Forecasting of New Zealand whole milk powder prices

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This paper explains a short term forecasting approach that uses whole milk powder prices from Fonterra's *global*DairyTrade. The latter provides forward contract prices eight months out from each event. The cumulative impact of up to seven successive events provides reasonable expectations around future turning points for Statistics New Zealand's FOB export prices expressed in United States dollars.

Whole milk powder, *global*DairyTrade, price forecasting

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INTRODUCTION

This paper describes the processes used by Policy Division of the Ministry of Agriculture and Forestry (MAF Policy) to forecast whole milk powder (WMP) prices over the short and medium term.

BACKGROUND

MAF Policy undertakes forecasting of a range of agricultural and forestry products for The Treasury's economic and fiscal update rounds. These forecasts, or revisions to them, are used to support other ministry activities, to meet international obligations and are published in MAF Policy's annual *Situation and Outlook for New Zealand Agricultural and Forestry* (SONZAF). The latest forecasting round was for SONZAF 2010.

There are a range of WMP product specifications, but over 99 percent of WMP exports come under one Harmonised System code (HS0402210019) with the remainder spread over five other HS codes. For the year to 31 May 2010, WMP accounted for 33 percent of total dairy export value or 8.9 percent of total merchandise export value. For monitoring and forecasting purposes, we are interested in WMP export prices expressed in United States dollars (USD).

New Zealand is the largest exporter of WMP, accounting for 35 percent of world exports and 16 percent of world consumption (OECD 2010).

WHOLE MILK POWDER PRICES

New Zealand export prices for WMP are available monthly with a lag of about four weeks. These prices are an average of export deliveries related to forward contract sales negotiated in earlier months and spot market sales during the particular month. The United States Department of Agriculture (USDA) has published international spot market prices, on a fortnightly basis, since 1993. These cover the main dairy products originating from Oceania (Australia and New Zealand) and Europe. The disadvantage of spot prices is the unknown quantities involved. The advantage of spot prices is that they are leading indicators of short term export prices.

Figure 1 shows monthly export and spot prices for WMP from January 2000 onwards (to June 2010 for export prices and August 2010 for spot prices).

Figure 1 Export and spot prices for WMP

Sources: USDA, Statistics NZ and MAF
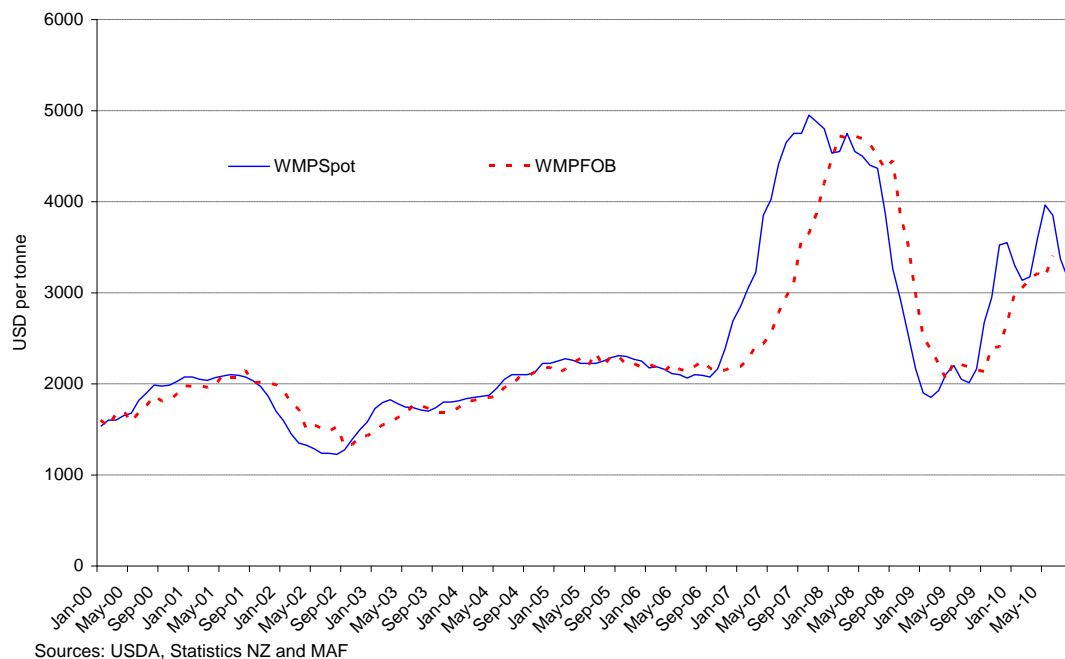
Spot sales information would be expected to have some influence on forward sales contract negotiations for delivery over the following three to six months. This is supported by Granger causality from spot prices to export prices[1].

*global*DairyTrade

Fonterra announced on 16 April 2008 the setting up of *global*DairyTrade (gDT). The first auction of WMP took place on 2 July 2008. This is an internet-based electronic trading platform run by CRA International Incorporated. It was designed to provide price and quantity transparency in a volatile environment for the benefit of both Fonterra and its customers. At the time, Fonterra considered that gDT would emerge as a global benchmark for dairy commodity prices and for dairy futures markets.

The gDT initially sold only WMP exports from New Zealand, but has subsequently added WMP from Australia in more limited quantities, added anhydrous milk fat (AMF) from 3 November 2009, skim milk powder (SMP) from 2 March 2010 and buttermilk powder (BMP) from 3 August 2010. Fonterra has offered its platform to other exporters, but none have taken it up. From September 2010 there will be two events per month, but the total monthly sales quantity remains unchanged.

Currently there are 291 qualified bidders. The event on 3 August 2010 had 127 bidders participating in the first round with 111 winning bidders after seven rounds taking one hour 28 minutes. The total offer quantities were 37,000 tonnes of WMP from New Zealand, 1000 tonnes of WMP from Australia, 6600 tonnes of AMF, 14,000 tonnes of SMP and 1300 tonnes of BMP. Fonterra forecast total supply for all products for sale on gDT for the next 12 months are 544,730 tonnes.

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[1] For a 6 period lag, the Granger causality runs from spot prices to export prices and not the other way.

For WMP there are three product categories, WMP regular, WMP instant fortified, and WMP for ultra high temperature (UHT) milk.

The bidding process involves bids for quantities desired, with the Trading Manager lifting prices round by round until the total bid volume falls to the available supply. Bidding is simultaneous on all products, product categories and contract periods. There are three contract periods. Contract period 1 is two months after the event, contract period 2 is the subsequent three month period and contract period 3 is the following three month period. Thus for the August 2010 event, the three contract periods are October 2010, November 2010 to January 2011 and February to April 2011.

Essentially, gDT provides Fonterra with a forward contract market for products over a future seven month period without any secondary market activities. The latter distinguishes gDT from a futures market such as the Chicago Mercantile Exchange. Interestingly, the New Zealand Stock Exchange's proposal for a WMP futures market will be linked to volumes sold on the gDT, thereby enhancing risk management.

Analysis of *global*DairyTrade prices
The reports on the gDT website provide the winning prices by product category and by contract period, and various aggregations. The latter include an average price outcome and product-specific indexes.

Further analysis of their data involves estimating future monthly average prices from successive gDT events. The estimated price of WMP at any month is an aggregation of the weighted average prices of up to seven previous gDT events for that month. Quantities supplied over contract period 2 and 3 are assumed to be spread equally over their three months of each period.

For any month, m, when event, e, takes place
Price = $P_{e-t,c,m-t}$
Where e-t is a past gDT event, c is contract period c = 1, 2 and 3, and t = 2, 3…8

In contract period c = 1
Quantity = $Q_{e-t,m-t}$ for t = 2

In contract periods c = 2 and 3
Quantity = $1/3*Q_{e-t,m-t}$ for t = 3, 4...8

The weighted average price for any month is then the sum of products of price times quantity divided by the sum of quantities.

Thus the forecasts for up to eight months ahead has decreasing contributions from seven past gDT events in two months time, down to one past gDT event in eight months time. This is illustrated in the Figure 2 below:

Figure 2: Illustration of gDT data analysis

Contract periods	c=1	c=2	c=2	c=2	c=3	c=3	c=3	gDT event
Month								
m								e-8
m+1								e-7
m+2								e-6
m+3								e-5
m+4								e-4
m+5								e-3
m+6								e-2
m+7								e-1
m+8								e
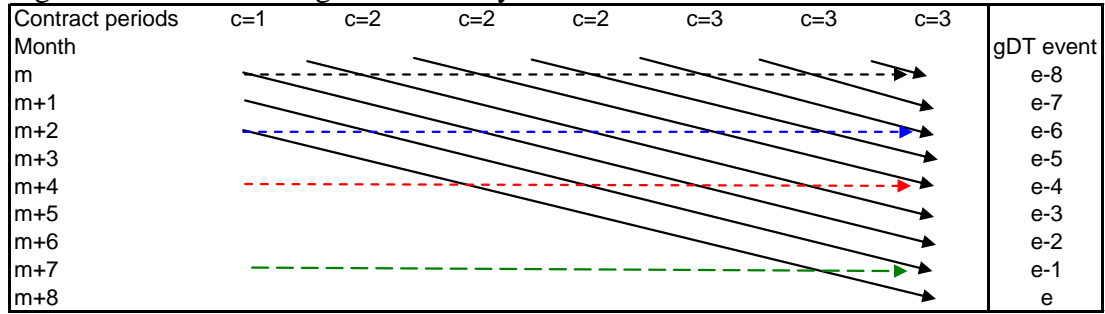
The reference point is month, m, when gDT event, e, takes place. The black diagonal lines represent the price per tonne and quantities supplied across contract periods (columns) in future months (rows) for events, e, e-1, e-2, etc. The dotted black line represents the contribution to the weighted average price for month, m, based on forward prices and quantities from seven earlier gDT events, e-2 back to e-8. The contributions:

- Quantity and price for contract period 1 from event e-2
- Quantity (one third of total) and price for contract period 2 from event e-3
- Quantity (one third of total) and price for contract period 2 from event e-4
- Quantity (one third of total) and price for contract period 2 from event e-5
- Quantity (one third of total) and price for contract period 3 from event e-6
- Quantity (one third of total) and price for contract period 3 from event e-7
- Quantity (one third of total) and price for contract period 3 from event e-8

The dotted blue, red and green lines represent contributions to weighted average forward prices in months m+2, m+4 and m+7, respectively.

Figures 3 and 4 provide the quantities and prices data from August 2010 to April 2011 deriving from the gDT events December 2009 to August 2010.

Figure 3: Quantities of WMP in tonnes supplied by month

Contract periods	c=1	c=2	c=2	c=2	c=3	c=3	c=3	gDT event	Total quantity
Aug-10	5000	3333	1667	2000	1333	1333	1333	Dec-09	16000
Sep-10	7500	2667	3333	1667	2000	1333	1333	Jan-10	19833
Oct-10	12000	6333	2667	3333	2000	2000	1333	Feb-10	29667
Nov-10		6333	6333	2667	1667	2000	2000	Mar-10	21000
Dec-10			6333	6333	2667	1667	2000	Apr-10	19000
Jan-11				6333	2667	2667	1667	May-10	13333
Feb-11					2000	2667	2667	Jun-10	7333
Mar-11						2000	2667	Jul-10	4667
Apr-11							2000	Aug-10	2000

Figure 4: Winning prices of WMP by month

Contract periods Month	c=1	c=2	c=2	c=2	c=3	c=3	c=3	gDT event	Weighted average
Aug-10	4022	3870	4061	3337	3287	3523	3716	Dec-09	3780
Sep-10	3436	3776	3870	4061	3204	3287	3523	Jan-10	3580
Oct-10	2935	3224	3776	3870	3773	3204	3287	Feb-10	3268
Nov-10		2936	3224	3776	3908	3773	3204	Mar-10	3312
Dec-10			2936	3224	3646	3908	3773	Apr-10	3305
Jan-11				2936	3100	3646	3908	May-10	3232
Feb-11					3186	3100	3646	Jun-10	3322
Mar-11						3186	3100	Jul-10	3137
Apr-11							3186	Aug-10	3186

Figure 5 shows monthly prices series for WMP exports, those estimated from gDT results, and cumulative contracted quantities from gDT events. The latest event was for 3 August 2010 with forward quantities and prices out to April 2011, and the latest trade data was for June 2010. However, as there are less quantities traded further out, the more volatile the prices become with successive gDT events. Therefore, the last three months of data are ignored for forecasting purposes.

Figure 5: Export and gDT prices for WMP and cumulative contracted quantities

Sources: Statistics NZ, *global* DairyTrade and MAF
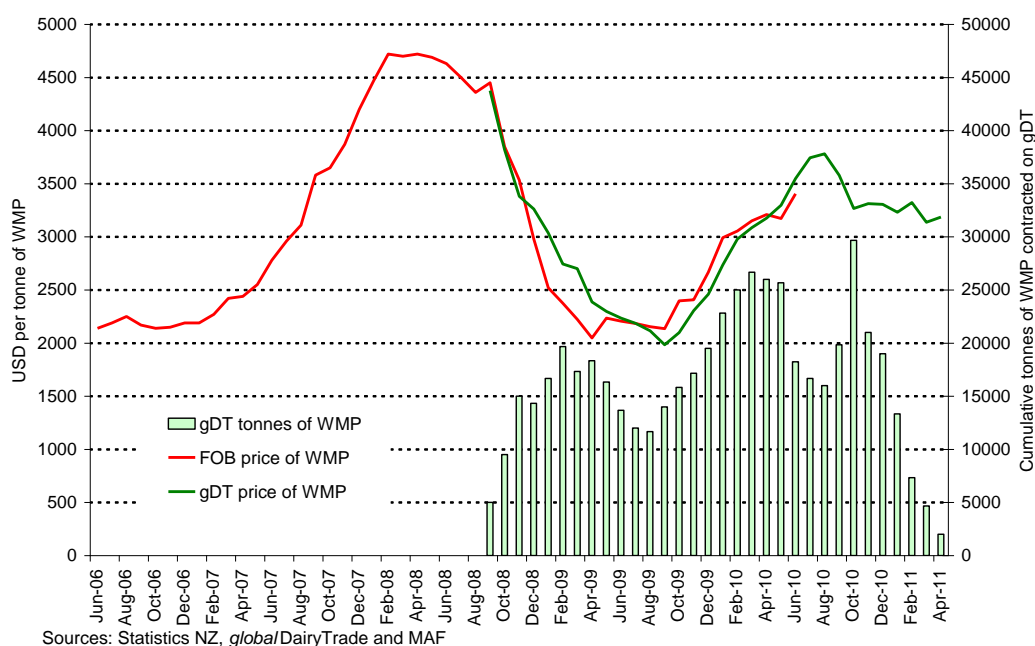
On a moving average 12 months basis, quantities of contracted sales from gDT events has been consistently 24 percent of total WMP export volume, with a slight upward movement in recent months.

The correlation between gDT prices and export prices from September 2008 to June 2010 was 0.94.

At the time of writing, one turning point has been verified by the analysis of gDT prices of WMP. This was the start of rising FOB prices in December quarter 2009 with the first indicator coming after analysing the July 2009 gDT event.

The gDT prices have been used to assist in the quantitative forecasting of quarterly export dairy prices from HYEFU 2009 onwards. A difference equation was set up to forecast monthly FOB price of WMP as follows:

$$D(WMPFOB) = f\{D(WMPgDT)\}$$

DISCUSSION

To date there have been 26 monthly gDT events since July 2008. The analysis of WMP prices established on Fonterra's gDT platform is proving useful for short term forecasting of monthly export prices. Some confidence can be placed on weighted average gDT prices up to five months from the latest gDT event as indicators of expected export prices. Or up to seven months from the latest available export statistics. The analytical approach is proving useful in identifying turning points three to four months ahead of the latest gDT event.

The quantities sold on the gDT platform are about 24 percent of average monthly total exports of WMP and therefore significant. This is an improvement on the use of lags from international spot market prices where quantities are not known.

In the latter part of 2009, Fonterra added AMF to the platform and more recently SMP and BMP. Next year there should be enough historical data to apply the forecasting method for WMP export prices to these other products. Forecasts of AMF can apply to group of products under butter and butter oil.

From September 2010, Fonterra has said that it will increase the gDT events to twice a month, but maintain the same monthly quantities of products.

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