

Fig.6 – The Southern Oscillation Index (red indicates El Niño and blue indicates La Niña)

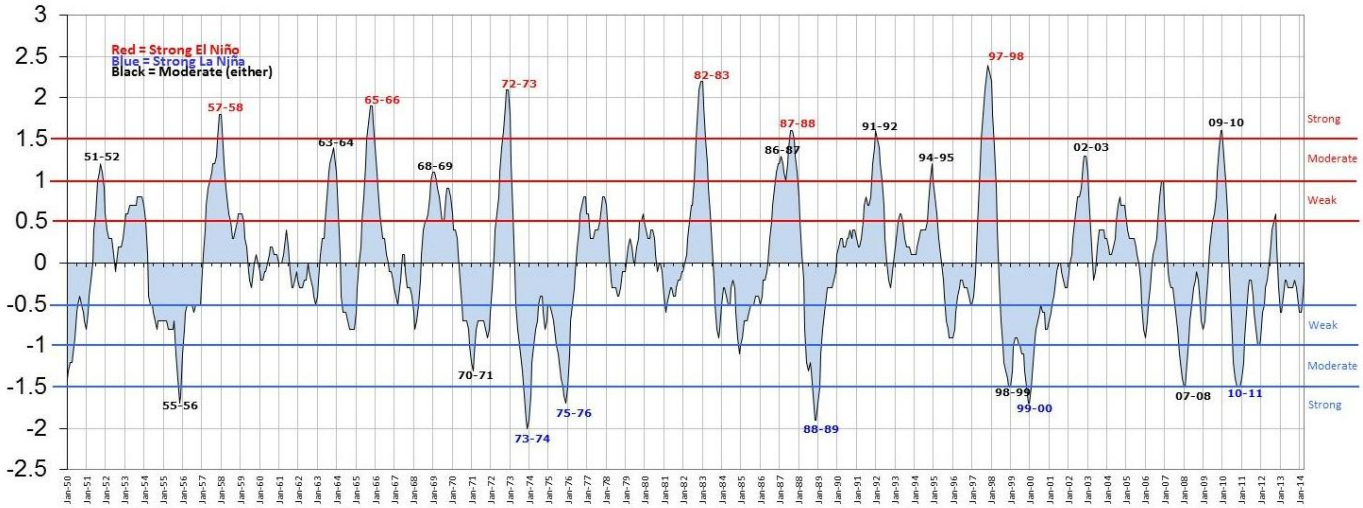

Fig.7 – The Oceanic Niño Index (ONI)

The last strong El Niño year was 1997-98 (the one in 2009-10 was only classified as "Moderate"). The table below (Fig.8) shows the mean Oceanic Niño Index in each rolling 3mth period;

	JJA	JAS	ASO	SON	OND	NDJ	DJF	JFM	FMA	MAM	AMJ	MJJ
1996/97	-0.2	-0.3	-0.3	-0.3	-0.4	-0.5	-0.5	-0.4	-0.1	0.2	**0.7**	**1.2**
1997/98	**1.5**	**1.8**	**2.1**	**2.3**	**2.4**	**2.3**	**2.2**	**1.8**	**1.4**	**0.9**	0.4	-0.2
1998/99	**-0.7**	**-1.0**	**-1.2**	**-1.3**	**-1.4**	**-1.5**	**-1.5**	**-1.3**	**-1.0**	**-0.9**	**-0.9**	**-1.0**

Fig.8 – The change in mean temperature in the Southern Pacific (red indicates El Niño and blue indicates La Niña)

You can see that the El Niño started in April/May 1997, peaked in November and was gone by May 1998.

As we noted above however, predicting an El Niño is notoriously difficult – and predicting its strength is even more so. There have been several occasions in recent years when an El Niño has started and then fizzled out. The last such occasion was in 2006-07 (see Fig.9 below) – which was classified as "Weak"

	JJA	JAS	ASO	SON	OND	NDJ	DJF	JFM	FMA	MAM	AMJ	MJJ
2006/07	0.2	0.3	**0.5**	**0.8**	**1.0**	**1.0**	**0.7**	0.3	-0.1	-0.2	-0.3	-0.3

Fig.9 – The change in mean temperature in the Southern Pacific (red indicates El Niño and blue indicates La Niña)

What are the effects of an El Niño?

The effects of a "Strong" El Niño can be devastating. As the warm water and subsequent rainfall moves East across the Pacific, Australia and South-East Asian countries become increasingly vulnerable to drought and fires – and both livestock and crop farming is adversely affected. Conversely the increased rains in Western South America can be torrential, causing flooding and landslides. Additionally the warmer waters are less rich in nutrients, which in turn leads to a significant reduction in fish. Aside from the collapse in fisheries and fishing-related industries, the whole eco-system is damaged.

Fig.10 – General overview of global climatic changes as a result of El Niño

And of course the financial cost can be tremendous. A summary of the costs of the 1982/83 event is shown in Fig.11 below (all costs in 1983 dollars). These only include the cost of reparation and not the social and human costs of the consequent increase in commodity prices;

Flooding		**Droughts/Fires**	
Bolivia	$300m	South Africa	$1,000m
Ecuador/ N.Peru	$650m	South India / Sri Lanka	$150m
Cuba	$170m	Philippines	$450m
US Gulf States	$1,270m	Indonesia	$500m
Hurricanes		Australia	$2,500m
Tahiti	$50m	S. Peru / W. Bolivia	$240m
Hawaii	$230m	Mexico / Central America	$600m

TOTAL COST = $8.11 billion

Fig.11 – Cost in US Dollars of 1982/83 El Niño

What does it mean for commodity prices?

An obvious place to assess what El Niño might mean for commodity prices is to look at the last "Strong" one in 1997/98. As you can see from Fig.8 on page 5, the event started in April/May 1997, peaked in November and was gone by May 1998. Given the potential for adverse weather, one might have thought that crops would be most affected. Fig.12 below shows the percentage returns for a variety of markets from January 1997 to December 1998;

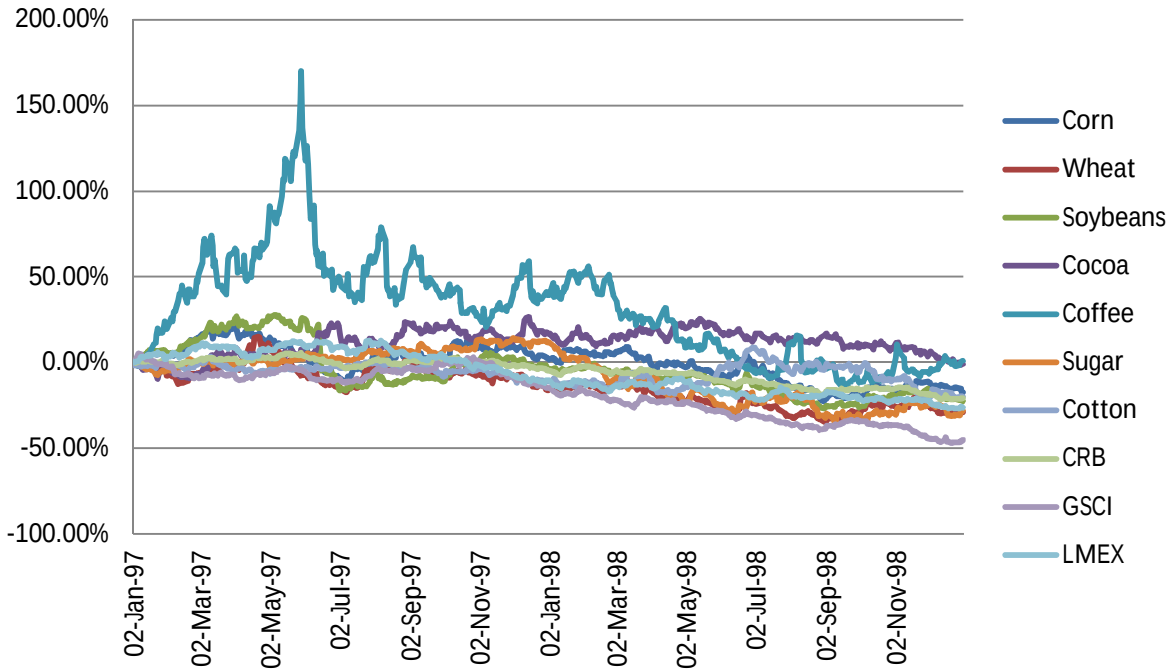

Fig.12 – Percentage change in price – re-based to January 1997

Clearly the coffee market reacted to El Niño. It spiked as the event started and then fell back to almost unchanged as the event ended. Fig.13 below shows the same graph without coffee;

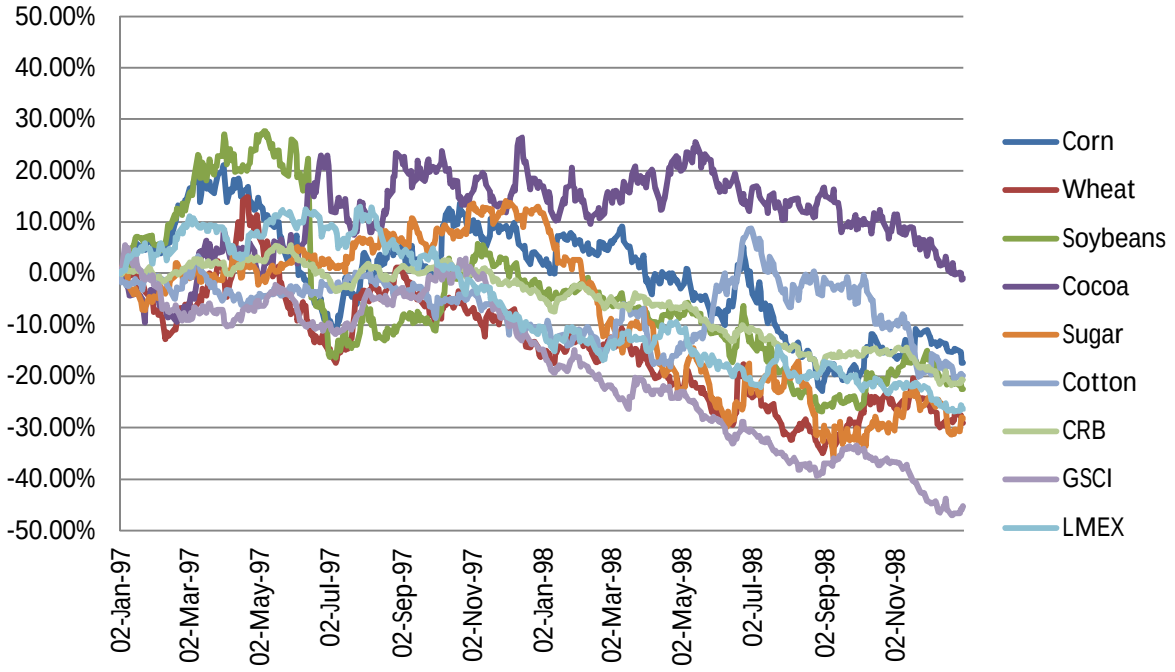

Fig.13 – Percentage change in price – re-based to January 1997

You can see more clearly from Fig.13 above that corn and soybeans both rose some 20% as El Niño hit, but prices soon fell back. Cocoa rallied a little later, but it too stalled at the 20% level and then fell back. Base metal prices (represented here by LMEX) and energy prices (represented here by the energy-heavy GSCI) both slipped away over the period.

So what has happened so far this year?

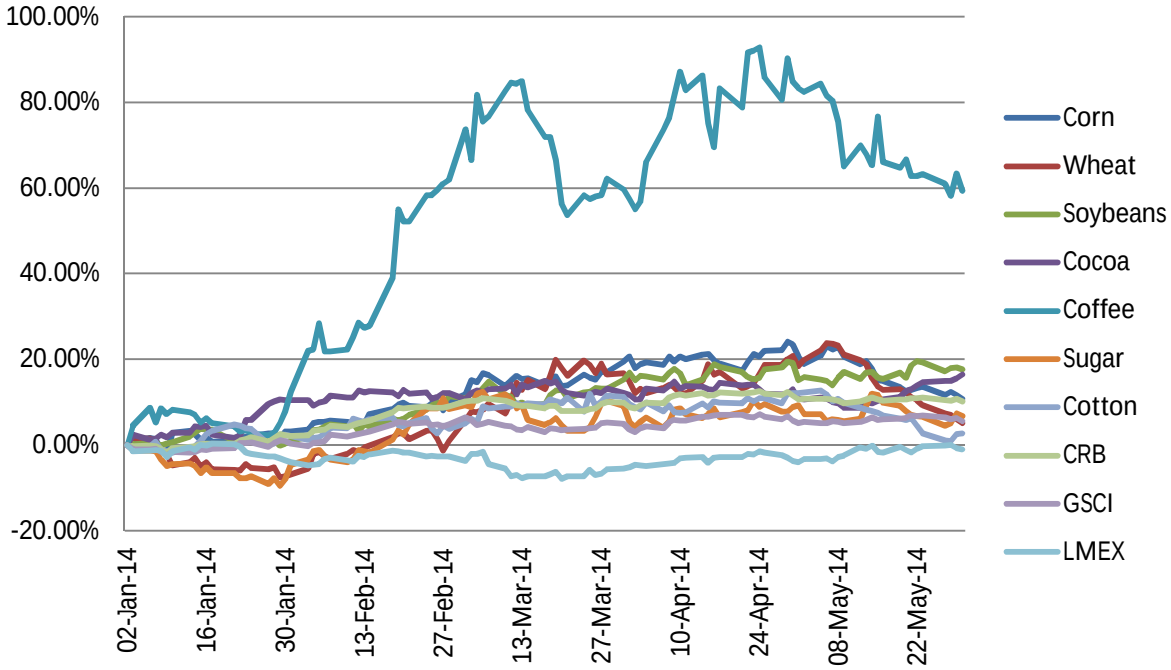

Fig.14 – Percentage change in price – re-based to January 2014

True to form, coffee has exploded albeit to not quite the same extent as in 1997. As in 1997, most crops have risen, peaking at the same 20% level before flat-lining and starting to slip back. The only real change is that LMEX and GSCI are both slightly firmer rather than slightly weaker – but this is more a result of technical and geo-political issues.

What is the likelihood of a "Strong" El Niño this year?

The World Meteorological Organisation (WMO) have updates on their website. Their latest observation, dated 15th April 2014 states;

"The tropical Pacific continues to be ENSO-neutral (neither El Niño nor La Niña). Model forecasts and expert opinion suggest that neutral conditions are likely to continue into the earlier part of the second quarter of 2014.

However, temperatures below the surface of the tropical Pacific have warmed to levels that can occur prior to the onset of an El Nino event, while climate models surveyed by WMO experts show a steady warming of the tropical Pacific during the months ahead.

A majority of models reach El Niño thresholds around the middle of the year. If an El Niño event does occur, it remains too early to determine its strength."

They go on to state that the likelihood of El Niño developing is about 65%, but they have no idea as to how strong it will be.

Summary

- El Niño events happen every few years but remain notoriously difficult to predict accurately
- They are classified as Weak, Moderate or Strong events, with Strong events potentially having catastrophic climatic impacts. These impacts are not just felt in the Eastern and Western Pacific but globally
- They are typically strongest at around November/December time
- In 2014, there is no El Niño as yet, but the likelihood of one developing is approximately 65%.
- The WMO are still unable to determine what classification it will be (if it occurs)
- In the last Strong event (1997/98) the only true market impact was in coffee, which rallied over 100%
- So far in 2014, coffee has already rallied almost 100%
- In the last Strong event (1997/98), other crop markets rallied some 20% before falling back
- So far in 2014, other crop markets have already rallied some 20%

"I've seen many tempests in my life. The majority of them took me by surprise, so that I had to learn…to exercise the art of patience, and to respect the fury of nature. ".

Paulo Coelho, 6th May 2006

Sources:
WMO (World Meteorological Organisation)
NWS (National Weather Service)
NOAA (National Oceanic and Atmosphere Administration)
NASA (National Aeronautics and Space Administration)