

The hidden cycle – where it is heading

As shown last month, evidence suggests dairy commodity prices follow a three-year cycle (*Dairy Exporter*, February, page 40), with a predicted peak in September this year.

I will explain its workings and point out expected future developments, comparing its predictability to that of the El Niño weather pattern.

Farmers around the world took up a lot of debt in the last price crest, but frustrated expectations prevented many from paying it back.

If the next crest does reach new record levels, some of them will borrow yet more as everyone tends to be overconfident when confronted with really good scenarios, but



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this would be dangerous.

Hopefully, this article will be remembered by farmers and also read by bank managers so they do not trap themselves into the illusion of a new milk price plateau again.

Sustainable and significant growth can only occur by pushing the limiting mechanisms of the system higher, not by pushing against them harder. Understand the feedback loops first and shoot for the heights later.

It is now known why we can't expect rising prices to remain high, but we also know that when they drop they won't stay low for long. Growing price volatility requires rigorous control of finances and careful investment policy.

We have recently gone through a price trough and are heading towards a new top. At the time of writing, January and February 2010 indexes were not available, but prices have suffered a small correction

downwards in this period.

Figures 3 and 4 indicate this is a short-wave effect, and as such, it's soon reverted. However, note that the four-month wave in Figure 4 has gone up quite far, so its correction could be in a similar magnitude.

Price peak

Fortunately, this correction is prone to be attenuated by the medium waves that are tracking up. These, associated with the long waves in a high mode, might evolve into another price peak.

Many uncertainties remain about the world economy at this stage, but our dissected system is telling us the forces are working to push prices



Holstein cows grazing pearl millet on Tambo Experimental, CCGL Tecnologia's dairy research unit, coordinated by Dr Wagner Beskow in Cruz Alta, Brazil.

up. Throughout the 24 years of data, peaks tended to occur every three years around September and troughs mostly around April. The last peak was September 2007, so the expectation is that another peak should occur around September 2010.

Since the last rebound was delayed by two months because of the world crisis, the peak may also take a little longer to happen. If uncertainties about the world economy are resolved in the first semester of 2010 we may witness new record prices.

If it takes longer than that, we may well miss the timing altogether, the currently unfolding crest going just a little further than its present height (Figure 2) to soon react with the down cyclic waves that should start influencing prices from late 2010 onwards.

Trend up

Because the long waves are powerful in this system (Figure 1) and they are in a high phase, the general trend remains up. However, note that they are approaching their tops which would indicate we are about to enter a down cycle in the next couple of years. That may not make sense now, but it is the trend that past events have set into motion.

Since we don't really know the longest wave's behaviour yet because of insufficient data (Figure 3), it might surprise us and continue determining a long-term up movement.

The cycle was detected in the ANZ dairy commodity price index data. It's formed by the prices of the main New Zealand dairy commodity exports, published monthly by the ANZ.

One version of the index is derived from prices in US dollars (USD) and another from the New Zealand dollar (NZD), neither of them deflated. This study uses the NZD data, but the phenomenon is present in both series.

Since physical and financial resources are limited, growth is usually associated with a mechanism that regulates the demanding pressure at some point in time, which eventually leads to a recovery in resource availability and the cycle restarts.

Other systems

This phenomenon is found in every lasting system that involves use, transformation, and accumulation of resources (ecology, biochemistry, economy, etc).

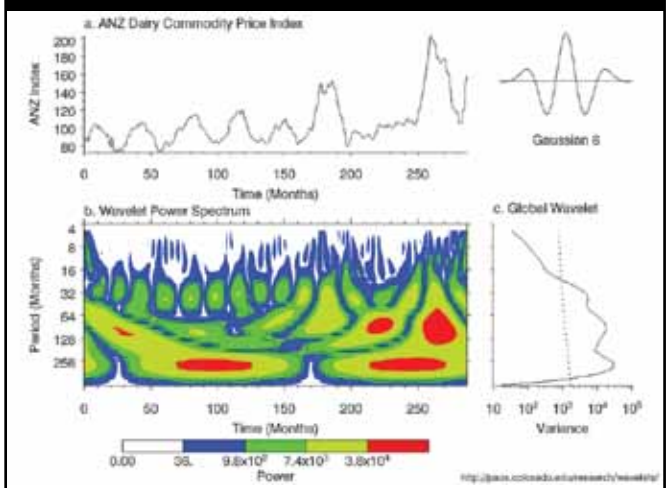
The limiting mechanism is known as negative feedback loop. When it is absent or fails to work, systems reach a point where recovery becomes impossible.

To help understand dairy commodity price changes in time (Figure 2) I used a mathematical method known as wavelet transform analysis to break down the price index into its components.

Technically, data were standardised and applied to an à trous multiscale wavelet algorithm as per the Multiresolution Analysis of Time Series by Starck and Murtagh (2001).

Calculations were performed with a MS-Excel add-in utility developed by ForeTrade Technologies for the analysis of financial-time series using the above method. I compare this process to a symphonic music

Figure 1. Wavelet transform analysis of the ANZ dairy commodity price index. (a) Signal. (b) Wavelet power contour map. (c) Statistical test (global wavelet with $p=0.10$).



Difficulty in foreseeing the future leads buyers to make decisions based on a time horizon they feel comfortable with, which rarely goes beyond a three to seven month span.

that is broken down into sounds produced by various musical instruments.

To help with interpretation, these components were combined into short, medium, and long wave groups (Figure 4), as if they were the strings, the woodwinds, and the brass or percussion. The yellow line shows the escalation of price volatility of the medium wave

group, but note that the other waves also present greater volatility in time.

Because data were standardised, wavelet values are in standard deviations of the index with the overall mean being zero (Figures 3 and 4). Increasing wavelet values contribute to price increase and vice versa. In either figure, curves contain all of the price

Figure 2. ANZ dairy commodity price index from January 1986 to December 2009. It yielded seven different waves (the "instruments").

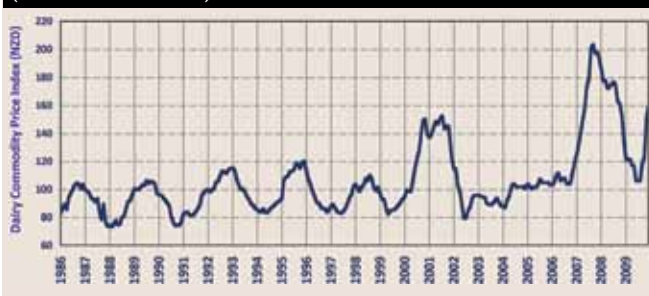


Figure 3. ANZ dairy commodity price index decomposed into seven forces through the à trous wavelet transform analysis.

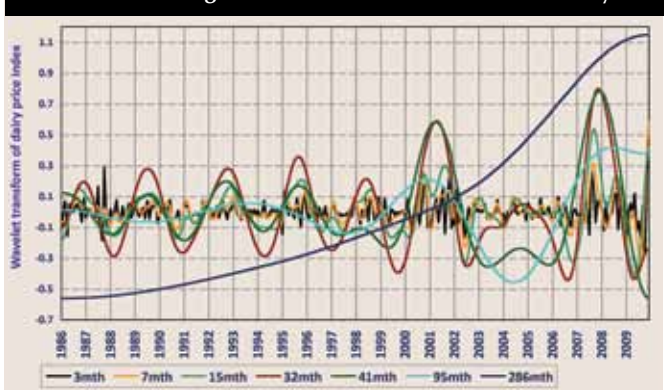
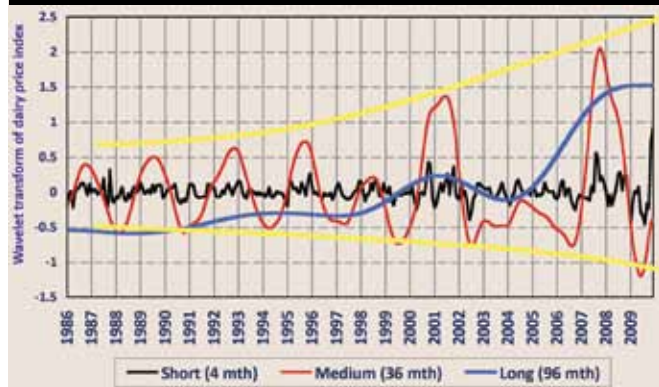


Figure 4. Main cyclic forces determining the behaviour of the ANZ dairy commodity price index obtained through the combination of the seven underlying forces into three distinct wave groups.



index information.

We now know how the component forces look and how they tend to behave in time, but what are they and where do they come from?

Firstly, their oscillating nature indicates that they are the net result of sub-systems containing negative feedback loops which have inherent limits to growth. This is good news because it's a sign that the larger system (the world dairy industry) has powerful inbuilt safety mechanisms which have been helping prevent its collapse (Figures 3 and 4).

Medium wave

The medium wave group has been exerting important effect on prices because of its greater volatility so it's natural to refer to the whole system as "the three-year cycle". However, what we actually have in hand are many cycles operating in conjunction, sometimes in tandem, sometimes in opposite directions.

Consequently, the prices we see are the net effect of all forces combined. The absence of the crest in 2004/05 is a good example. Its driving forces (32- and 41-month waves) were weaker than normal and their up phase coincided with the opposing 95-month cycle (Figure 3).

So, the effect was the short waves riding along the 286-month wave with prices oscillating on an uptrend (Figure 2, 2004/05). Similarly,

the September 2007 peak was a major event (Figure 2) because all of the waves were stronger than usual and their crests coincided in time (Figure 3 and 4).

While the data are compiled in New Zealand, it must be noted that, in a globalised economy, effects come from various geographical and political sources. With these in mind, I put forward the following as hypothetical reasons for the wave patterns:

- The short waves seem to be largely originated from seasonal variations in supply and demand for dairy products, both within and between hemispheres. Some of its variation is probably also attributable to fear and greed, the two main price driving forces. The expectation of a milk shortage or increased demand leads to strong competition among buyers and when expectations are not confirmed, prices immediately suffer corrections. This is a permanent process.

Difficulty in foreseeing the future with any certainty leads buyers to make decisions based on a time horizon they feel comfortable with, which rarely goes beyond a three to seven month span. This would also help explain the corrective jigsaw effects of the short waves.

- The medium waves are far more important in magnitude and probably more complex too. The best explanation

Figure 5. ANZ dairy commodity price indexes derived from both the USD and the NZD and corresponding exchange rates from January 1986 to December 2009.



for their overall three-year oscillation seems to be the time it takes to generate a new milking cow. Future market outlook is of paramount importance for farmers to decide whether to expand, maintain or reduce their herds. So, when the outlook is encouraging, more animals are retained and more heifers are produced (sexed semen added a new dimension to this).

From the decision to inseminate the dam to its daughter first calving, it will take 36 months, a little more or less depending on herd fertility. If the decision is to hold pregnant cows that would otherwise be sold out, the cycle is shortened. If it involves attempting to make problem cows conceive (common in continuous calving systems), the cycle is lengthened.

Herd decisions

Outlooks are widely publicised so herd-expanding decisions are made by masses of farmers worldwide. This way, an approaching shortage of milk or an inflated demand is seen as a profitable opportunity to expand but, within three years wide-scale expansion will have resulted in high input costs and too much milk in the world market, triggering an array of negative feedback loops.

Extremely low farmgate prices follow, unbearable debts, bankruptcy and so on, eventually reducing cow stocks. With lower milk production and lower costs, the cycle starts again. It is possible that this cow cycle is influenced by other

forces of similar periodicity, but I am unable to identify their sources at this time.

- The long waves are more likely related to factors beyond the dairy industry. One of them is inflation. Since inflation tends to result in a steady price rise rather than oscillations, it could be a factor behind the longest wave in Figure 3. Exchange rate, on the other hand, would be expected to cause an oscillatory pattern.

In principle, a strong USD tends to discourage dairy imports and vice versa. While this seems to hold true some of the time, the relationship may not be that simple. When the USD/NZD exchange rate is plotted against the ANZ index, this pattern is not consistent.

In mid-1980s, early 1990s, and early 2000s, the USD was strong and yet dairy commodity prices were high, as measured by both currencies, so demand was also high (Figure 5). Could these apparent anomalies be explained by larger US imports during those times? I have not checked it but suspect it was not the case.

Curiously, high dairy commodity prices tend to occur at the opposite ends of the exchange rate axis (Figure 6), ie prices are higher when the NZD is either very weak or very strong against the USD. The high coefficient of determination ($R^2 = 0.77$) would indicate that a large proportion of the ANZ index variation is, at least statistically, explained by the exchange rate (the correlation is 0.88).

High correlations do not

necessarily reveal cause-effect relationships (eg pasture growth rates and milk bacterial count present high correlation in developing countries, but the cause is temperature fluctuation affecting both variables, not pasture growth rate affecting

milk bacteria dynamics). I suspect exchange rates and commodity prices are mostly effects with similar causes and that the exchange rate has a much smaller influence on commodity price oscillations than usually believed.

Figure 6. Overall effect of USD/NZD exchange rate on the ANZ dairy commodity price index.

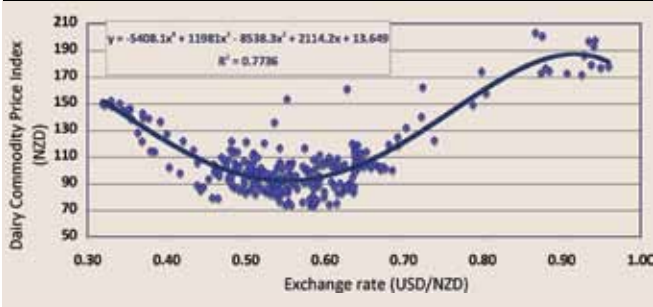


Figure 7. Example of how a perfectly predictable system (a) looks like when its wavelet transforms are plotted on a power contour map (b).

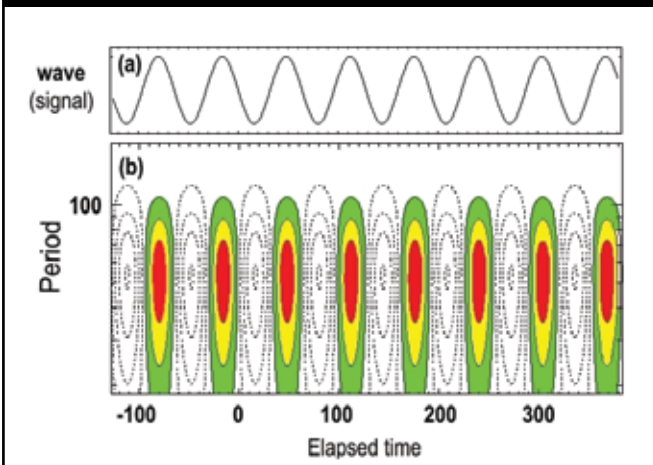
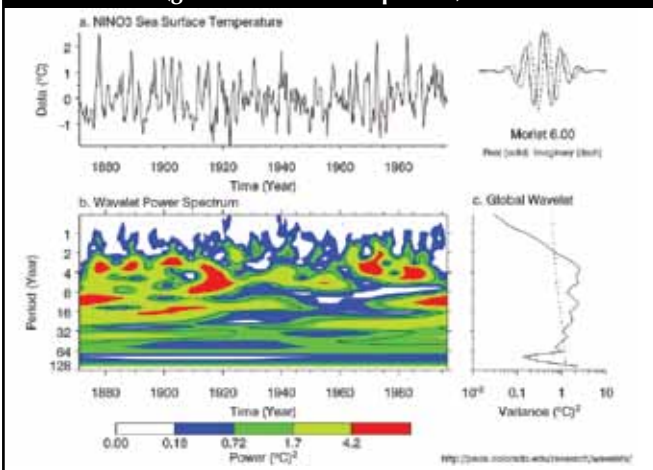


Figure 8. Wavelet transform analysis of the El Niño southern oscillation. (a) Signal. (b) Wavelet power contour map. (c) Statistical test (global wavelet with $p=0.10$).



Other forces likely to exert cyclic oscillations on dairy commodity prices are: government policies followed by contrasting policies from succeeding powers (recent stimulus packs and government interventions round the world will probably have major impacts on the system down the track) and the price oscillations of other commodities (those like oil, soybean and maize with direct influence on the dairy industry). World market expansion is probably another force behind the longest wave (Figure 3).

Predictability of the proposed system can be answered visually, by comparing the next figures (the more regular their shapes, the more predictable the phenomena). Figure 7 shows a contour map (b) illustrating the power of a perfectly predictable signal, the sine wave (a).

“noise” (noise is the blue and part of the green areas in b, outside the black line).

With the knowledge above, check the ANZ index in Figure 1. The short waves are depicted as noise (blue scale-shaped forms in b), but medium waves with periods between 32 and 40 months are regular and statistically significant and those around 96 and 286 months (red tops) are very powerful.

Contour map

The contour map pattern of the dairy price data is closer to Figure 7 than the El Niño data, especially if we look at wave groups by periods. Despite the irregular and confounding information contained in the El Niño phenomenon it is the most predictable, short-term fluctuation in the Earth’s climate system and its forecasts are becoming better by the year.

Since the dairy commodity

Sustainable and significant growth can only occur by pushing the limiting mechanisms of the system higher, not by pushing against them harder.

The map is a top view of the waves. Their crests are coloured (red being the top) and their valleys are dotted. In terms of forecasting cyclic phenomena, this example is as predictable as it gets.

Now compare that with this wavelet transform of the El Niño southern oscillation shown in Figure 8. The signal (sea temperatures) is shown in graph (a) and its power contour map in (b).

Note that it is much more irregular than Figure 7, thus far less predictable. It shows underlying waves of various periods tending to concentrate around three, five, 10, and 16 years (b), all of these being statistically significant. Graph (c) is a left side view slice of (b). The waves going beyond the dotted line means they aren’t mere random background

price system is more regular, we could build a forecasting model that is at least as powerful as the El Niño ones. El Niño prediction only became reliable when scientists understood the dynamics of associated systems. We could use this experience.

This proposed sketch of the dairy commodity price mechanism will, hopefully, be improved upon by others and help implement forecasting tools. While these are not available, predicting movements is risky.

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We can all learn from this...



Which way are milk prices headed?

Three New Zealand experts were asked their views of Dr Wagner Beskow's theory on price cycles.

Kelvin Wickham, managing director of Fonterra global trade:

Fonterra's view is that volatility in dairy prices is here to stay, although the causes at any one time will vary.

The drivers of volatility are numerous. They include changes in consumer confidence and demand, supply side responses, oil and grain prices, inventory levels in the global supply chain, weather patterns, subsidies and currency cross rates.

To help manage volatility, farmers, buyers, and sellers need transparent pricing based on supply and demand. Our globalDairyTrade electronic trading platform supplies this.

Over the longer term, the outlook for dairy prices is bright as demand for protein is increasing alongside consumer affluence in developing countries.



Kelvin Wickham.

But there will be ups and downs along the way.

Matthew Newman, DairyNZ economist:

The analysis to understand milk price cycles provides an interesting description of trends that happen in the marketplace. In practical terms, we would analyse the economic fundamentals of supply and demand in predicting short- to medium-term price movement. For example, as dairy prices rise, consumption and production responses follow to affect future price.

We certainly agree with the main conclusion of this article, which is not to fall into the trap in times of very high milk prices of believing that market fundamentals have changed and that milk prices will be sustained at a new level. At some point in the future, prices will decline in line with well-



Matthew Newman.

established market dynamics.

Keith Woodford, professor of farm management and agribusiness at Lincoln University:

The analysis by Wagner Beskow is both interesting and complex. The challenge for farmers is to identify the key "take home" messages. For me, the key message is that dairy prices have always been volatile and that the volatility has been increasing.

Many farmers have a tendency to place too much emphasis on the current price rather than recognising that prices are likely to continue jumping around.

Looking back, it is reasonably easy to explain why prices rose so high in 2008 (linked to the overall commodity boom, increased demand from oil producing countries, and with Venezuela becoming for

a short time our biggest dairy market).

The crash in late 2008 and early 2009 can also be explained in terms of the crash of those markets. The recovery in late 2009 has been considerably influenced by demand out of China for foreign dairy production and this is linked to, but not caused totally by, the melamine scandal. None of these were predictable with any confidence until they had happened, using wave theory or any other theory.

So we can expect it to be the same going forward – there will be different causes of volatility, but volatility is unlikely to go away.

For those who are risk-averse, the strategy should be to plan on low prices and then take the bonus if things go well. For those who like risk, then plan on good payouts but don't blame anyone else if it all turns sour.

My best guess is that the medium and long term future for dairy is good, but I don't expect smooth travel.



Keith Woodford.