Report Prepared for the European Dairy Association

Price Volatility in the EU Dairy Industry: Causes, Consequences and Coping Mechanisms.

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Executive Summary

A study has been completed for the EDA on price volatility in the EU dairy industry. The following primary questions were addressed

- The Range and Frequency of Price Oscillations
- Causes of Price Volatility
- What are the consequences of increased price volatility?
- What options are available at processor/farm level to deal with or reduce price volatility?
- Public policy instruments and price stability.
- Lessons from other sectors

The Range and Frequency of Price Oscillations

- Both the EU and World dairy commodity markets have experienced occasional periods of extreme price volatility over the past 20 years, combined with periods of comparative price stability
- A range of different methods were used to precisely measure price volatility ranging from non-technical to increasingly technical methods as used by economists. When applying these methods to EU and world prices over the past two decades, it is clear that world butter, SMP and cheese prices continued to display considerably greater levels of volatility than their comparable EU prices. Taking butter and SMP for example, price volatility on the world market using one method was 3.47 and 2.24 times greater respectively than for the EU over the past 20 years.
- There has been a marked increase in both the frequency and level of volatility in both EU and world prices over the last decade compared with the 1990's.
- It is clear that EU price volatility has moved much closer to that of the world market over the past decade.

Causes of Price Volatility

- The causes of extreme price volatility in dairy commodity markets are very well established in economics literature and they relate primarily to a combination of the somewhat unique characteristics of demand for food (inelastic demand) combined with unanticipated variation in supply due to weather, disease, etc., whereby even small changes in supply can cause very large changes in price.
- This has been further accentuated in an EU dairying context over the last few years by major policy change (the Luxembourg agreement) and the global recession affecting demand.
- While extreme price volatility in EU and world dairy commodity markets happens occasionally and somewhat randomly when a particular combination of causative factors arise, price volatility can also follow a more regular cyclical pattern and this is discussed in the context of US dairy markets.

- Price volatility and the stage in the supply chain is also discussed with particular emphasis on the causes of reduced price volatility at retail level relative to basic dairy commodity markets and farm milk price. It is suggested that limited price competition among very large retailers reduces price volatility at retail level relative to commodity markets.

What are the consequences of increased price volatility?

- While price variation to some degree is desirable as a means of providing price signals that reflect changing market conditions, both industrial economics principles and an industry survey concur that extreme price volatility results in a set of mostly negative consequences.
- Extremely low prices cause many financial problems and ultimately threaten solvency, while extremely high prices result in product substitution which can subsequently be difficult or impossible to reverse. Buyers prefer stability for planning and customer relationship purposes and hence, if alternatives are available, will prefer to conduct business with more price stable sectors. Extreme volatility can also inhibit innovation and R and D.
- The industry survey provided detailed information on the effect of price volatility on buyer and supplier relationships, including in particular larger retailers, ingredients buyers and farm milk suppliers.
- It was generally accepted by respondents that, following the major policy changes of recent years, increased price volatility in the EU dairy sector in the future is inevitable compared with past decades.
- A number of risk management mechanisms were suggested, including the importance of providing more objective, timely and transparent price indices within the EU to assist in contract agreements, the development of futures markets for dairy commodities, the restructuring of product portfolios, increased merger activity to provide greater product and market diversification, more transparent and direct linkages between product prices and farm milk prices and specific policy responses with regard to both modification of current policies and new policy mechanisms.

What options are available at processor/farm level to deal with or reduce price volatility?

- There are a broad range of instruments, both public and private market, which may be utilized to manage price/income volatility. This suite of instruments includes over the counter (OTC) contracts, forward contracting, futures contracts and insurance contracts. All have potential benefits but also some limitations as discussed.
- While not necessarily reducing price volatility in general futures contracts in particular offer considerable risk management benefits but will require considerable support from both the EU private and public sectors in the initial launch stages to ensure success.

- The evolution of both private and public sector risk management instruments in the US dairy sector as summarised provide some useful pointers for EU dairying.
- All of the private market instruments require high quality, timely, objective and transparent market information which needs to be easily sourced and freely available. There would appear to be a particular role for the European Commission in this regard. The range and quality of free data dissemination provided by the USDA and US extension colleges provides a useful template.
- The development of any or all of these instruments will require proper regulation and oversight which again suggests a central role for the European Commission. An agency somewhat similar in nature to the USDA Risk Management Agency may be appropriate.
- It is desirable in the interim that some public policy instruments such as counter cyclical measures are maintained in order to moderate the effects of high price volatility. However it should be acknowledged that such measures should not inhibit the development of private instruments as may have happened to some extent in the US.

Public policy instruments and price stability

- Price stability in EU dairy markets was a key feature of policy prior to the Luxembourg Agreement, however the reduction of price support to the much lower "safety net" level has left EU internal markets much more exposed to price volatility as recently experienced.
- The recent announcement by the US Agriculture Secretary of the establishment of a high level Dairy Industry Advisory Committee to seek "to avoid the boom and bust cycle" and help build "a more stable market for dairy producers for years to come" indicates that the US government is actively looking for policies to address price volatility.
- The recent announcement by the EU Commission that they propose to establish a working group of experts from the Member States which will look, among other things, at contractual relations between farmers and the dairy industry, the results of the report into the workings of the food chain in the dairy sector and the possibility of a dairy futures market is a welcome development.
- The effect of some specific policies on price stability were analysed in detail, including milk quota policy, policy towards product inventories and import tariff policies. For example it was shown that an inflexible milk quotas policy accentuated price volatility.
- The recent accumulation of public stocks has meant that the European Commission now has a de facto policy instrument, the management of which can have significant consequences for price volatility. Options with regard to its management, including in particular the adoption of a buffer stocks policy approach, were analysed in detail. If extreme price volatility is to be avoided, an enlightened strategy with regard to inventories can make a valuable contribution. For example the holding of longer term buffer stocks so as to alleviate occasional extreme price volatility may make a valuable contribution in certain circumstances.

- The advantages of a specific tariffs policy compared with an ad valorem tariffs policy as a means of maintaining greater price stability in the internal EU market were demonstrated.

Lessons from other sectors

- While the dairy sector has many unique characteristics, price volatility for dairy commodities is shown to be fairly similar to that of a number of other food commodities.
- Where free market conditions have existed for some other commodities, successful futures markets have evolved over time. As the EU dairy sector is now emerging into a more free market situation, it is likely with appropriate support that a successful futures market can evolve for dairying also with considerable benefits for industry participants from a risk management viewpoint.

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1 Introduction

Price variation to some degree is both desirable and inevitable in all free markets as it reflects the changing needs and preferences of customers and the changing cost and competitive positions of participants at all stages in the supply chain. Price movements reflecting these changes occur through the price discovery process among market participants and these price movements act as price signals to reallocate resources efficiently. While this element of changing prices may be regarded as normal and desirable in free markets, the emergence of exceptional price volatility in dairy and food markets in recent years is creating many problems for processors, farmers and other supply chain participants as discussed in detail later.

Thus the consequences and management of price volatility is now a central issue for both the dairy industry itself and public policy. This has been recognised in the US in particular where this issue was central to the July 2009 hearings of the House of Representatives House Committee on Agriculture Subcommittee on Livestock, Dairy, and Poultry. The decision of the US secretary of agriculture in August 2009 to establish a high level Dairy Industry Advisory Committee where farm milk price volatility and dairy farmer profitability are to be central issues is further evidence of a desire to address the problem associated with price volatility.

In this research the following primary questions and issues relating to price volatility in the EU dairy industry are being addressed.

- The Range and Frequency of Price Oscillations
- Causes of Price Volatility
- What are the consequences of increased price volatility?
- What options are available at processor/farm level to deal with or reduce price volatility?
- Public policy instruments and price stability.
- Lessons from other sectors

While the report is mainly written in non-technical form, some relevant technical material is outlined briefly in the appendices and technical boxes.

2 The Range and Frequency of Price Oscillations

2.1 Introduction

Butter and SMP prices represent basic commodity prices for all milk solids (fat, protein, lactose and other) and the volatility present in these prices should be indicative of the price volatility present in dairy commodities in general. For the following analysis the USDA North European FOB skim milk powder (SMP) and butter prices are taken as representative world prices, while the comparable EU prices used are Dutch price series sourced from Agra Europe[1]. A comparable analysis for EU and world cheese prices is presented in Appendix 1. Figure 1 shows the comparable monthly world and EU SMP prices from January 1990 to February 2009. The comparable butter series are presented Figure 2. In both charts there is clear evidence of large price increases and declines over short periods of time (e.g. from February 2007 to May 2007 world SMP prices increased by over 60% while EU SMP prices recorded a gain of over 45%). While the greater volatility of the world series is visibly evident on close examination of Figures 1 and 2, the precise methods of expression of this volatility present challenges for analysts.

Figure 1 World and EU Wholesale SMP Prices

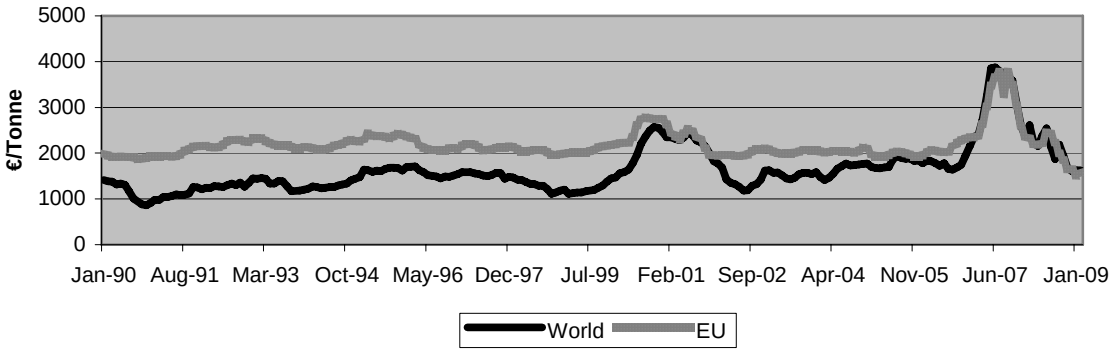
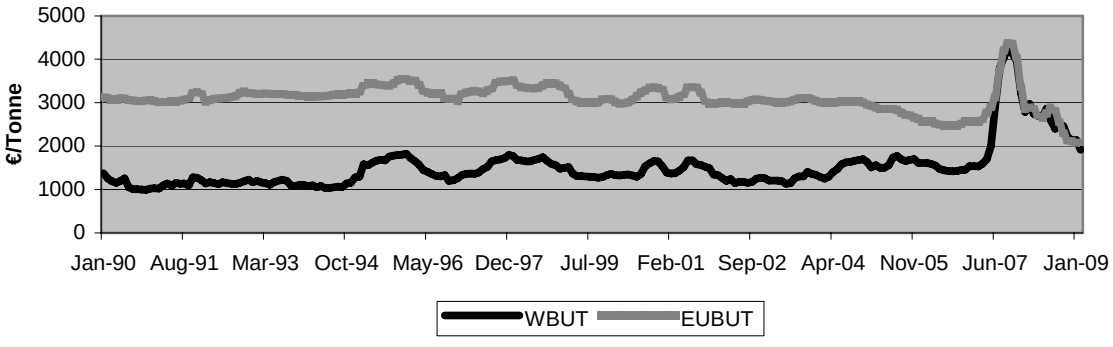


Figure 2: World and EU Wholesale Butter Prices



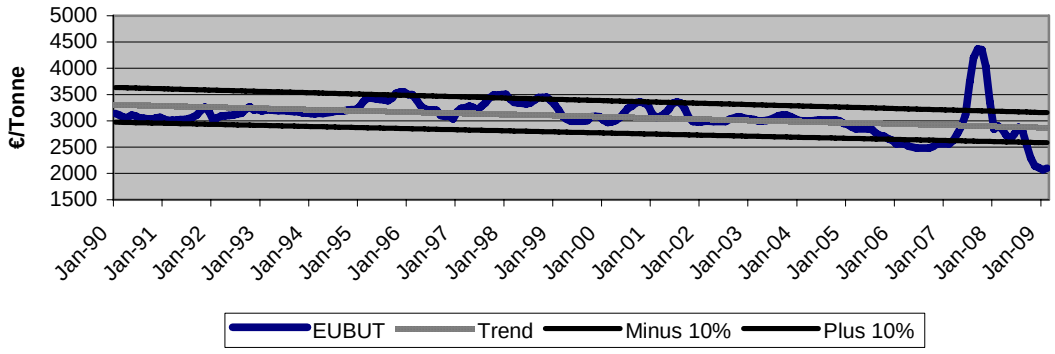
[1] The USDA publishes a monthly high and low quotation and the series considered in this analysis is the mid interval of these quotations.

The authors have developed a particular approach to precise measurement of price volatility which involves presentation in both non technical and technical forms as discussed.

2.2 Non technical analysis

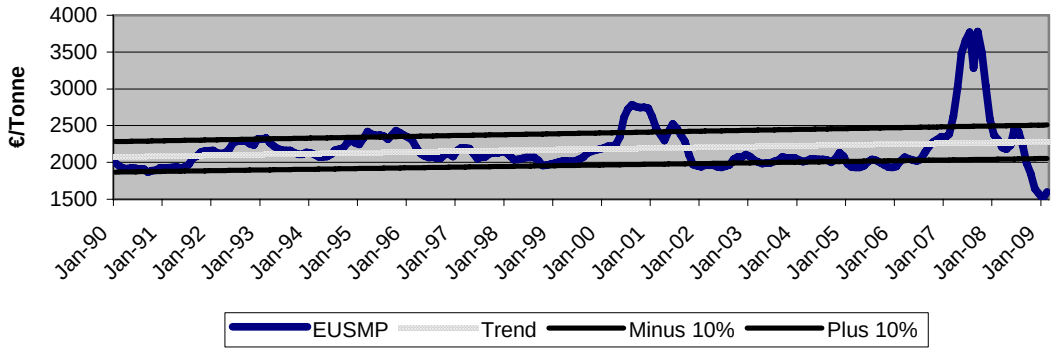
For the purpose of this analysis price volatility may be defined as substantial variation in price from the long term trend. In Figure 3 the EU butter series along with its long term trend is presented. The downward trend reflects the movement towards the lower level of intervention price over time. In order to capture the volatility of the series two further lines are added. The first is the long term trend value plus 10% while the second shows the long term trend value minus 10%.[2] For the purpose of this analysis any value which falls outside these 10% bands is considered a volatile observation. Taking this metric of volatility, it is clear that there were few instances of volatility in the EU butter price series prior to 2006, while from that period to the present there were relatively many and large price fluctuations outside the plus/minus10% trend price band.

Figure 3: EU Butter, Trend and 10% Bands



In the case of EU SMP prices (Figure 4) there is a slight positive longer term trend and, with the exception of the period around 2000/2001 and post 2006, there were few instances of volatility.

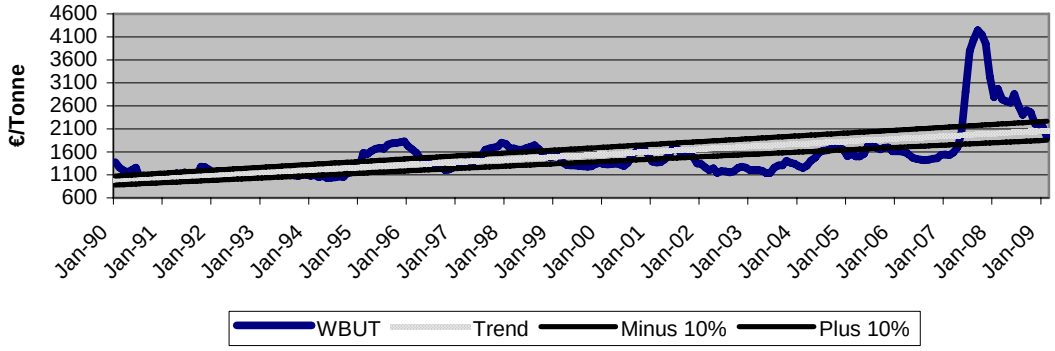
Figure 4: EU SMP, Trend and 10% Bands



[2] It may be noted that the target price for milk under the "old" CAP was approximately 10% higher than the intervention milk price equivalent.

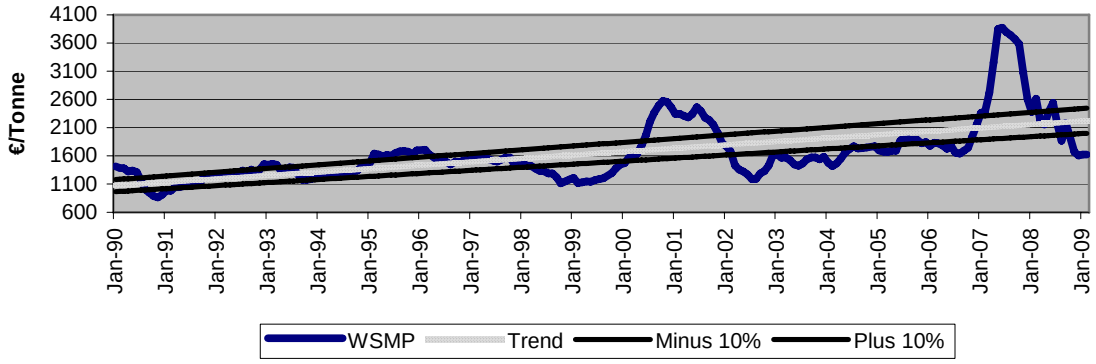
For world butter prices the longer term trend is gradually rising. As regards volatility, prices were outside the 10% band for a number of periods between 1995 and 2005 along with the exceptional volatility of the last two years (Fig 5).

Figure 5: World Butter, Trend and 10% Bands



An examination of Figure 6 shows that for world SMP prices a clear upward trend is evident, along with a substantially greater number of volatile observations. In addition the duration of these periods of volatility appear longer than for the EU.

Figure 6: World SMP, Trend and 10% Bands



A summary of the frequency of volatile observations as defined above for each series is presented in Table 1. This shows that over the period January 1990 to February 2009 volatile prices were observed less than 18% of the time for EU butter and less than 30% for EU SMP, whereas on world markets this value exceeded 60% in both cases. Furthermore when the analysis is split into two periods, pre and post the year 2000, the far greater volatility in the latter period is striking. In the post 2000 period 50% of the EU SMP values fall outside the 10% range while 80% of the corresponding world price series may be considered volatile. Overall, based on this simple metric of volatility, it is very clear that world prices for both SMP and butter have been much more volatile than for the EU and that all prices post 2000 have been much more volatile than for the previous decade. Conclusions with regard to cheese, which show broadly similar results**,** are shown in Appendix 1.

Table 1: Frequency of Volatile Observations.

	World		EU	
	SMP	BUTTER	SMP	BUTTER
Jan 1990- Feb 2009				
Within 10% range	39.11	39.56	70.31	82.60
% Above trend + 10%	25.21	23.48	13.91	8.26
% Below trend - 10%	35.65	39.96	14.78	9.13
Jan 1990- Dec 1999				
Within 10% range	56.67	53.34	90.83	90.00
% Above trend + 10%	20.83	30.83	8.33	10.00
% Below trend - 10%	22.50	15.83	0.83	0.00
Jan 2000- Feb 2009				
Within 10% range	20.00	24.55	50.00	74.55
% Above trend + 10%	30.00	15.45	20.00	6.36
% Below trend - 10%	50.00	60.00	30.00	19.09

2.3 Technical analysis.

The analysis in this study focuses on monthly price data and while these data reflect trends in the market place they also in, many cases, hide the greater volatility associated with daily or weekly data. This averaging effect cannot be avoided as comparable higher frequency data were not available so it is important to note that the level of volatility may be understated in this report.

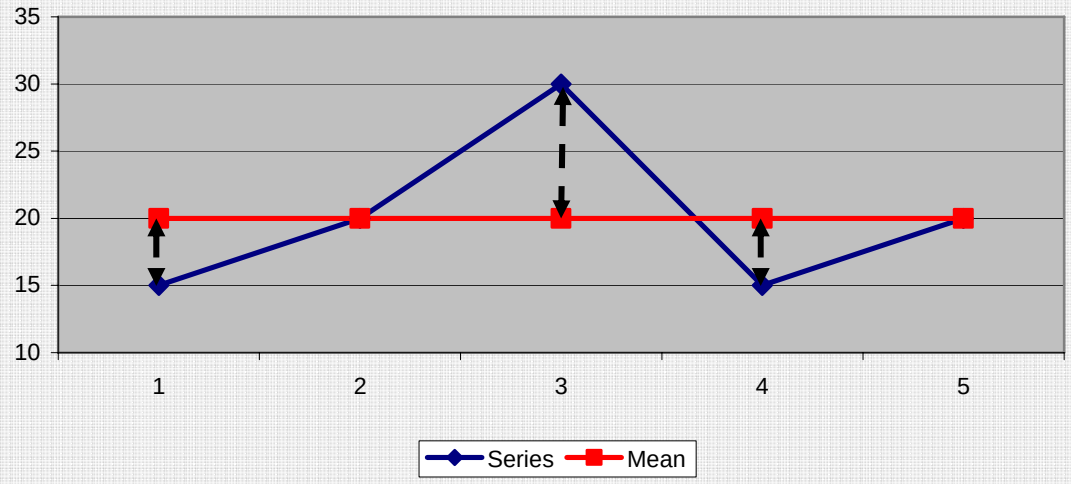
Acknowledging this caveat it is common practice in statistical analysis to use the standard deviation (SD) and coefficient of variation (CV) as measures of volatility. A brief intuitive description of the calculation and interpretation of SD and CV is presented in Technical Box 1.

The mean, standard deviation and coefficient of variation of each of the series described above are presented in Table 2. Again the data are also presented for the sub periods pre and post 2000. While the world prices series display greater standard deviations, caution is required as each of the series have different mean values and thus the CV is the more appropriate metric (see technical box 1). The much larger coefficients of variation reported for the world price series clearly show the greater volatility associated with these series. For butter and SMP, the world market CV's were 3.47 and 2.24 times greater than for the EU during the period 1990 to 2008, meaning that direct exposure to the world market could lead to between twice and four times greater price oscillations in the future. Comparing world market price volatility for butter and SMP for the periods 1990 - 1999 and 2000 - 2008, it was found that the CV's had approximately doubled for the world prices, demonstrating that the world market itself has become much more volatile over the last decade. Furthermore it has been estimated that the CV's for EU butter and SMP prices for the period 2000 to 2008 were up to three times greater than for the period 1990 to 1999, meaning that EU exposure to price oscillations has already moved considerably

Technical Box 1: Standard Deviation and Coefficient of Variation

The standard deviation is the square root of the variance which captures the squared distance of each of the individual observations from the mean. Take a simple example where we have five values (15, 20, 30, 15 and 20). These values sum to 100 giving a mean (simple average) value of 20. To measure the variability we calculate the variance as the squared distance of each value from the mean (i.e. $(15\text{-}20)^2$, $(20\text{-}20)^2$, $(30\text{-}20)^2$, $(15\text{-}20)^2$ and $(20\text{-}20)^2$). When solved this provides the following values (25, 0, 100, 25 and 0). The sum of the values (150) is then divided by the number of observation[1] (5) and this value (30) is referred to as the variance while the square root of the 30 (i.e. 5.477) is referred to as the standard deviation. This process is presented graphically in Figure A. In this case the length of the three dashed lines is squared (equal to 150) and the calculations completed as above.

Figure A: Standard Deviation Explained



The standard deviation is calculated as the deviation from a given mean so datasets which have different mean values are not directly comparable. In such circumstances it is common to compare the coefficient of variation (CV) for the series. This is a scaled measure which expresses the standard deviation as a percentage of the mean and may be represented as follows,

$$CV = \frac{s}{\bar{x}} * 100$$

where s is the standard deviation and $\bar{x}$ is the mean.

closer to world market levels, reflecting the major EU policy changes for dairying associated with the Luxembourg agreement in particular.

Table 2: A comparison of World and EU dairy prices 1990-2008

	World		EU	
Jan 1990- Feb 2009	SMP	BUTTER	SMP	BUTTER
Mean	1646.25	1518.13	2177.99	3087.86
Standard Deviation	534.01	538.29	315.46	314.81
Coefficient of Variation	32.44	35.46	14.48	10.19
Jan 1990- Dec 1999	SMP	BUTTER	SMP	BUTTER
Mean	1341.74	1324.34	2123.68	3211.78
Standard Deviation	196.06	241.29	136.46	151.47
Coefficient of Variation	14.61	18.22	6.43	4.72
Jan 2000- Feb 2009	SMP	BUTTER	SMP	BUTTER
Mean	1978.44	1729.53	2237.24	2952.68
Standard Deviation	586.27	677.30	426.57	384.46
Coefficient of Variation	29.63	39.16	19.07	13.02

A limitation of this approach is that it assumes the variance of the price series is constant over time. Observation of the graphs presented earlier shows that the world prices series in particular display periods of high volatility followed by periods of lower volatility, while the price movements in all the series from late 2006 are greater than in the more distant past. In order to capture these dynamics economic analysts engage in more detailed and complex analysis. A very brief summary of these methods is now provided.

2.4 Advanced technical analysis.

In the literature an important distinction is made between historic and implied volatility. Historic volatility is based on past price movements and reflects the resolution of supply and demand factors. A number of approaches have been utilized by economists to model the time-varying pattern of agricultural commodity prices including price volatility. Of these, the moving average (MA) model, autoregressive (AR) model or the more general autoregressive integrated moving average (ARIMA) model have usually been fitted to identify the structure of a time series. Recently more complete but complex price models have been developed with models such as the autoregressive conditional heteroskedasticity (ARCH) model and generalized ARCH (GARCH) models receiving the most attention. ARCH models allow the shocks in more recent periods to affect the current volatility positively while the GARCH models, which generalize the ARCH model, postulate that not only previous shocks but also previous volatilities affect current volatility. The authors have developed a technical paper using these methods to measure the volatility of the EU and world butter and SMP price series which was presented at a European Association of Agricultural Economics conference in September 2009. In summary the results show that the EU achieved its aim of providing stable prices up to the Luxembourg agreement. The high levels of volatility experienced in both world and

European prices in recent years is exceptional in the long term historical context. If one accepts increased transmission of price volatility from world to EU prices then there is a need to consider the development of new tools to manage this increased volatility. A more complete summary is provided in Appendix 2.

Other authors (e.g. FAO and European Commission) have used the annualized standard deviation[3] of the change in price to compute historic volatility.

Implied volatility represents the market's expectation of how much the price of a commodity is likely to move in the future. Intuitively this is appealing as the conditions and data upon which historical volatility is calculated may no longer be reflective of the prevailing or expected conditions. For this reason, implied volatility tends to be more responsive to current market conditions. However this type of volatility cannot be observed and can only be inferred from the prices of derivative contracts such as "options" through the use of sophisticated models e.g. the Black-Scholes option pricing model[4]. The absence of any such contract in the EU means that no estimates of implied volatility can be provided.

2.5 Summary and Conclusions

Both the EU and World dairy commodity markets have experienced occasional periods of extreme price volatility over the past 20 years, combined with periods of comparative price stability. Different methods may be used to measure price volatility ranging from non-technical to increasingly technical methods as used by economists. When applying these methods to EU and world prices over the past two decades, it is clear that world butter, SMP and cheese prices continued to display considerably greater levels of volatility than their comparable EU prices. Taking butter and SMP for example, price volatility on the world market using one method was 3.47 and 2.24 times greater respectively than for the EU over the past 20 years. There has been a marked increase in both the frequency and level of volatility in both EU and world prices over the last decade compared with the 1990's. It is clear that EU price volatility has moved much closer to that of the world market over the past decade.

[3] The annualized standard deviation is the standard deviation multiplied by the square root of the number of periods in one year. $AnnStdDev(r_1, ..., r_n) = StdDev(r_1, ..., r_n) * \sqrt{NumPeriodsPerYear}$ where $r_1, ..., r_n$ is a return series, i.e., a sequence of returns for n time periods.

[4] See "Corporate finance: theory & practice" By Stephen Lumby, and Chris Jones Thompson Learning; 7th Revised edition (May 2003) ISBN-10: 1861529260

3 Causes of Price Volatility

3.1 Introduction

In the absence of Government intervention, markets for basic dairy (and food) commodities tend to be extremely volatile due to fundamental underlying economic forces. With a given income level, food consumers in developed countries are not very interested in buying additional food in general beyond the point of "being satisfied" or satiety, even if prices were to fall substantially. (This would of course vary for individual foods depending on substitutability). By extension from food consumer behaviour, buyers of basic food commodities back along the supply chain tend to be weak buyers of any additional volume above the "normal" or expected quantity, thus precipitating substantial price falls if any extra volume materialises from producers. In contrast, if quantities were to be a little scarce relative to "normal" or expected levels, final food consumers and by extension basic food commodity buyers will be prepared to compete and bid quite high prices, as consumers will forego other "non-essential" purchases but will seek to retain virtually unchanged purchasing patterns for food in general. (Again this may vary for individual foods depending on substitutability). With regard to supply of food commodities, weather (drought versus good growing conditions), disease, changes in policy etc. can cause unanticipated changes in the quantity of farm produce produced. Given the somewhat unique characteristics of food buyers as described above, even small changes in production creating modest surplus amounts coming available will have few interested buyers and, in the absence of Government intervention, prices will have to drop substantially to clear the market. By the same token, if unfavourable weather, disease etc, cause even modest scarcity, food commodity buyers will be prepared to bid quite high prices knowing that the ultimate food consumers will, if required, be prepared to pay substantially more to ensure normal food consumption levels. Thus substantial price volatility can be expected to be a major characteristic of food commodity markets due to some fundamental aspects of buyer behaviour combined with production uncertainty.

All of the above food market characteristics apply with given income levels. As incomes vary in accordance with the business cycle, buyers purchasing power is affected either positively or negatively for all goods including food, however changes in income have much less consequences for food markets than for many other more discretionary goods such as for example automobiles.

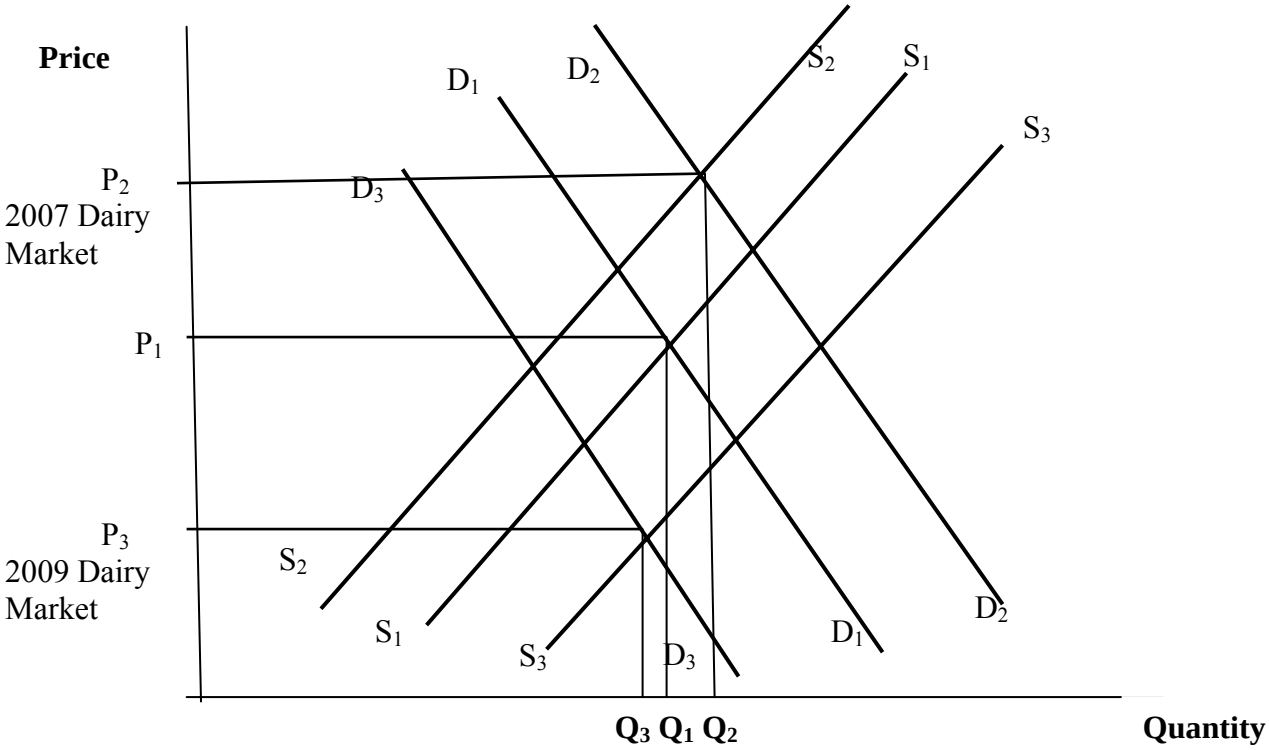
Technical Economics Explanation: The somewhat unique characteristics of food markets outlined above are described by economists in term of supply and demand. Essentially demand for basic food commodities, especially at processor and farm levels, is extremely price inelastic. When combined with modest changes in supply due to weather, disease etc. or, due to inappropriate policy intervention disturbing anticipated supply, major price volatility can result. This volatility can become quite extreme when stocks shrink to very low levels. Changes in world demand for dairy products due to changed world economic growth or consumer health scares can further accentuate these price cycles.

Economists represent these food market characteristics in simple supply-demand diagrams and, using these methods, the extreme volatility of basic dairy commodity markets over the past two years is captured in Figure 7.

The "normal" demand for dairy commodities is represented by D1 D1 and normal supply by S1 S1. The relationship between demand D1 D1 and quantity shows that the quantity purchased will not change very much even if prices go much higher or much lower (inelastic demand). The anticipated "normal" or equilibrium price is shown as P1 which is the unique price at which the quantity produced exactly matches the quantity that the buyers are willing to purchase at that price. If anticipated production is affected by even a small amount, such as for example by drought in a leading producing country, the new supply is shown by S2 S2, and if at the same time demand strengthens due to exceptional economic growth represented by D2 D2, then price may rise very substantially from P1 to P2. This major price increase occurs even with a very small change in quantity traded from Q1 to Q2. This is a simple economists explanation of the very large price increase for dairy commodities in later 2007 and early 2008. If on the other hand more favourable conditions lead to increased milk supply represented by S3 S3, and furthermore if at the same time a severe economic recession with major income decline affecting demand for all goods occurs, represented by D3 D3, then prices for dairy commodities may be expected to fall very substantially to P3 to clear the market. Again this major price reduction occurs even with a very small change in quantity traded from Q1 to Q3. This is a simple representation of dairy commodity markets in 2009, with price P3 (2009) being perhaps half that of P2 (2007).

The above is an extremely basic explanation of much more complex market dynamics as many important factors are ignored, such as the impact of changes in levels of stocks, the differential effect of changes in supply and demand at different points along the supply chain from farm to retail and the effect of changes in government policy, all of which are discussed later. Nevertheless it is hoped that the brief outline captures the fundamentals of basic dairy (and food) commodity markets and essentially proves that dairy product markets are inherently volatile in a market economy in the absence of government intervention.

Figure 7: Illustration of Price Volatility and Supply-Demand[5]



3.2 Price Volatility and Dairy Markets

Specialised teams of economists (econometricians) have developed sophisticated models to explain dairy and food market changes and such models typically involve hundreds of variables[6]. However the focus of these models is normally on long term market developments rather than price volatility. In practice much of price volatility such as on world dairy markets can be adequately explained by focussing on a small number of key supply and demand variables. As discussed in section 2 the world dairy market is characterised by periods of comparative stability which are punctuated by briefer periods of extreme price volatility. Since 1990 there have been two periods of extreme price volatility, 2007-2009 and 2000-2002, with each characterised by a sharp rise in world price followed by a sharp fall as illustrated by the world price for SMP (Fig 8). Given that small shifts in demand or supply can cause very large changes in price as outlined earlier, just two key variables, changes in world demand and changes in milk production in Oceania, can help to explain much of this price volatility. Changes in world demand can be simply captured by changes in the world economic growth rate which we have sourced

[5] All economic illustrations in this report are based on the simplified assumptions of partial equilibrium, single market models

[6] Such models include OECD/FAO; FAPRI; USDA as recently reviewed by the European Commission in "AGRICULTURAL COMMODITY MARKETS OUTLOOK 2009-2018 : A Comparative Analysis of Projections" (2009) Brussels.

from the International Monetary Fund (IMF). Changes in milk output in Oceania is used to represent supply change on the world market as Oceania is the largest supplier of dairy products to the world market and, being weather dependant, production can fluctuate significantly. (Of the other major world market suppliers, EU output has been mostly constant over the period due to quotas while the US has largely operated as a self-contained market). Taking the specific periods of extreme price volatility, the 2007-2009 period was characterised by very strong growth in world demand up to 2007 (Fig 9) combined with firstly comparatively modest growth in milk output in Oceania pre-2007 and then a significant output decline in 2007/08. Hence a major price surge occurred on world dairy markets in 2007/08 (first half of 2008) generating some negative consequences for the dairy industry such as uncompetitiveness resulting in product substitution**.** (Exhaustion of stocks was another strong driver of the price surge). This has then been followed by the major price fall of 2008/09 which resulted from the major fall in demand due to the most severe world economic recession of the modern era (Fig 9) combined with a return to strong milk output growth in Oceania (Fig 10). Taking the 2000-2002 period, the world economy grew strongly in 2001 but then suffered a major fall in 2001/02 (Fig 9) which corresponded with the price surge and decline in world dairy markets (Fig 9). There was also an exceptional decline in milk output in Oceania followed by a resumption of growth during this period (Fig 10). While many other variables also play a part (e.g changes in stocks), these two variables, changes in world demand and changes in supply in Oceania, are key drivers of price volatility in world dairy markets. The increased variation in both of these key market drivers in the present decade, as well as the Luxembourg agreement in 2003, provides much of the explanation of the increased price volatility in the EU in the present decade compared with the 1990's as outlined in section 2.

Figure 8: World Wholesale SMP Prices

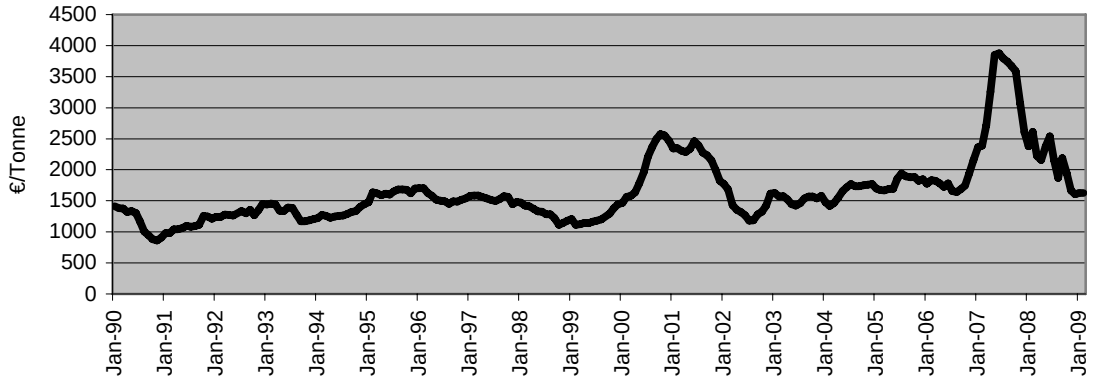


Figure 9: Global GDP Growth, %

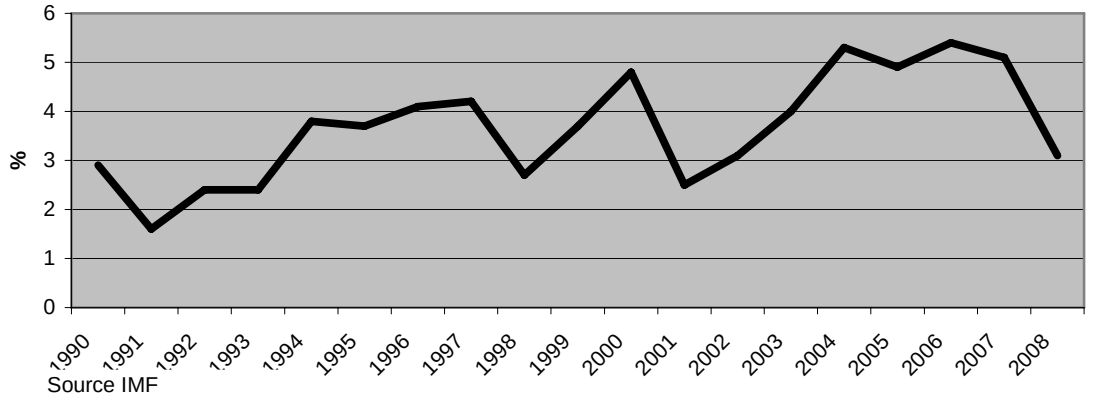
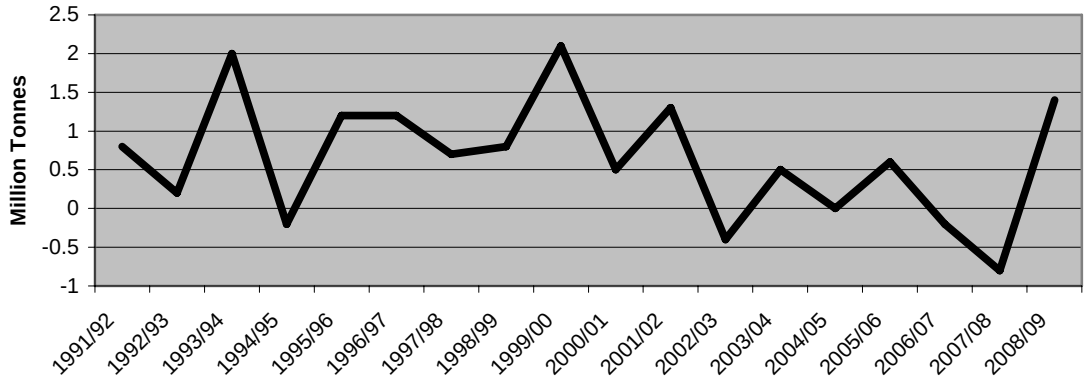


Figure 10: Oceania: Annual Change in Milk Production (Million Tonnes)



3.3 Cyclical Price Patterns

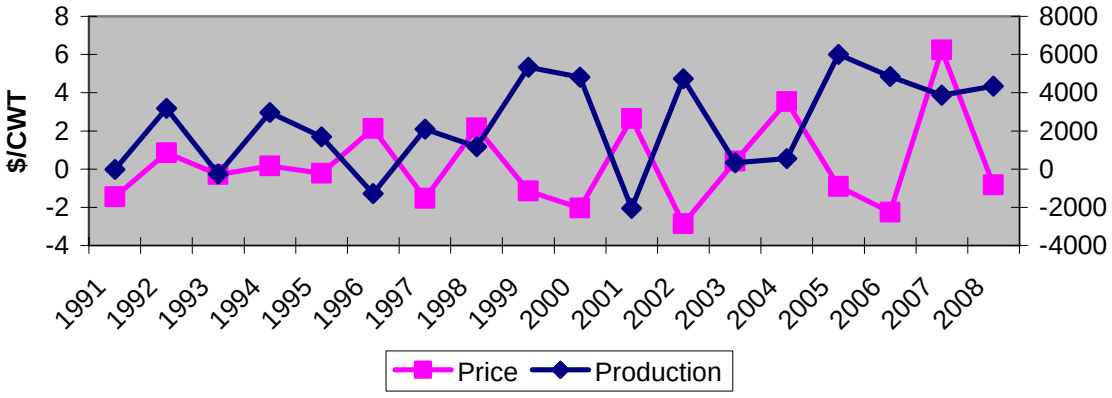
The patterns of price volatility outlined earlier for the EU and the world dairy markets show occasional periods of extreme volatility such as 2007-2009 and 2000-2002 and the possible causes of these extreme variations have been discussed. However there is a very well established theorem in economics called the cobweb theorem which suggests that in certain circumstances price volatility can display a recurring cyclical pattern[7] and this is now discussed in the context of variation in milk price and production in the US. The theorem suggests that if there is a lag in production response to price change, such as for example biological reasons, product prices and quantities produced will both move in an opposite cyclical recurring pattern. Thus for example an initial high price in period 1 will result in a lagged production response in period 2 which in turn will cause price to fall, the response to which will be a lagged cut in production in period 3 resulting in a high price again which will then cause the whole process to repeat itself on an ongoing basis.

While quite difficult to isolate due to many other intervening factors, the US dairy industry may have displayed some aspects of this cyclical price and production pattern over the past 12 years, with milk price at farm level and milk production moving in opposite directions to some degree at least in a recurring pattern for some of the period (Fig 11). (Seasonal variation in price and production should also be considered in any detailed analysis of such price volatility, however this was not possible due to time constraints). It can also be legitimately claimed that various other factors intervene to ensure that a precise recurring cyclical pattern does not develop, such as, in the US context, Government policy change in the Farm Acts, private sector activity such as that of the Cooperatives Working Together (CWT) herd retirement scheme as discussed later in Section 4, as well as more random factors such as animal disease, food scares, etc. These regular patterns of price variation have been recently analysed in depth by Professor Andrew Novakovic of Cornell University at the recent World Dairy Summit (Berlin September 2009).

The contrast between the very occasional extreme price volatility in the EU dairy markets and the somewhat more recurring cyclical pattern of price and milk production in the US can also perhaps be explained by the EU quota system. The introduction of the quota system in 1984 and the almost static milk production level for most of the period since then, with nearly all countries fully producing their quota for nearly all years up to recently, has meant that the normal production response to price change in a free market has not occurred in the EU. It is interesting to speculate whether the abandonment of the EU milk quota system as planned for 2015 will result in the emergence of a cyclical milk price and production pattern in the EU in the future. The EU milk quota regime and price volatility are further discussed in Section 6.

[7] Tomek W.G and Robinson K.L: Agricultural Product Prices: Cornell Univ. Press

Figure 11: Annual Change in US MIlk Price and Milk Production



3.4 Price Volatility and the Dairy Supply Chain

Price volatility is far more extreme at the farm and basic dairy commodity market levels of the supply chain than at the more advanced (closer to final customer) stage, especially retail/food service. There are many reasons for this phenomenon, related both to the effect of fundamental price stabilisation factors that arise depending on the stage in the supply chain and also pricing practices and behaviours by participants along the chain.

3.4.1 Price Volatility and Stage in Supply Chain

At its simplest, if price volatility is defined in percentage terms, then there will be much less volatility at retail/food service levels than at farm/basic food commodity levels due to the stability of the cost wedge from farm to retail/food service. As a simple example, consider a situation where there is a completely stable absolute cost wedge from farm to retail where the retail price is 100, the farm price is 40 and the farm retail cost wedge is 60. A 25% increase (or reduction) in price at farm level, reflecting price volatility, results in farm price change from 40 to 50 (or 30). However even with complete price transmission to retail, this will only result in a 10% price change at retail level, 100 to 110 (or 90). Furthermore the larger the stable price wedge the greater the difference in percentage price variability between farm and retail levels when prices change, even with perfect transmission. Thus if the farm price is just 30 and the retail price is again 100, a 25% increase (or reduction) in the farm price from 30 to 37.5 (or 22.5) is reflected, even with perfect transmission, in just a 7.5% price change at retail level, from 100 to 107.5 (or 92.5). As the cost wedge from farm to retail/food service has widened steadily over the years, as has been widely documented, price volatility at farm/basic food commodity levels is reflected in steadily lower percentage price volatility terms at retail/food service levels. A good example of this aspect of price volatility is captured in the UK Milk Development Council reports on price changes for dairy products at different points on the supply chain.

There is a widespread belief and acceptance however that price transmission through the supply chain is imperfect and that this further accentuates the comparative stability of prices at the more advanced stages of the supply chain. In practice prices at advanced levels in the supply chain, especially retail, are often "sticky", and change comparatively little even taking account of the cost wedge described above. Various explanations are proffered for this phenomenon and these generally relate to behaviour of chain participants. For example in periods of surplus or glut, when there is a major fall in price at farm or basic commodity levels, traders closer to the final customer, particularly when competition is limited (imperfect), may take the opportunity to widen margins through maintaining price stability. Likewise in periods of scarcity or unanticipated shortage they may bid aggressively for supplies and margins may be squeezed in the short term, again by maintaining price stability. Such behaviour patterns if present accentuate price stability at retail/ food service relative to farm/basic food commodity levels.

At retail/food service levels, the companies involved may not wish to disturb the existing prices for consumers/final purchasers, especially when the percentage price changes being considered are modest. As well as avoiding the incurring of the extra costs involved in marking up price changes each time, in addition to avoidance of negative publicity associated with price rises, the nature of competition between retailers, especially among retailers who have a substantial market share, is also a factor. When prices increase substantially at farm/food commodity levels, due perhaps to a temporary shortage with an associated price increase, any one retailer may believe that, even though a higher price may be paid to suppliers, a price increase to the retailer's customers would not be followed by competing retailers who instead would seize the opportunity to maintain stable prices and increase market share at the expense of the retailer who increased prices. Thus prices at retail level remain stable. Alternatively when prices fall substantially at farm/food commodity levels, any one large retailer may believe that, if they reduce their prices correspondingly (full price transmission), other retailers will immediately follow their pricing initiative so as to avoid loss of market share, so retailer behaviour may result in avoidance of a price reduction that full price transmission would dictate. Sometimes however "price wars" may occur as a retailer may embark on on a major price reduction programme seeking first mover advantage to increase market share. Furthermore milk and possibly other dairy products can be sold as "loss leaders" at this time. Other retailers in order to avoid loss of market share usually follow with their own price reduction programmes and there is a short-term period of intense competition and price instability. Eventually as market conditions change a new stability in prices and retailer relationships may emerge.

While the consequences for price volatility of various other practices along the supply chain could be discussed, in overall terms it is hoped that the above brief outline gives some insight into the reasons why prices may sometimes change comparatively little at retail/food service levels despite major price volatility at farm/basic food commodity levels.

Price Volatility and Stage in Supply Chain – Technical Economics Explanation (Brief)

The market at farm/food commodity level is directly linked to that at retail/food service levels as the demand at farm level is derived from primary final customer demand. Supply at final customer level is equally derived from primary raw material supply at farm level (see Figure 12 for primary and derived demand and supply in a basic supply chain market model where the farm-retail margin is shown as Pr-Pf). When a constant absolute farm to retail margin is assumed, the derived level price elasticity will always be smaller in absolute value than the primary level elasticity. For example if the farm value of a commodity is 50% of the retail price, the farm level elasticity is one half of the retail level elasticity (i.e. demand is much more inelastic at farm level). The more inelastic the demand the greater the price volatility, hence much more price volatility occurs at farm than at retail levels. Furthermore, as the farm to retail cost wedge increases over time, the difference in elasticities between farm and retail levels and associated difference in price volatility widens further.

As outlined in economics textbooks the widening of the farm-retail margin over time is illustrated in Fig 13 where the original farm-retail margin is depicted as M1. A widening of the cost wedge causes a shift in the derived demand from D1 to D2 and a shift in the derived supply from S1 to S2. Thus the farm-retail margin widens from M1 to M2 (Fig 13). This simplified presentation does not capture the more complex dynamics of the dairy supply chain which from an industry viewpoint embraces consumer products, ingredients and commodity products as well as the diverse nature of the many participants throughout the supply chain.

3.5 Summary and Conclusions

The causes of extreme price volatility in dairy and food commodity markets are very well established in economics literature and they relate primarily to a combination of the somewhat unique characteristics of demand for food (inelastic demand in economic terms) and unanticipated variation in supply due to weather, disease, etc. This has been further accentuated in an EU dairying context over the last few years by major policy change (the Luxembourg agreement) and the global recession affecting demand. While extreme price volatility in EU and world dairy commodity markets happens occasionally and somewhat randomly when a particular combination of causative factors arise, price volatility can also follow a more regular cyclical pattern and this is discussed in the context of US dairy markets. Finally price volatility and the stage in the supply chain is also discussed with particular emphasis on the causes of reduced price volatility at retail level relative to basic dairy commodity markets and farm milk price.

Figure 12: Illustration of Price Volatility and the Supply Chain

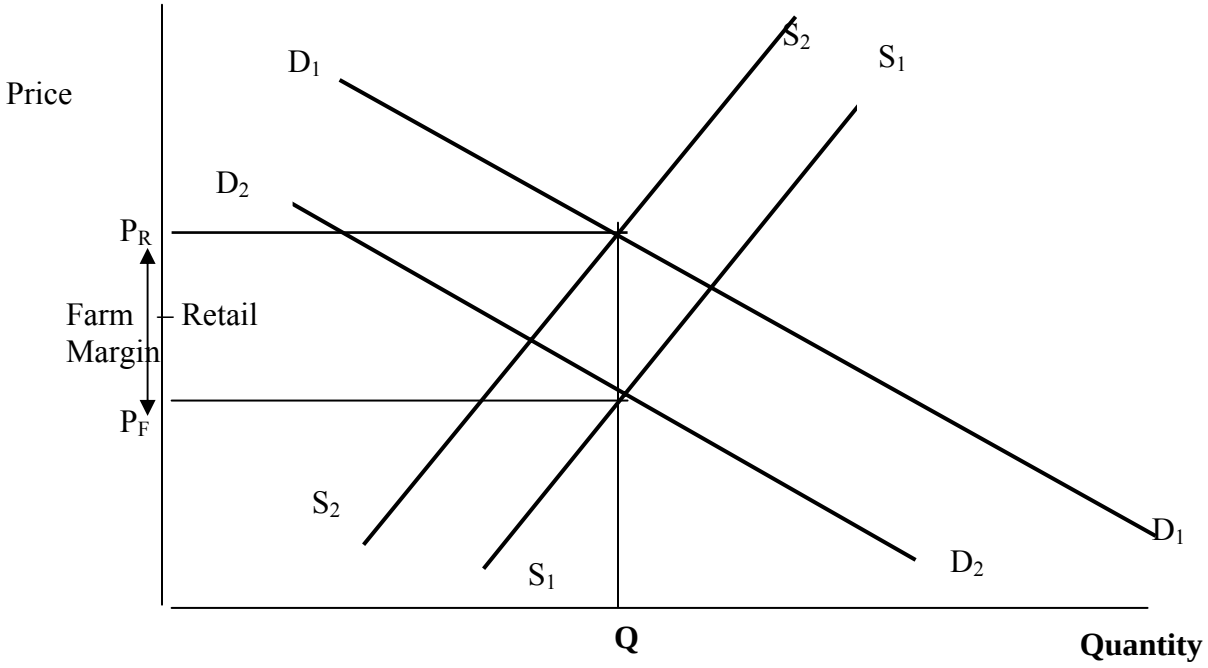
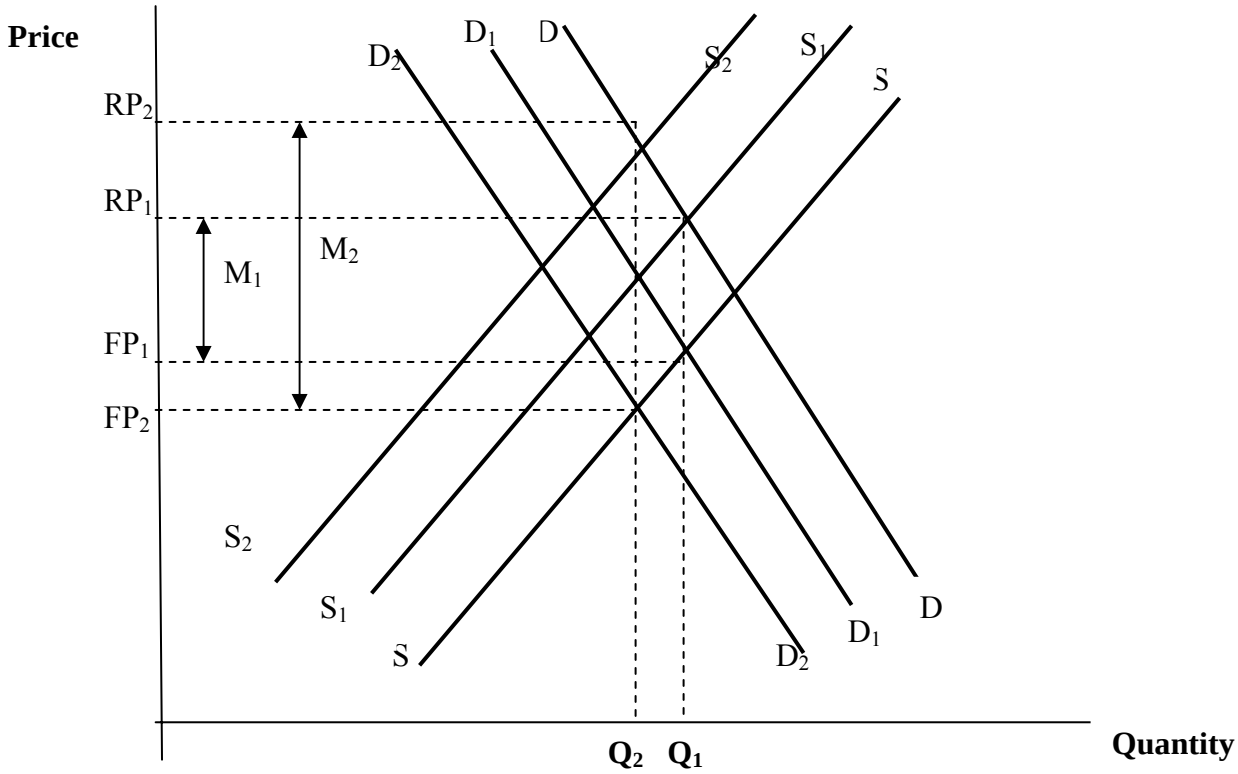


Figure 13: Illustration of Increase in Marketing Margin



Source: Derived from Tomek W.G and Robinson K.L: Agricultural Product Prices: Cornell Univ. Press

4 What are the consequences of increased price volatility?

4.1 Introduction

While it must be accepted that a certain amount of volatility is indicative of a well functioning market responding to market signals, the levels of extreme price volatility recently experienced presents major challenges for dairies. This section is comprised of a general discussion of the consequences of price volatility for dairies, both adverse and positive, followed by presentation of the results of a survey of EDA members of the consequences of volatility.

4.2 Consequences of Price Volatility

The consequences of major price volatility for any industry are generally considered to be quite adverse[8]. If price volatility results in a large price fall which persists for some time, some firms can experience major cash flow and debt repayment crises and ultimately may be driven into bankruptcy. While one may speculate that these firms would be the least efficient operations and that a more efficient industry may ultimately emerge, it has been claimed in practice that sometimes it is the newer, smaller, innovative firms that fail, as they are weakest financially in their early growth stage and do not have reserves or well developed banking connections. It is frequently claimed that the loss of capacity due to business closure at times of weak demand and low prices destroys capacity that may be required when demand recovers. However it is also often the case in practice that technically efficient production facilities are acquired at modest cost by a solvent firm during the price slump which then restores operations as demand recovers without the burden of major capital charges. Major price volatility involving persistent weak demand/low prices followed by a period of high prices also introduces the likelihood of many practical operational inefficiencies as the stop-go operation of plants may result in maintenance and replacement of machines being deferred, skilled workers being laid off, staff training being discontinued, R and D projects being postponed or terminated, etc. The competitive behavior of firms during price slumps may also result in intense price competition with severe discounting to try to maintain market share and capacity utilization which can ultimately bring the firms involved collectively to the brink of collapse. Ultimately, if prices fall below the unit costs of efficient producers during the downside, prices must rise above cost during the boom period if average profits overall are to be at a level over the whole cycle of volatility to attract a healthy longer term flow of investment. "An industry subjected to alternating periods of highly profitable operation and price warfare might have to pay more to attract a given amount of capital than more stable industries"[9]. Furthermore the dairy cooperative sector may again be a special case as the cooperative members may seek to extract most of the profit during the boom period through higher raw milk price so as to resolve their own farm solvency problems. The desirability of longer term strategic thinking at industry level is even more necessary in industries prone to extreme price volatility such as the dairy industry.

8 Scherer F M, Ross D Industrial Market Structure and Economic Performance" Houghton Mifflin Boston
9 Scherer F M, Ross D Industrial Market Structure and Economic Performance" Houghton Mifflin Boston

4.3 Problems during the High Price Period

Major problems can also arise during the high price period of a price volatility cycle and these mainly involve loss of market share through product substitution. As already outlined in Section 3, demand for food in general is highly inelastic, thus volumes purchased change little even with very high prices, however some specific foods with fairly close substitutes have considerably more elastic demand and volumes sold and market share can fall considerably during periods of very high prices. Sometimes this loss is not easily recoverable when prices fall as technologies to accommodate the substitutes may now be in place. Thus for example customers may invest in R and D including organoleptic research leading to new recipes and/or processing equipment. Butterfat may be replaced with vegetable oils or new products may be formulated with "healthy" alternatives to dairy products during extreme price peaks. This is much more likely to occur when the price peak is persistent as substitution will normally occur with a delay, partly to observe if the price peak persists and also because of the necessity to reformulate recipes or change processing equipment. Lactose is another example where, because of the price peak, many food producers stopped using lactose and changed their recipes, packaging etc. They are now reluctant to change back to lactose despite the return to low competitive prices.

4.4 Volatility versus Stability

Industries subject to extreme price volatility have much greater problems than more stable industries in relation to customer relationships and contract negotiation. Major price volatility means that all longer-term contracts become burdened with much greater risk and, if entered into, become far more complex due to the need to accommodate agreed market risk sharing dimensions. In general customers will highly value market stability rather than price uncertainty as they can better engage in longer term planning, both financial and operational. Examples of comparative price volatility for dairy commodities versus competing ingredients such as palm oil are discussed in section 7. The survey analysis which follows also explores customer relationship issues including the effect of price volatility on the nature of contracts. Finally significant price volatility makes farm planning much more difficult and, for processors, makes future milk intake planning much more uncertain.

4.5 Positive Consequences of Price Volatility

While price volatility has far more negative than positive consequences, some positives can also be suggested. As already mentioned in the introduction, price variation to some degree is both desirable and inevitable in all markets as it reflects the changing needs and preferences of customers, the changing cost and competitive positions of participants at all stages in the supply chain, changing policies at Government level and trends and developments in the overall economy. The price movements reflecting these changes occur through the price discovery process among market participants and these price movements act as price signals to reallocate resources efficiently. The threat to profitability or product substitution as discussed earlier can create positive pressures to achieve greater efficiency in operation, increased economies of scale or can lead to the enhancement of focused R and D in an otherwise complacent industry. Achieving economies of scale however, while positive as such, is often associated with an increase in specialization and thus movement away from diversification as a risk management

strategy. Risk management is discussed in detail in Section 5. Furthermore market traders with specialized knowledge may welcome increased price volatility as their specialist skills become more highly valued.

4.6 Industry Survey on Price Volatility

The authors decided to conduct an industry survey on price volatility to establish dairy industry opinion on the consequences of volatility, measures currently being taken to offset volatility problems and suggestions for the future at both private and public levels. The survey was conducted primarily by email with a mailing list provided by EDA. A copy of the questionnaire is shown in Appendix 3. Given the nature and timing of the survey, the response was considered quite satisfactory, with responses received from leading dairies in seven different countries. In addition two phone conferences were conducted at the request of the dairies concerned. The responses in general show that the problems of price volatility as identified by respondents are fairly common across the different countries of the EU, however ideas on how to respond are more diverse. A summary of the survey results is now presented under a series of headings which follow the basic structure of the questionnaire, while a set of representative quotes (unattributable) is outlined in Appendix 4.

Summary of Responses

A. Consequences of Price Volatility

Overall Risk Related Issues including Milk Supply

It was suggested that price volatility creates a crisis of confidence at producer, processor and consumer levels. It was stressed that dairy farming is a long term investment and a risky business and that, without raw milk for processing, there would be no dairies or product development. The threats to milk supply particularly in less competitive regions was emphasized. The novelty of price volatility for dairy farmers relative to pig producers or market gardeners was mentioned. It was also clearly stated that instability was bad for business, making forecasting and anticipation very difficult.

Consumer Issues

It was emphasized that price volatility has resulted in a negative consumer/customer reaction with a serious negative impact on demand and a contraction of the market. It was suggested that, despite dairy products having a strong image of healthy products and a strong capacity for innovation, the lack of price stability was harmful from a marketing or investment policy and was dangerous on a long term perspective.

Finance/Profitability/Investment issues

It was suggested that price volatility caused major finance and credit risk implications with fluctuating working capital requirements and stock "profits" and "losses" as a result of the lag between input costs and output pricing. It was stressed that without clarity of future returns it is more difficult to plan future investment and that this is an issue at both producer level, as well as for the processor. It was also claimed that price volatility undermined the ability of branded players to follow a consistent consumer-investment strategy and meant that the category develops less added value. Volatility also

undermined investment confidence and as a result, consistent, consumer-investment strategies were harder to follow. Finally volatility required a very good and flexible relationship with banks.

Retailer Issues

It was claimed that price volatility presents a major challenge for premium brands to hold market share, consumers are disturbed by price changes, and that it is a shot-in-the-arm for the hard discounters. It was repeatedly emphasized that volatility accelerated the long-term trend for consumers to buy private labels and undifferentiated products. It was stated that while retailers can force producers to reduce prices in a surplus situation without reducing consumer prices accordingly while, in a shortage situation, price increases are (almost) completely passed on to consumers. The market power of the retailers in the supply chain was alluded to in different ways throughout the responses.

Product Substitution Issues

Virtually all respondents emphasized that dairy product substitution had occurred, that buyers, especially of food ingredients, were actively searching for dairy alternatives that had more predictable pricing and that the substitution was now very difficult to reverse. A number of specific examples of product substitution were provided.

Policy Issues

It was expressed, perhaps with a note of surprise, that the recent extreme price volatility had resulted in a renewed reliance on institutional supports, despite the major Luxembourg agreement policy change which was expected to result in a "hands off" approach" with regard to markets. In the short term it was stated that 3rd country business is very difficult due to the lack of availability of funds/insurance, inadequate export refunds and very vigorous competition from NZ and US. It was stated that the policy changes had opened markets to new competition from countries with lower milk prices, both internally in the EU as countries vary in the pace of the price adjustment process and externally from 3rd countries.

Other Issues – Processing, Product Portfolio

It was stated that price volatility and the response of milk suppliers had created plant capacity issues, with processing plants sometimes underutilized and sometimes very tight. A few respondents mentioned product portfolio implications, suggesting that price volatility and the renewal of institutional price supports increased the necessity of a decrease of the share of industrial products in turnover, with some regions in particular having a too high level of industrial products.

B. Mechanisms to Offset Price Volatility at Present

Product related

Approaches mentioned included the adoption of a rigorous marketing and sales strategy, a mix of forward and spot business and devotion of increased attention to market research with a root-and-branch review of all existing and potential market segments. An increased emphasis on branding and a larger spend on promotion in key markets was mentioned by a few respondents. The desirability of maintaining a broad portfolio which has businesses which benefit in the up cycle but others which benefit in the down cycle was mentioned, as well as benefits from internationalising sales to increase the share of consumer products. Other respondents thought that the industry should seize the opportunity of added value products while it was also suggested that volatility generated a new interest in the B2B sector with contracts linked to some sort of independent measure/quotation. The spreading of risk through merger to provide a more diversified portfolio with wider geographic sales was also mentioned. Finally a number of respondents emphasized the need for an increased focus on innovation and associated research.

Farm Related

A number of respondents thought that adjustment of the milk price paid to farmers to reflect market developments should be emphasized and a few responses indicated quite specific approaches that should be adopted in this regard.

C Instruments that your firm would like to see developed to alleviate price volatility problems

Private

Some respondents emphasized that implementation of futures trading where risks can be hedged should now occur, emphasizing that this was normal in other volatile commodity industries. The question of contracts related to product portfolio was raised, with a suggestion that there should be contracts for one volume corresponding to products for consumption bought at a relatively stable price, with another one corresponding to industrial products (butter in bulk, powders) with a fluctuating price. It was also suggested that industry should accept the need for further consolidation.

Public

Some thought that basically the policies are sound but that it was most important that political decisions are made well in advance (3-5 years) so as to allow the industry and the milk producers to plan forward. The need to study new mechanisms to stabilize revenue for producers (contra-cyclic, pooling) and which allow flexibility and reactivity in milk price was mentioned. It was outlined that the European dairy market has come from a situation of very limited volatility (a managed market situation) and is now in a transition phase to a free markets system like what has happened in other industrial and agricultural sectors and that volatility is inevitable in the future due to the planned deregulation. A number of respondents suggested specific improvements with regard to current policy instruments.

D Contracts and Price Volatility

Duration of Contracts
Respondents placed a lot of emphasis on the effect of volatility on the duration of contracts with virtually all claiming that contracts had become shorter following recent price volatility accompanied by specific examples as quoted in Appendix 4. Some emphasized the way that buyers vary their contract negotiations with some looking for longer term contracts in the current low market, whereas they were buying shorter during peaks.

Price in Contracts
There was substantial diversity among respondents with quite a few proposing the linking of price to external quotations. Various mechanisms were suggested with index linking or "independent" quotations getting some emphasis. It was suggested that it can vary greatly by country and that often the retailer had unequal negotiating power. The need for objective, independent price indices was emphasized, linked to a role for the European Commission/Eurostat.

Could Contracts be Better Structured Given Price Volatility
There was a variety of responses including the desirability of establishing a well functioning transparent futures market with producer participation. With regard to contracts with farmers, long term fixed contracts for a certain share of milk delivery (consumer products) with the other part of milk volume linked to commodities prices was mentioned, emphasizing the need to link selling price to purchase price of raw material. However a more skeptical minority viewpoint was also expressed indicating that while in theory one can establish risk sharing mechanisms, in practice they never work in the real market. Given that customers must stay competitive at any given time and that switching costs are close to zero for both customers and milk producers and that either the customer or the dairy company can go out of business quite quickly, switching may be inevitable.

4.7 Summary and Conclusions

While price variation to some degree is desirable as a means of providing price signals that reflect changing market conditions, both industrial economics principles and an industry survey concur that extreme price volatility results in a set of mostly negative consequences. Extremely low prices cause many financial problems and ultimately threaten solvency, while extremely high prices result in product substitution which can be subsequently difficult or impossible to reverse. Buyers prefer stability for planning and customer relationship purposes and hence, if alternatives are available, will prefer to conduct business with more price stable sectors. Extreme volatility can also inhibit innovation and R and D.

The industry survey provided detailed information on the effect of price volatility on buyer and supplier relationships, including in particular larger retailers, ingredients buyers and farm milk suppliers. Some interesting suggestions were made with regard to both private and public sector responses to price volatility, while the effect of volatility

on contracts was explored in detail. It was generally accepted that, following the major policy changes of recent years, increased price volatility in the EU dairy sector in the future is inevitable compared with past decades. A number of coping mechanisms were suggested, including the importance of providing more objective, timely and transparent price indices within the EU, the development of futures markets for dairy commodities, the restructuring of product portfolios, increased merger activity to provide greater product and market diversification, more transparent and direct linkages between product prices and farm milk prices and specific policy responses with regard to both current and new policy mechanisms.

5 What options are available at processor/farm level to deal with or reduce price volatility?

5.1 Introduction

Increased price volatility translates into an increase in risk for dairy industry participants. In simple terms lower than anticipated prices create cashflow and operational problems for suppliers while higher than anticipated prices encourages substitution further along the supply chain and thus a loss of long term market share and revenue.

While some market participants may be willing to accept the increased risk posed by more volatile prices, many others will be willing to transfer this risk to others. Those willing to accept the greater risk may be willing to assume the greater risk in return for anticipated greater returns in the long run or may be in a position to diversify their portfolio and thus mitigate the increased risk. [The use of diversification as a risk reduction tool is explored in Appendix 5]. However the expected abolition of the milk quotas and the envisaged increase in production at farm level will mean that diversification opportunities will be curtailed as both farmers and manufacturers strive to build the economies of scale required to survive in an increasingly competitive environment. This in turn will increase the numbers seeking to manage their risk by transferring it to others. We now consider some of the longer term alternatives available to these market participants. Risk coping strategies such as, for example, short term refinancing, advance receipt of payments, and changes to taxation codes are not considered.

This section commences with a review and discussion of market based risk management instruments (over the counter contracts, forward contracting, futures markets and insurance). The section is then completed by a discussion of US and New Zealand risk management initiatives, with the US component in particular emphasising the integration of both public and private risk management activity.

5.2 Market Based Price Risk Management Instruments

5.2.1 Over The Counter (OTC) Contracts

These are typically contracts which are executed outside of the regulated exchange environment and whose values are derived from the value of an underlying asset, reference rate or index. These contracts can be individually customized to an end-user's risk preference and are highly flexible. In general in the OTC market, trading occurs via direct interaction between two companies, in this case client and "intermediary" (with the intermediary being a bank, a trading house or a brokerage firm) as there is no central exchange or meeting place for this market. Price formation in OTC markets is by nature not transparent and depends on the availability of necessary information and bargaining strength. The customized nature of these contracts means that these contracts are often difficult to trade and preclude taking advantage of favorable movements in spot markets.

Moreover, use of the OTC market involves a counterpart risk so the trading partners need to have mutual confidence in each other.

The growth in popularity of OTC markets coupled with increasing concerns regarding counterparty credit risk have resulted in many exchanges developing OTC clearing services. Exchange cleared OTC contracts are transacted identically with bilateral OTC contracts, i.e. negotiated between two counterparties either directly or via an intermediary. However, once a trade is executed it is posted to the exchange for settlement and clearing. As the exchange acts as counterparty to both the buyer and seller the counterparty credit risk is virtually eliminated. Exchange cleared OTC contracts are particularly popular within the Energy spectrum but are now available in Metals and Soft Commodity markets and new commodity contract structures are being developed and offered by exchanges regularly. An example of an exchange mechanism for OTC clearing is the Chicago Mercantile Exchange's Clearport platform.

The very nature of OTC markets and the lack of transparency results in a difficulty in accurately quantifying the volumes transacted. However, if we look at Exchange cleared OTC contracts we could use this as an estimation of their popularity. Chicago Merchantile Exchange (CME) Clearport cleared an average daily volume of 537,000 contracts in Quarter 2, 2009 an increase of 29% from the same period in 2008 (417,000)[10]. This is particularly interesting when one considers that exchange traded volumes in general have decreased significantly in this period.

5.2.2 Forward contracting

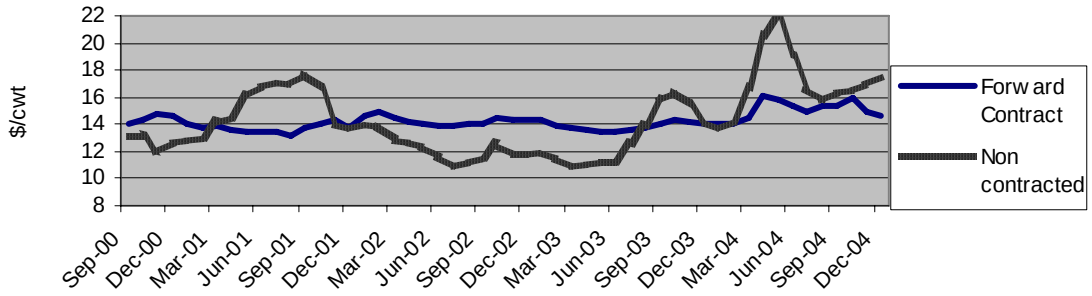
In its simplest form, a forward contract is an agreement to sell a stated quantity of a good or service, at a stated period into the future, at a stated price. A program of this nature which currently operates in the US allows milk producers and cooperative associations to voluntarily enter into forward price contracts with milk handlers for milk used for non-fluid purposes. The following chart, which uses data that the United States Department of Agriculture collected during the forward contracting pilot program from September 2000 to December 2004, illustrates how this risk management tool can be effectively used to provide less volatile prices (Figure 13). In this chart the average forwarded contracted price in eight Federal orders which participated in the Dairy Forward Pricing Program (Appalachian, Central, Mideast, Northeast, Pacific Northwest, Southeast, Upper Midwest, and Western orders) is compared with the average monthly price received by those farmers who did not forward contract. It should be noted that the average contracted price for the period was $14.25/cwt while the corresponding value for non-contracted was $14.33/cwt.

This type of risk management instrument has potential benefits to both parties. As the contracts are tailor made both parties can hedge as they are able to “lock in” prices, thereby reducing risk associated with price and income volatility and enhancing their ability to plan and to obtain new or continued financing. These contracts are flexible with regard to quantities and delivery dates and can be used alone or in conjunction with other

[10] http://www.reuters.com/article/pressRelease/idUS129378+02-Jul-2009+PRN20090702
http://www.cmegroup.com/clearing/clearport/sevenyears.html

pricing tools to manage price risk. Normally these contracts require delivery and thus ensure a physical market for the commodities. However once entered into they have to be executed in the prescribed manner regardless of market developments. This may in turn lead to one of the parties assuming the entire downside risk. A further issue which arises in forward contracting relates to the setting of the price at which the contract will be executed. This price should be transparent, verifiable and free from manipulation. Finally these markets involve a counterpart risk so the trading partners need to have mutual confidence in each other. A well functioning futures market should be capable of providing transparent reference prices free from counterparty risk and these markets are now discussed.

Figure 13: Foward contract versus non contracted milk price



Source: USDA, AMS Dairy Forward Pricing Pilot Program: Information for the Complete Program Periods, September 2000 through December 2004

5.2.3 Futures contracts

Unlike forward contracts which in general are privately negotiated and are not standardized, futures contracts are standardized and traded on commodity exchanges. These contracts allow market participants to hedge their position in the market and thus reduce the risk of unfavorable price movements between the time the hedge is placed and the delivery of the commodity is made. This process involves simultaneously taking an offsetting position in the cash and futures markets. A simplified example of hedging is presented in Technical Box 2. In the EU, futures markets exist for many agricultural commodities such as potatoes, cereals, and hogs. However in the US there is much wider coverage and, from a dairy viewpoint, futures contracts are now available for Grade AA Butter, Cheddar Cheese, Fluid Milk, Nonfat Dry Milk, Whey and BFP Milk on the Chicago Mercantile Exchange (CME). These contracts continue to grow in popularity with 470,000 Class III milk futures and options contracts traded last year representing approximately one-half of US milk production. Class III milk futures and options combined open interest[11] stood at about 79,500 contracts on June 30 2009, equal to about 8% of annual US milk production[12].

[11] Open interest is the sum of all contracts that have not expired, been exercised or physically delivered

12 Witness Statement of Phil Plourd President Blimling and Associates, Inc/Roger W. Blimling, Inc to . United States House of Representatives House Committee on Agriculture Subcommittee on Livestock, Dairy, and Poultry 21th July 2009 http://agriculture.house.gov/testimony/111/h072109/Plourd.pdf

Technical Box 2: A simple hedging example

The following is a simple example of a short hedge (a person who already owns or is in the process of producing a commodity bears the risk that the price will fall). This risk can be mitigated by *selling futures* (short hedge) which may be used to illustrate the principle rather than the detail of hedging. For simplicity the example ignores the issues of basis risk and fees along with the costs associated with placing money in the futures account to cover initial margin requirements (good faith deposits) and the maintenance of the margin calls (additional deposits to cover adverse price variations).

Hedging in the futures market is a two-step process. In the first step the hedger will either buy or sell a futures contract which is executable at some future point in time. So if he is going to buy a commodity in the cash market at a later time, his first step is to buy futures contracts now. Likewise if he is going to sell the commodity at a later time, his first step in the hedging process is to sell futures contracts now.

The second step in the process occurs when the cash market transaction takes place. At or prior to this point in time the hedger takes an opposite position in the futures market thus closing out their position. If the hedger initially bought a contract, he would offset his position by selling the contract back. If he sold the future, he would buy back the futures contract.

If we assume that in March a processor expects to produce 1,000 tonnes of butter during July and wishes to protect itself against the possibility of future falling prices. Suppose the price in March for an August futures contract is €2,400 per tonne and this price is sufficiently satisfying to the processor. Thus he can more or less lock in this price by selling a number of August futures contracts on the Exchange (The number of contracts will be 1,000 divided by the quantity in a standard contract. So if for example the standard quantity is 250 tonnes he sells 4 contracts). Imagine that in July, prices have fallen. The processor sells his butter on the spot market for €2,100 per tonne. The price of the August contract has declined also, to €2,100 per tonne. This means that the processor is able to buy four August contracts for €2,100 per tonne, and use these to offset the four contracts he had sold, for which he had received €2,400 per tonne. He thus makes a profit of €300 per contract on the futures market. The effective price he receives for his butter per tonne is therefore €2,400 (€2,100 on the spot market plus €300 on the futures market). So with his sale of four futures contracts in March he effectively "fixed" the price of his butter four months before the physical sale took place. Had the price in July increased to €2,700 and the August futures price also increased he would have sold the butter on the spot market for €2,700 and lost €300 on the futures he would have had to buy to close out his position, also giving a net return of €2,400.

While the US futures markets provide opportunities to manage world price fluctuations, it should be noted that it is important to consider the role of futures markets in relation to intra EU trade in dairy commodities. Taking 2005 as a representative stable year in product price terms the figure for intra-EU trade in dairy products was 14.6 million tonnes, with a value of EUR 18.6 billion, much higher than for exports outside the EU which were valued at EUR 5.4 billion for 2.5 million tonnes of products, European Commission (2006). Such data suggest that a futures market denominated in Euros is desirable. Indeed the recent increase in volatility has made the launch of an EU based dairy futures markets a more attractive proposition as these markets require a certain amount of volatility in order to attract speculators, however excessive volatility has the opposite effect. Recently a number of parties have expressed interest in launching dairy futures in the EU (LIFFE, EUMIX). Extensive discussion has been taking place with regards to such potential launches.

Benefits and Limitations of Dairy Futures Markets

Benefits

- Futures markets facilitate hedging to lock in floor prices as has already been mentioned.
- These markets would facilitate price discovery up to three years into the future
- Counter party risk is minimal as these are highly regulated markets.
- These markets bring a greater degree of price transparency to the supply chain and do not require the negotiation of contract specifications
- A major benefit of the creation of a futures market often lies in the derivatives which follow. For example options may be used to place a floor while benefiting from upside movements in spot markets while the futures prices may offer transparency and reference prices for insurance products such as the Livestock Gross Margin for Dairy Cattle Insurance Policy (discussed below) which was recently introduced in the US.
- It is possible to close out the initial position at any point.

Limitations

While the benefits of futures markets to the supply chain are obvious, however their limitations, particularly in a dairy context, should also be considered.

- Emerging futures markets in many instances initially require an index price against which trades are settled. The designation or creation of such an index may be problematic as a number of reference prices are currently used and their integrity is sometimes questionable.
- Margin payments tie up working capital.
- The possibility of profiting from favourable spot market developments may be lost.
- Basis[13] risk may be difficult to hedge.
- While farmers may wish to hedge milk prices, the contracts may be for commodities such as butter and milk powder.

[13] Basis is the difference between the spot price of the hedged asset and the futures price of the contract while basis risk is the risk that the change in price of a hedge may not match the change in price of the asset it hedges.

- Likewise the quantities specified in the contracts may be large relative to the scale of many participants. However in the current context it should be noted that a number of individuals may pool their resources in order to attain the scale required. This bundling may be done for example by processors or financial intermediaries such as brokers thus allowing farmers to benefit from hedging[14].
- While greater price transparency in the farm gate price and a more active role by milk processors and buyers in providing risk management tools to their suppliers may alleviate such problems, it is by no means guaranteed that they will be forthcoming. Such actions will require processors/buyers to acquire a new skill set and a more personal relationship with their suppliers.
- However it is the novelty of these instruments which might provide the largest obstacle to their adoption. Up to recently the European Commission has successfully managed price risk in the EU dairy industry and as a result participants have not had great need for these instruments.
- There is a fear that these markets may encourage excessive speculation which may in turn lead to greater volatility and thus a greater incentive to speculate with a destabilizing effect on cash prices. This is discussed further in section 7.

The conditions which favour the successful establishment of futures and options markets are presented in Technical Box 3.

5.2.4 Insurance Contracts

The principle behind insurance is that of risk pooling which involves combining the risks faced by a large number of individuals who contribute through premia to a common fund which is used to cover the losses incurred by any individual in the pool. In order for a risk to be insurable the adverse effects of "asymmetric information" and "systemic risks" need to be managed.

Asymmetric information refers to the situation where the buyer of insurance and the insurance company may not have the same information as regards the probability of losses occurring. This in turn may lead to adverse selection (i.e. where those at greater risk buy more insurance than others, without the insurance company being aware of this) and moral hazard (i.e. an individual´s change in behaviour after having taken out an insurance policy resulting in an increase in the potential magnitude and/or probability of a loss e.g. not spraying crops for certain diseases). Systemic risks result in many people making a claim at the same time with the effect that the premia paid into a pool are not sufficient to cover the loss incurred, which may threaten the solvency of the insurance pool. Examples of systemic risks are price risk or yield risk. Insurance is a popular means of risk management in crop production. However it can also be applied in a dairy context. In Canada dairy farmers may receive an AgriStability[15] payment when their margin falls below 70% of their three year reference margin. Likewise in the US the milk income loss

[14] For example in the US Dairylea provides a similar service to its members see http://www.dairyriskmanagement.com/priceStabilizer.asp

[15] The funding of this program is shared between the Government of Canada and the provincial and territorial governments.

contract (MILC) and Livestock Gross Margin for Dairy Cattle Insurance Policy (LGM-Dairy) are examples which are discussed in greater detail later.

Technical Box 3: Conditions for the successful establishment of futures and options markets

Along with the need for high quality and timely market information which is easily sourced Sarris (1997) identifies the following conditions which are necessary for the successful establishment of futures and options markets

- *Substantial commodity price variability*

Without price variability market participants would have no incentive to use the market for hedging and the market would not attract any speculators, as potential profits would be small.

- *Large number of potential traders and speculators (to ensure liquidity of the market).*

If the trade volume is too small, there is a danger that few transactions can influence the price significantly.

- *Products with standardised grades and quality*

Futures relate to standardised commodities (size, grade, place of delivery, date of maturity). Products with a large number of grades and quality variations are therefore not entirely suitable for successful futures contracts (e.g. rice, as opposed to soybeans, wheat, corn)

- *Limited government intervention in pricing and trade*

Transactions in commodity markets must be unhindered by physical or legal barriers and government controls.

- *The existence of a regulatory body*

to safeguard the integrity of the markets and prevent fraud and manipulation

- *Good transportation and telecommunications systems*
- *A well-functioning financial system*
- *·An effective legal environment*
- *Political and macro-economic stability.*

Sarris, A. H. (1997) "*Price Variability in Cereal Markets and Risk Management Strategies for Market Participants*" , Report presented to OECD Group on Cereals, Animal Feeds and Sugar of the Working Party on Agricultural Policies and Markets, Paris (AGR/CA/APM/CFS(97)8).

Mutual funds are a special case of insurance. Mutual funds are owned by the participants and cover losses of members either through money already available in the fund and/or through an additional collection among participants. By organizing regionally, the problems of moral hazard and adverse selection are reduced, as members exert social control over each other, however the homogenous nature of many of the funds tends to increase systemic risk.

5.3 The Role of Public Policy in the provision of Market Based Price Risk Management Instruments

In the EU, private market instruments have not been developed because the instruments employed by the Commission have successfully managed price volatility until recent times. However as the Commission proceed with its stated intention to withdraw from market management and support apart from "safety net" management, then when prices become more volatile the development of these markets may become critical. The successful development of these markets will require regulation, accurate and timely data, training and most importantly encouragement from the European Commission. The Commission can in particular play an active role in the provision of each of these elements. For example it can establish the necessary legal framework for the creation of markets for risk coverage. Likewise, as the quality and timeliness of information and data is essential to the proper functioning of these markets, public policy can aid in the collection, verification and dissemination of this information and data. The importance of high quality, timely, objective and transparent market information was recently emphasized by Phil Plourd at the recent IDF World Dairy Summit (Berlin September 2009). Public policy can also provide incentives for the development of such markets (e.g. by encouraging training in the use of risk management tools) or can lower the costs of such tools (e.g. by providing subsidies for insurance premia or subsidising the cost of futures contracts). Indeed governments can also provide risk coverage themselves (e.g. by providing re-insurance). Finally the European Commission can provide an abundance of public policy instruments as will be discussed in section 6.

5.4 Managing Risk in the US Dairy Sector

The US dairy industry has been much more active in the management of risk and lessons from their experience provide a valuable insight into which tools may be more appropriate in an EU context. The dairy industry in the US is highly regulated with federal and state programs providing price support and product storage, import protection and marketing regulations that set minimum prices by use and pool revenues for producers, export subsidies and direct producer payments. The broad suite of tools mentioned fulfill many policy objectives, however for the current analysis only those programs intended to provide price and income stability and will be considered.

Central to any analysis of US dairy policy is the role played by the federal milk marketing orders (FMMOs)[16]. These orders set the minimum milk price paid to dairy farmers in many parts of the country, and the few areas of the country not under FMMO regulation often have similar state milk price regulations. These orders use price formulas to assign values to the different components of farm milk. These values vary depending on which dairy products are made from farm milk. According to the USDA (2004) the major objective of FMMOs is to equalize competition between milk buyers and producers and promote a greater degree of stability in marketing relationships. Two concepts are at the core of Federal milk marketing orders: classified pricing and market-

[16] FMMO's are detailed and somewhat complex to explain so the interested reader who requires further detail is referred to USDA 2004 "Economic Effects of U.S. Dairy Policy and Alternative Approaches To Milk pricing" http://www.milkprocon.org/2004congressreport.pdf or Jesse and Cropp "How the Milk Pricing System Works" http://future.aae.wisc.edu/collection/tutorial/risk_team/risk_team_1.htm

wide revenue pooling. Classified pricing means that milk is priced based on its end use or "class."[17] Under revenue pooling, all producers that sell milk in a particular milk marketing order area receive the same minimum "uniform" or "blend" price. This ensures that even though the producers sell their milk to different types of plants (fluid, cheese, powder etc) they will each receive the same (minimum) price for their milk. This "blend" price ensures that the high level of volatility associated with individual commodities is transmitted directly to the farmers but is mitigated by less volatile and often contrary volatility in other commodity prices. Farmers may also manage price risk through forward contracting as a previous restriction which affected roughly one third of US dairy farmers was removed in the 2008 Farm Bill as it now allows proprietary dairy plants to pay less than federal order minimum prices to producers who forward contracted at lower prices.

The Dairy Product Price Support Program (DPPSP) will buy, at support purchase prices, any butter, cheddar cheese or nonfat dry milk that is offered to it and meets the required specifications. In the 2008 Farm Bill these support prices were set at $1.13/lb for 40-pound cheddar blocks, $1.10/lb for cheddar barrels, $1.05/lb for butter and $0.80/lb for nonfat dry milk. However, provisions in the bill state that the Secretary *may* reduce the purchase price of cheddar cheese, butter or nonfat dry milk, if DPPSP net removals for a period of 12 consecutive months exceed certain trigger volumes. So in a response to recent market conditions the USDA raised the buy in prices from August 2009 to October 2009 to $0.92/lb for nonfat dry milk, to $1.31/lb for 40-pound cheddar blocks and to $1.28/lb for cheddar barrels with the objective of increasing dairy farm revenue by $243 million.

The **Dairy Export Incentive Program (DEIP)** pays cash bonuses that allow dairy product exporters to buy U.S. products (milk powders, butter and butterfat, and several cheese varieties) and sell them abroad when international prices are below domestic prices. As well as removing dairy products from the domestic market, DEIP helps develop export markets, and plays an important role in milk price support. Likewise **Import measures** such as protective tariffs and restrictive tariff-rate quotas (TRQs) isolate the U.S. dairy sector from international markets, raise prices to producers, and prevent lower priced dairy products from compromising the price support program. In addition there are a number of dairy promotion programs that raise producer revenue by increasing demand for milk and dairy products.
As well as benefiting from the government programs outlined, US dairy farmers are also fortunate to be in a position whereby they can avail of a number of private market instruments to manage price risk. For example since 1996 the Chicago Mercantile Exchange (CME) has traded dairy futures and options and now offers six different futures and options: two on different types of milk (class III and class IV), two different butter contracts, a dry whey contract and a nonfat dry milk contract (SMP)[18]. As with any

[17] There are at present 4 classes in the US system. Class I: Beverage milk, Class II: Fluid cream products, yogurt, perishable manufactured products (ice cream, cottage cheese, and others), Class III: Cream cheese and hard manufactured cheese, and Class IV: Butter and dry milks.

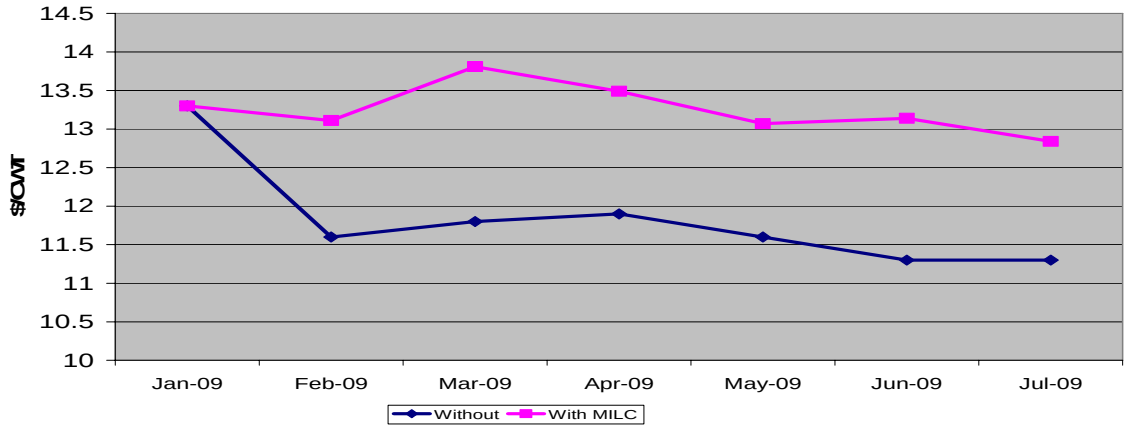
[18] Details of the specifications of these futures and options may be found at, http://www.cme.com/files/Options_on_CME_Dairy_Futures.pdf

financial market instruments, these dairy futures and options may be used in combination with each other, or other instruments, to create new instruments which may be used to manage risk. An example is the fence, floor, and stabiliser products offered by Dairylea Cooperatives Risk Management Service to its members (see http://www.dairyriskmanagement.com/priceStabilizer.asp). While these instruments are provided by the private sector, US government funding has been used to support their introduction. For example through the Dairy Options Pilot Program (DOPP), transaction costs for dairy farmers using dairy options were subsidised in order to promote their use. Likewise a number of academic institutions have played a very significant role in disseminating information on the potential uses and benefits of these particular risk management tools[19].

The 2002 Farm Act established a national **milk income loss contract (MILC)** program to provide income stabilization for dairy producers. Under this scheme a monthly direct payment is made to dairy farm operators if the monthly Class I price in Boston (Federal Order 1) is less than a target price per cwt. The 2008 bill sees the adoption of a feed cost adjuster to the target Class I price. This adjuster is based on the estimated cost per hundredweight of a 16 percent protein dairy ration that USDA uses to calculate the Milk-Feed Price Ratio. So in effect at the end of each month the feed cost adjuster is calculated and compared to the base value of $7.35. If the cost is less than or equal to $7.35, then the MILC Class I (Boston Class) target price of $16.94 remains. If the feed cost is higher, then the percentage difference between the current feed ration cost and $7.35 is multiplied by 45% (MILC payout rate established) and this resulting percentage is then added to the $16.94 target for the previous month[20]. These countercyclical payments serve as a safety net for dairy farmers[21]. The effects of this payment can be seen in Figure 14 which shows the US "all milk" monthly average price for 2009 and that price when the monthly MILC payments are added. These payments ran to approximately $450 million from February to April of this year and are expected to double that amount by year end. The MILC program is a public program open for participation to U.S. dairy producers. Currently, there approximately 50,000 dairy producers participating in the program covering approximately 37 million pounds of dairy production[22].

[19] For example the University of Wisconsin Dairy Marketing and Risk Management Program.
[20] A detailed account of the mechanics of this contract is provided by Jesse et al (2008) at http://future.aae.wisc.edu/publications/farm_bill/M&P_Dairy_6-1.pdf
[21] Critics would argue that this program only protects against price falls rather than volatility and creates production distortions and moral hazard as it encourages production regardless of market conditions.
[22] Personal communication with US Farm Service Agency.

Figure 14: US All Milk Average Price and Price Adjusted for MILC



From January 2009 the **Livestock Gross Margin for Dairy Cattle Insurance Policy** (LGM-Dairy) provides protection against the loss of gross margin (market value of milk minus feed costs) on the milk produced from dairy cows. The indemnity at the end of the eleven-month insurance period is the difference, if positive, between the gross margin guarantee and the actual gross margin. The LGM-Dairy uses futures prices and state specific basis[23] for corn, soybean meal and milk to determine the expected gross margin and the actual gross margin. The price the producer receives at the local market is not used in these calculations. This policy is owned and maintained by a private entity, Iowa Agricultural Insurance Innovations (IAII), and reinsured through the Federal Crop Insurance Corporation. At present there are only circa 30 policies issued amongst the 65,000 US dairy farmers[24].

Herd retirement schemes

In the US an industry directed and funded supply balancing program has been operational since 2003. This initiative organized by Cooperatives Working Together (CWT) will have financed the removal of herds with a total production capacity of 4.8 billion pounds of milk since December 2008. This represents approximately 2.5% of 2008 production. The current scheme is the ninth and, while each had reduced the national herd, overall milk production has increased steadily from 2003 to 2008 despite the six retirement schemes during this period (Table 3). This increase is attributed to higher yields and the result of more selective breeding (for example the use of sexed semen).

Table 3: USA Milk Production (Million pounds) and Annual Growth Rate

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Production	167,393	165,332	170,063	170,394	170,934	176,929	181,789	185,602	189,992
Growth %	2.95	-1.23	2.86	0.19	0.32	3.51	2.75	2.10	2.37
Herd Size (000,s)	9,199	9,103	9,139	9,083	9,012	9,043	9,112		9,260

Source USDA

[23] The difference between the cash price of commodity at a specific location and the price of a specific futures contract is known as basis.

[24] From private correspondence with the RMA.

While some critics feel the scheme is an expensive method used to cull less productive cows on small farms, data from the latest scheme suggests otherwise as both average herd size at 298 cows and average production at 20,884 lbs are slightly above the national average. These schemes are voluntary thus creating a free rider problem, however while mandatory participation would solve this problem it is possible that such a move may contravene World Trade Organization (WTO) rules. A further criticism lies in the negative effect on the beef industry as extra meat enters the supply chain. From an EU perspective the Commission view is encapsulated in the following quote from its recent report on the dairy market situation to the Council[25] *"The most direct way to reduce supply is to eliminate production before it takes place by reducing cow numbers (not necessarily whole herds). However an immediate effect can only be reached by slaughtering cows with an EU subsidy. It will be difficult to justify spending taxpayers money for such a measure"*

Managed expansion and Volume Contracts

The Holstein Association USA, for example, has proposed limiting milk supply by taxing increases in production. Under this proposed scheme those who increase supply over the previous year pay into a pool which helps support the existing producers who decide not to expand. This could allow a fixed expansion per period and thus provide milk processors with greater control and enhanced planning. However it is felt that this proposal would not only penalize many dairy producers all over the country, but could also artificially raise domestic milk prices and make U.S. dairy products less competitive on world markets. It is also felt that taxing new milk production will limit the industry's ability to modernize, innovate and grow because of the infrastructure investments required for the increased milk supply. Furthermore an advisory board would be required which would set the amount of milk needed and the market access fee per hundredweight. The composition of any such board may be contentious. This scheme is similar to an A and B quota system and would thus suffer from a number of negative connotations. A variant of this type of scheme has existed for a number of years in New Zealand (peak notes) as part of their milk pricing model.

The priority the US assigns to risk management may be gauged by the dedicated role played by the Risk Management Agency (RMA) which is part of the U.S. Department of Agriculture. The goal of the agency is to help producers manage their business risks through effective, market-based risk management solutions. RMA's mission is to promote, support, and regulate sound risk management solutions to preserve and strengthen the economic stability of US agricultural producers. RMA provides crop and livestock insurance to American producers and will for example administer the LGM-Dairy which was discussed above. In addition this agency sponsors educational and outreach programs and seminars on the general topic of risk management. Its promotion and administration of the Dairy Options Pilot Program can be seen as falling within this remit.

While it is beyond the scope of this paper to gauge the success of these measures in helping US dairy farmers manage price risk, it is interesting to note the growth in US

[25] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0385:FIN:EN:PDF

milk production from 2000 to 2008 (Table 3). During this period production rose by almost 13.5% while in the EU a number of countries now fail to even fill their quota.

5.5 New Zealand

New Zealand plays a pivotal role in global dairy trade as it accounts for approximately 40% of all such trade (excluding intra-EU trade). Within New Zealand, Fonterrra Co-operative Group Limited (Fonterra) is the dominant processor and trader accounting for circa 95% of the industry with an annual turnover of NZ$14 billion. In recent months, as a first response to requests from many customers to provide a greater degree of price-risk management, it has developed globalDairyTrade, an internet-based electronic trading platform through which Fonterra will sell a portion of its commodity products[26]. Through monthly auctions it expects to sell approximately 200,000MT of WMP covering Regular, Instant and UHT during the first year of operation[27]. On its website globalDairyTrade claims that it offers Fonterra's customers and supply partners improved price transparency, forward price information and enhanced price risk management. It offers three contract maturities with different delivery periods allowing traders to 'mix and match' these maturities to create a delivery profile that closely meets their needs. The three contract periods are:
Contract Period 1: A 'near-spot' contract that provides for product to be shipped during the third month after the trading event;
Contract Period 2: A contract where shipment begins in the fourth month following the trading event and continues in equal monthly deliveries for three months; and
Contract Period 3: A longer term contract where shipment begins six months after the trading event with the duration being three months.

Fonterra intends to make other commodity products available through *global*DairyTrade as soon as it is practical. Skim Milk Powder (SMP) and Anhydrous Milk Fat (butter oil) are likely to be the next products added to the platform[28]. It is interesting to note that all prices are quoted in US dollars. Also, while still at an embryonic stage, sharemarket operator NZX plans to launch a derivatives trading platform in late 2009, kick starting it with milk futures and energy options, among other instruments.[29]

5.6 Summary and Conclusions

There are a broad range of instruments, both public and private market, which may be utilized to manage price/income volatility. This reflects the fact that market participants inhabit the full spectrum from risk averse to those willing to assume greater risk in return for enhanced returns. Furthermore, as the European Commission acknowledges, the nature and extent of the risks faced vary throughout the EU and "an EU-wide solution (based on a "one-size fits-all" approach) would not be appropriate" (EU 2007)[30]. These observations imply that a suite of instruments may be

[26] For further details see http://www.globaldairytrade.info/DesktopDefault.aspx?tabid=427
[27] The first auction in July 2008 saw 5,000 tonnes transacted.
[28] See http://www.globaldairytrade.info/DesktopDefault.aspx?tabid=427#sec1
[29] See http://www.businessday.co.nz/market/4689267

[30] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52007DC0722:EN:NOT

required to manage the emerging problem of price volatility in the EU dairy industry and that uptake of these instruments must be on a voluntary basis.

All of the private market instruments mentioned above require high quality and timely market information which is easily sourced. At present data on stocks, production, prices and markets are difficult to source and often dated when located. This presents a strong argument for the establishment of a dedicated agency which will ensure that transparent, timely and comprehensive data is freely available. The free availability of this data would provide a vital incentive for the establishment of the private market instruments. The level of free data dissemination provided by the USDA and US extension colleges provides a useful template and clear direction for the European Commission. The successful introduction of these instruments requires that the intended clients are aware of and understand these instruments. The European Commission can provide encouragement in this area by establishing educational programmes and promotions. These promotions could for example provide subsidised trades[31] or subsidised premiums. Furthermore the development of these instruments will require regulation and oversight. Again this appears to be a role for the Commission. Given the diverse nature of these tasks it may be suggested that an agency somewhat similar in nature to the U.S. Risk Management Agency may be appropriate.

Market participants will have to play a crucial role in the provision of verifiable and timely market data which will need to be presented in a transparent manner. This transparency should facilitate forward contracting on a voluntary basis. Likewise processors may need to follow the example of DairyLea in the US and provide financial instruments such as futures, fences and straddles to its suppliers. In turn farmers may be expected to hedge or insure risk or otherwise cope with more volatile prices. Insurance policies which cover income may be desirable as this would protect producers in instances of price squeezes as recently experienced. Such policies may require subsidisation or re-insurance by the Commission. Contracts may have to explicitly acknowledge price volatility or else the parties will have to assume their own responsibility for managing it.

It is desirable in the interim that some public policy instruments such as counter cyclical measures are maintained in order to moderate the effects of high price volatility. However it has to be acknowledged that such measures may inhibit the development of private instruments. A clear example is the contention that the high level of market management slowed the rate of uptake of private instruments in the U.S. Furthermore as the number of instruments employed expands there is a greater probability that they will work at cross purposes. For example in the U.S dairy farmers are on the one hand offered counter cyclical insurance policies which serve to maintain the national herd while at the same time receiving incentives to reduce herd size by the CWT herd retirement programme. A further point to note is that significantly greater levels of price volatility have been faced by US dairy farmers in recent years (see figure 15). While it is farm income rather than milk prices which

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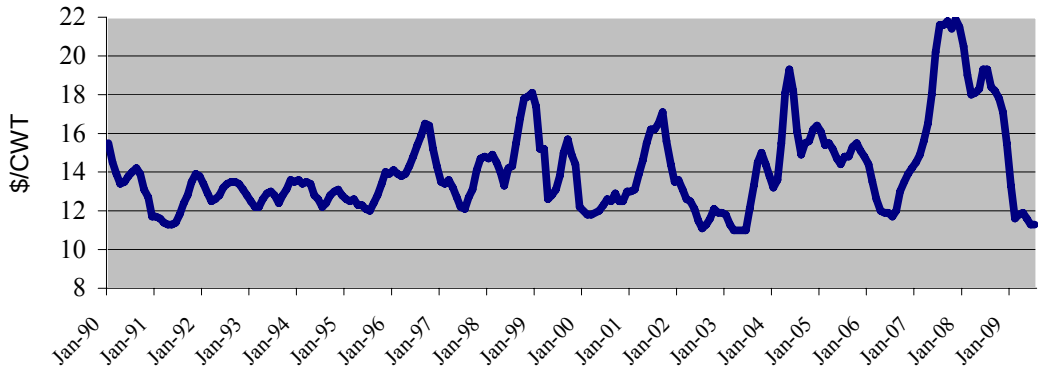
[31] In the US the Dairy Option Pilot Program (DOPP) was used to promote trading.

determine the long run viability of the sector this chart demonstrates the challenges faced by the US industry.

Figure 15: Average US Farm Gate Milk Price



It is necessary to acknowledge that any single instrument is unlikely to manage price risk for all industry participants given the diverse nature of the EU dairy industry. Furthermore some tools currently exist which may benefit the EU dairy industry. Futures markets exist for many dairy sector inputs such as energy and feed. Their usefulness in a dairy context should be explored. Likewise the potential of weather derivatives to manage climatic and yield risk may require further consideration. Indeed the extensive menu of instruments and services provided in the US, though sometimes seeming to be somewhat contradictory, confirms that the USDA sees management of price risk as participant specific and a process which continues to evolve with a role for public and private institutions. The European Commission, by stating its desire to substantially withdraw from market support and management, has encouraged the private market to begin to provide price risk management services to the dairy industry. This reliance on the private market would appear in itself to be risky, however by providing support through data dissemination, education, promotion and incentives to avail of these private instruments, the European Commission could greatly help in the successful development of such instruments which will help ensure the long run competitiveness of this most important agricultural sector. However, should these instruments fail to launch, or launch unsuccessfully, and the European Commission proceeds with its withdrawal from its market management role, then the consequences for the future of the EU dairy industry could be serious. In conclusion now is the time for the EU to investigate risk management options, and to review, examine and possibly even pilot some schemes as both its' own and global policy initiatives suggest that an era of much freer trade in dairy products is rapidly emerging.

6 Public policy instruments and price stability

6.1 Introduction

Many public policy instruments are familiar as they have been utilised in the EU dairy market over the past four decades. Following a general discussion of the influence of dairy policy on price volatility the focus in this section will be on the influence of EU milk quotas, inventory and buffer stocks, import tariffs and export subsidies on price volatility.

6.2 Price Volatility and Dairy Policy - General

6.2.1 EU

Increased price volatility in dairy commodity markets has also been greatly accentuated by the gradual reduction in the various policy instruments that contributed to price stability in the past. Market stability was a core objective in the original Article 39 of the Treaty of Rome. This stability objective was encapsulated for many years in the EU dairy sector through the concept of the target price for milk. The basic policy instruments developed for the dairy sector, (reg. 804/68, variable import levies, intervention buying, variable export refunds and internal market supports), together with the subsequent quota policy in 1984, did create much greater market stability than would have been the case without such active EU market management. Now however, as these market stabilisation policy instruments have been steadily reduced, internal EU markets have become much more volatile. The abandonment of the concept of a target price for milk and, in association with this, the steady reduction in EU market support policies has affected all of the main policy instruments that had contributed to market stability. In principle the movement from variable import levies to specific (or ad valorem) and declining tariffs (GATT Uruguay Round) is a key enabling driver in the "importing" of greater price volatility from the world market, and is consistent with the key mechanism by which almost all global markets have moved to much freer trade since GATT was established in 1947. While in practice tariff reductions to date have had a much lesser impact than other policy changes, further tariff reductions proposed under the Doha trade round and in subsequent prospective trade rounds will further accelerate this trend. Of other major policy changes, the steady restriction of intervention buying together with the approximately 20% reduction in intervention prices (25% butter and 15% SMP) under the Luxembourg Agreement created much greater price volatility as the latter has for example permitted a further 20% price movement on the downside during periods of market weakness as recently experienced. Likewise the restrictions in export refunds, as well as restrictions in internal market supports have in practice contributed much more substantially to increased price volatility in internal EU dairy markets.

6.2.2 US

Price volatility has been taken very seriously at Federal Policy level in the US. In July 2009 the Subcommittee on Livestock, Dairy, and Poultry of the house committee on agriculture conducted a public hearing to review the economic conditions facing the dairy

industry[32]. In addition the establishment of a high level advisory committee to address price volatility and related issues in the US dairy sector has recently been announced (August 2009) with the following press release[33].

"Agriculture Secretary Tom Vilsack today announced that as part of USDA's continuing efforts to listen to and respond to the needs of producers in the dairy industry he is moving forward on establishing the Dairy Industry Advisory Committee and is requesting nominations. "The Obama Administration is committed to working with all sectors of the dairy industry to develop changes to the dairy pricing system to avoid the boom and bust cycle behind the crisis facing many dairy farmers this year," said Vilsack. "The input provided by the members of this committee will play an important role in building a more stable market for dairy producers for years to come."

Once appointed, the committee will review the issues of farm milk price volatility and dairy farmer profitability. The committee will also offer suggestions and ideas on how USDA can best address these issues to meet the dairy industry's needs. USDA is establishing the committee under the authority of the Federal Advisory Committee Act of 1972. The Secretary of Agriculture will appoint up to 15 representatives of the dairy industry to serve in an advisory capacity on the Committee. Representatives will include: producers and producer organizations, processors and processor organizations, handlers, consumers, academia, retailers, and state agencies involved in organic and non-organic dairy at the local, regional, national and international levels".

The recent announcement by the EU Commission that they propose to establish a working group of experts from the Member States which will look, among other things, at contractual relations between farmers and the dairy industry, the results of the report into the workings of the food chain in the dairy sector and the possibility of a dairy futures market must also be seen as a welcome development.

6.2.3 Other Countries

The use of export taxes in both Argentina and India also provide a clear example of how policy effects price volatility. It may also be argued that the production quota in Canada has encouraged production constrained farmers in that region to develop alternative sources of income which has lead to a trade in heifers, embryos and sexed semen with the US which in turn has accelerated expansion in that region. Likewise policies in China, Russia and other countries can have global consequences leading to greater price volatility.

Price volatility and public policy are now discussed in detail in relation to milk quota policy, product inventories and import tariffs.

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[32] See http://agriculture.house.gov/hearings/statements.html

[33] See http://www.usda.gov/wps/portal/!ut/p/_s.7_0_A/7_0_1OB?contentidonly=true&contentid=2009/08/0399.xml

6.3 Price Volatility and Milk Quota Policy

While the introduction of the milk quota regime in 1984 helped to stabilise the EU dairy industry at a time of crisis, its effect on price volatility is complex. While at one level quota policy prevented further price falls over the years on falling markets as it inhibited further production which would have accentuated the falling prices, milk quotas have also prevented increased production response at times of rapidly rising prices. Such production responses, if permitted, would have lessened price peaks on those occasions. The effect of quota policy on both price peaks and troughs is now briefly outlined from an economics perspective.

6.3.1 Milk Quota Policy and Price Peaks

Assume that market equilibrium in the absence of a quota policy is represented by price P1 and production by Q1. In the EU, as technology drove expansion in milk production prior to the introduction of the quota regime, market prices would have fallen rapidly in the absence of the market support mechanisms. (For simplicity neither the growth in milk production, which would be represented by a shift in the supply curve to the right, or the EU price support mechanisms are illustrated in Fig 16). Milk quotas were introduced in 1984 to avoid the prospect of the market support system being overwhelmed with surplus produce purchased at the prevailing intervention price. Market equilibrium under the milk quota regime is represented by Q2 (quota) and P2 (price). (The milk supply curve in effect becomes S1 A S2, Fig 16). Market volatility has meant that on some occasions. such as 2007, prices have moved to unprecedented high levels. The causes of this aspect of volatility are represented in simplified terms by a shift in the demand curve to the right from D1 D1 to D2 D2. Given the quota regime as represented by Q2, price levels then rise very steeply to P3. If the quota regime had not been in place during this period of strong market demand, price levels would have risen much more modestly to P4, with production rising to Q3 (Fig 16). Thus a rigid quota system in this specific circumstance can be shown to have contributed to increased price volatility.

6.3.2 Milk Quota Policy and Price Troughs

Using a similar approach to the above, the various causes of low prices are represented in simplified terms by a shift in the demand curve to the left from D1 D1 to D2 D2 (Fig 17). This is reflected in a very large fall in price from P2 to P3 under a rigid quota regime. If however adjustments are made to the quota regime such that volume is reduced as shown by a shift in the quota from Q2 to Q3, then price can increase significantly from P3 to P4 (Fig 17). It could be claimed that this theoretical response may be reflected in practice to some extent at least as a result of the recent European Commission policy suggestion whereby those individual producers who exceed their quota will be liable for levy regardless of the national quota limit situation, with the funds generated used for voluntary retirements or redistribution to priority groups.

In overall terms it has been demonstrated that an inflexible quota regime can contribute to increased price volatility both in respect of price peaks and price troughs.

Figure 16: The Milk Quota Regime and Price Peaks

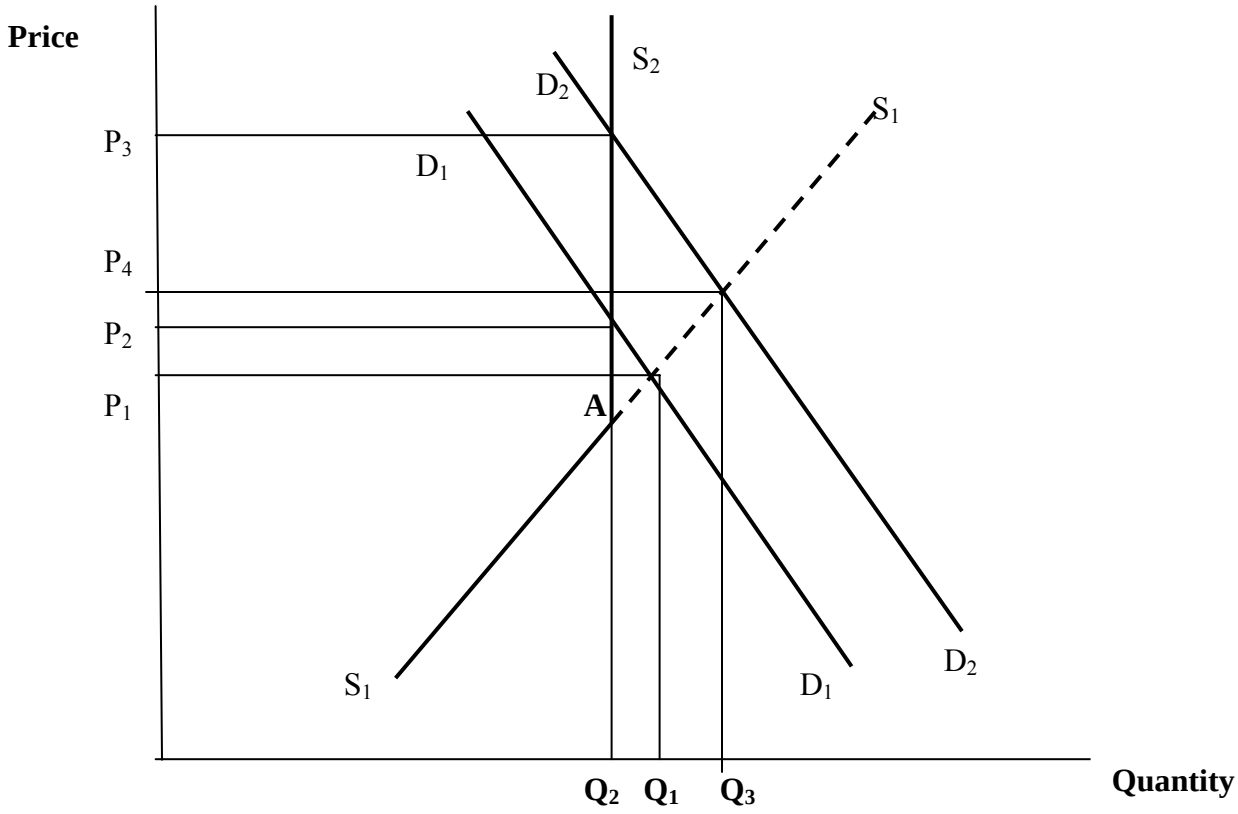
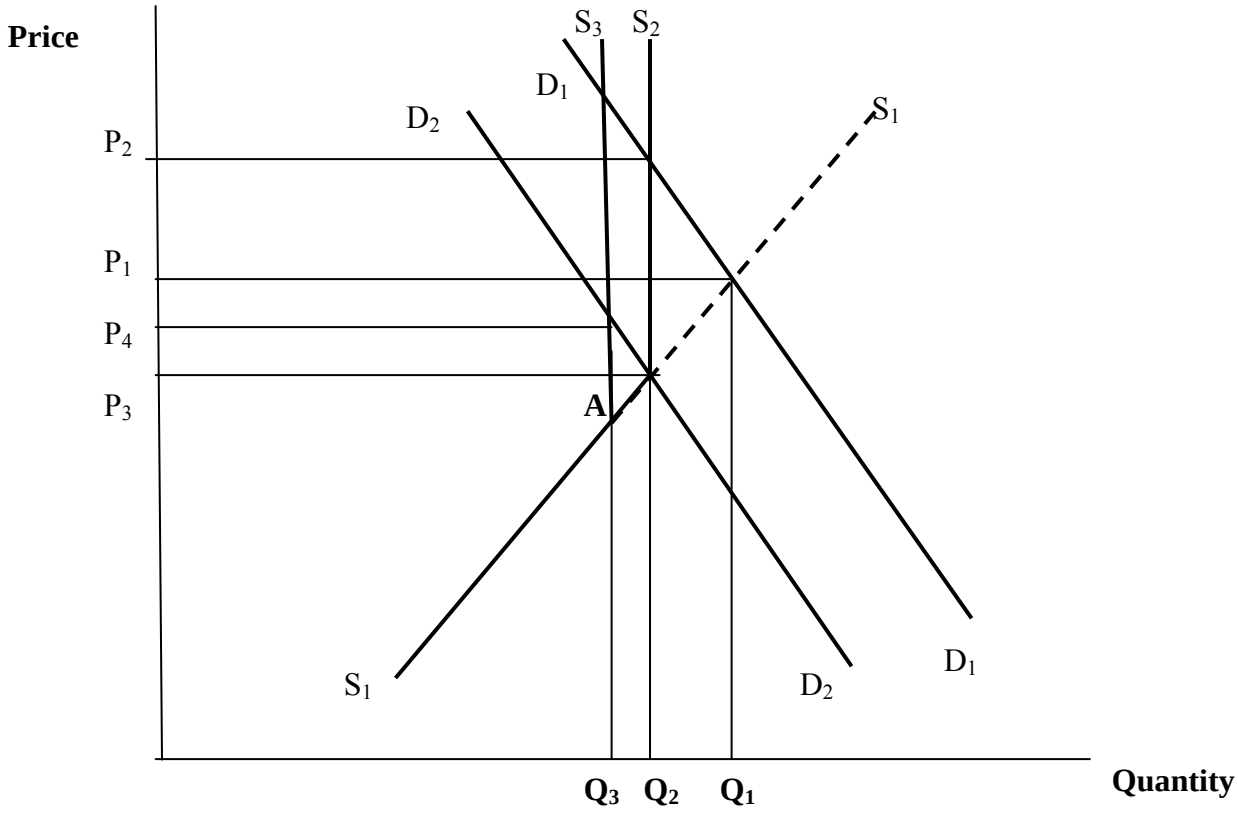


Figure 17: The Milk Quota Regime and Price Troughs



6.4 Price Volatility and Product Inventories

Product inventories may be classified into a number of sub-categories, working inventory, seasonal inventories, carryover (year to year) stocks, long term reserve or buffer stocks and speculative stocks. The management of inventories can act to substantially lessen price volatility as now briefly discussed in an economics context.

In the case of storable products such as SMP and butter, buffer stocks can be built up in "surplus" market conditions such as times of business cycle and demand weakness combined with increased production. Taking this production off the market (public or private storage) can help to stabilise prices in a falling market in the short term. If demand conditions strengthen and also production is reduced, creating conditions leading to high prices, the timely release on to the market of the buffer stocks will help to lessen price volatility thus contributing to greater price stability.

Intervention Purchasing and Stockholding

This measure is employed in both the EU and US and can be considered to have an impact on both local and world prices in the short run. By entering the market it places a floor on domestic prices while strengthening world market prices as both these regions are dairy exporters. In the long run, however, it may be argued that this measure will keep more supplies in production in the supported region than would otherwise be the case. Furthermore when the markets recover the disposal of built up stocks will dampen the upswing in dairy product prices as these stocks will lead to greater competition in the market than would otherwise be the case. Intervention purchasing also creates an incentive for processors to produce the eligible commodities regardless of the longer term demand for these commodities, thus compounding future negative effects. In addition intervention purchasing may not place an absolute floor on market prices as the high production standards exclude certain produce which may now be forced to trade at a discount to the intervention price as not all processors meet intervention requirements.

Nonetheless engagement in counter-cyclical stock-holding appears sensible in the short run as a means of mitigating the effects of extreme price volatility. That is provided the intervention price is not set above the long-run market equilibrium. However the use of this instrument may be limited in the future if as is expected amber box subsidies are to be severely curtailed under proposed Doha Round.

6.5 EU Stocks and Price Volatility

Changes in EU SMP and butter intervention stocks from January 1990 to February 2009 show very wide variation, with stocks for both products peaking in the early 1990's, with lesser peaks in the late 1990's and in 2003/2004 (Fig 18). Virtually zero stocks occurred in 1995/1996, 2001 (SMP) and in 2007/2008.

When stocks are related to EU and world market prices for SMP, the very high price peaks in 2007/2008 and to a lesser extent in 2001/2002 coincided with a period of stocks exhaustion, thus the absence of the capacity to manage price volatility through timely

release of stocks is evident (Fig 19). Likewise in the case of butter, the virtual exhaustion of stocks in the 2007/2008 period again removed the capacity to manage price volatility at that time (Fig 20). The use of buffer stocks to act as a very useful instrument in the lessening of price volatility, as well established in economic literature, is now discussed in a brief technical section.

Figure 18: EU Intervention Stocks

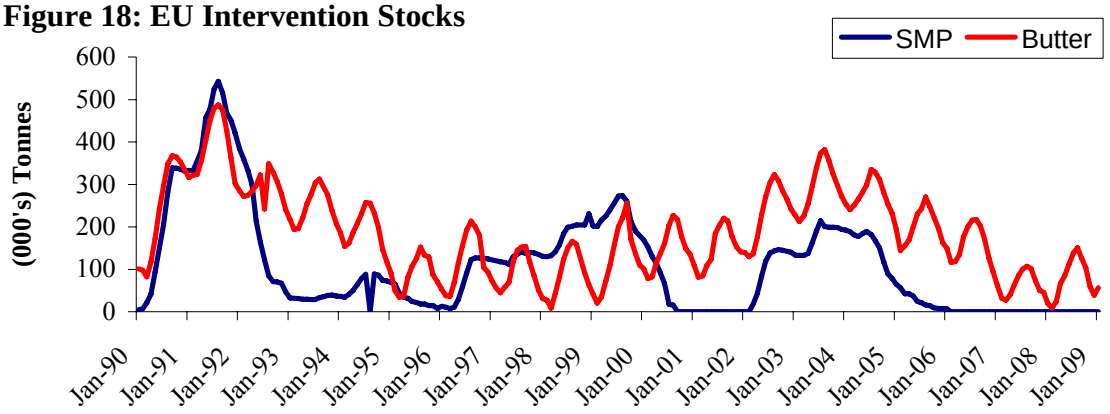


Figure 19: SMP Inventory and Prices

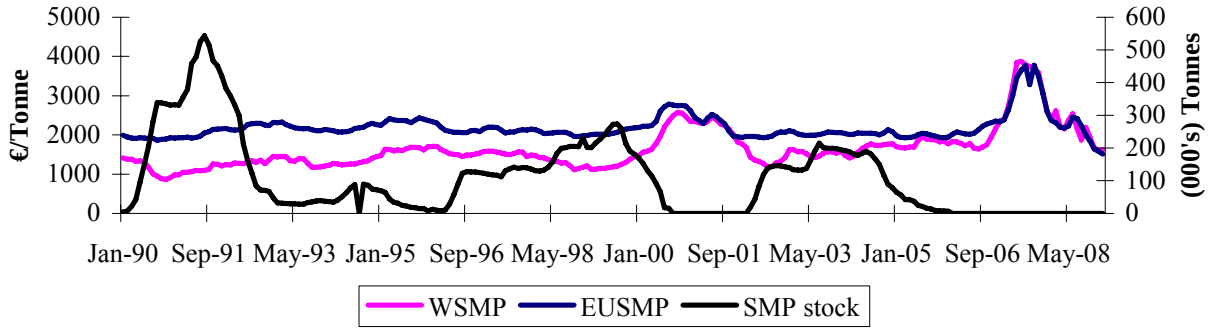
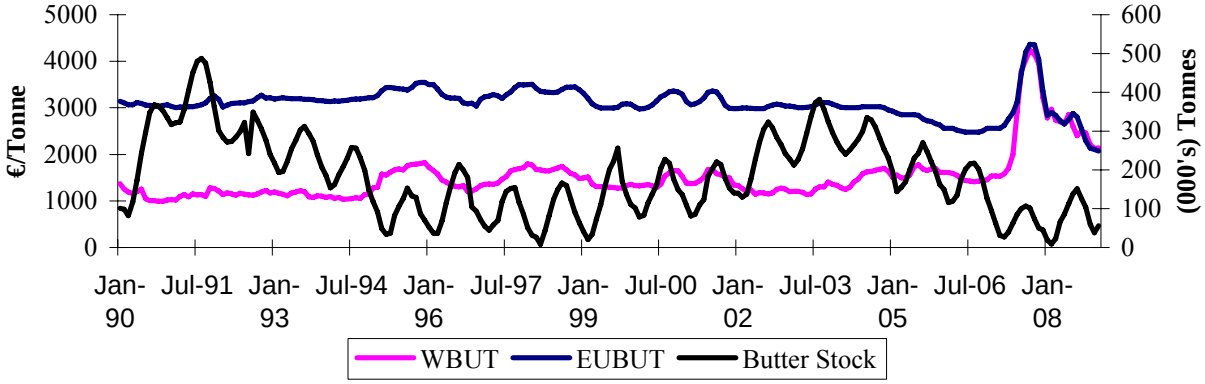


Figure 20: Butter Inventory and Prices



6.6 Price Volatility, Buffer Stocks and Market Stabilisation – Technical

Extreme price volatility increases the risk of investment for farmers and processors, and production cycles in response to volatile prices reduce capacity utilisation and thus increase cost at both farm and processing levels. Extreme price volatility at farm and processing levels is also likely to lead to price variation at consumer level which may be considered undesirable. Consequently governments, the EU or the private sector can attempt to stabilise prices so as to avoid these adverse consequences. One approach is for government/EU to manage buffer stocks to seek price stability. Such a buffer stock scheme operates by storing a portion of the stock during periods of high production for subsequent release into the market during periods of low production. A simple economic explanation of this is provided in Figure 21[34].

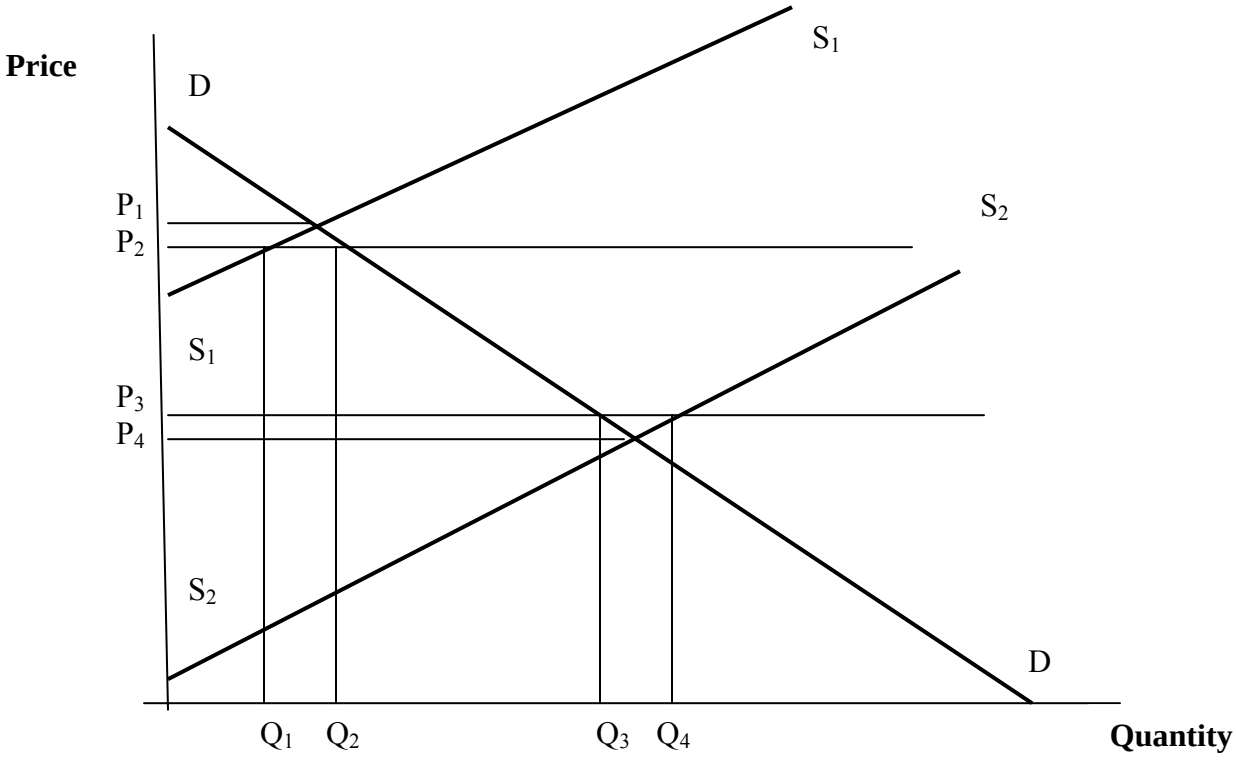
Assume for simplicity that high and low periods alternate with equal frequency and offsetting consequences. The supply curve representing low production is S1 S1 and with no government intervention the price would rise to P1. In periods of high production represented by S2 S2, the free market price would fall to P4. Suppose however government sought to stabilise the market and reduce price volatility. In the high production period government could buy an amount Q3 Q4 and, by taking this volume off the market, price in this period would rise from P4 to P3. This volume constitutes the buffer stock. In the following period of low production, the government can release its buffer stock into the market, shown as Q1 Q2. This would serve to reduce price from P1 to P2. Thus the extreme price volatility between P1 to P4 in the absence of government market stabilisation activity is considerably reduced to price movement from P2 to P3 through the government adoption of a buffer stock market stabilisation scheme. As well as government, private firms may also engage in such a market arbitrage scheme, all of which can contribute to the evening out of the amplitude of price fluctuations. It may be noted in passing that this buffer stock operation to lessen market volatility can be

[34] Reference: Matthews A: Supply and Demand Applied to Agriculture; in Norton D. Economics for an Open Economy; Oak Tree Press.

profitable for the government or agency involved as it will be buying stock at a low price and selling it at a high price while incurring the cost of storage.

This is a simple economic representation in a closed economy model of what in practice could be extended to include more complex market dynamics including open market and international trade dimensions, however it is hoped that it is sufficient to provide an introduction to the fundamentals of buffer stocks and price volatility issues from an economics perspective.

Figure 21: Buffer Stocks and Price Volatility



In overall terms it has been demonstrated that inventories can be used to successfully alleviate extreme price volatility. Given that the European Commission is accumulating substantial stocks as part of its current crisis market management activities, it in effect has a further powerful policy instrument to lessen price volatility. The strategies available include

- Maximize revenue by selling at highest attainable price the stocks bought at low price
- Release stocks gradually and judiciously into the market so as to minimize market disruption
- Hold stocks as long-term buffer stocks so as to alleviate occasional extreme price volatility
- Combinations of the above

If extreme price volatility is to be avoided, an enlightened strategy with regard to inventories can make a very valuable contribution.

6.7 Price Volatility and Import Tariffs

Negotiations under the WTO Doha trade round involve proposed tariff reductions. These proposed reductions can take the form of specific (fixed amount) or ad valorem (percentage) tariffs. A brief technical economic illustration of the effect of these different forms of tariffs on price volatility is now provided.

Price Volatility and Tariffs – Technical Economics Explanation

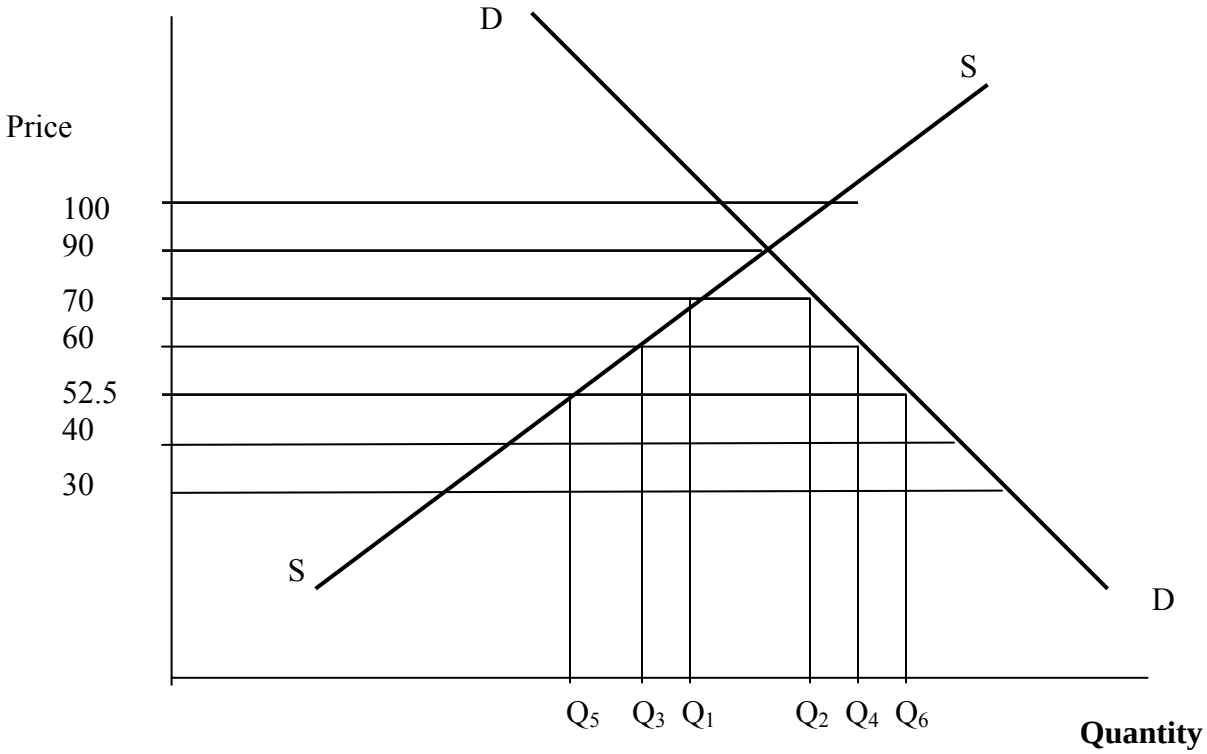
Suppose the original world market price is 40 and the specific tariff in the protected market is 60, or in equivalent terms the ad valorem tariff is 150% (60/40*100%). (It may be further assumed that the actual market price in the protected market is 90 so that there is a "protection margin" of 10 and the market is just self sufficient). Now suppose tariffs are halved, with the specific tariff falling from 60 to 30, or alternatively the ad valorem tariff falling to 75%. If world price remains at 40, the internal price in the protected market would now fall to 70 and imports would increase from zero to Q1 Q2. This outcome would be identical for either the changed specific or ad valorem tariff. If however due to market volatility the world price fell to 30, with a specific tariff of 30 the price in the protected market would fall from 70 to 60 and imports would increase from QI Q2 to Q3 Q4. However with an ad valorem tariff of 75%, price in the protected market would fall from 70 to 52.5. (The ad valorem tariff applied of 75% would result in a tariff of 22.5, 75% of 30). In this case imports would increase further to Q5 Q6. The effect of an ad valorem tariff rather than a specific tariff in this instance would be that the price in the internal market would be lower, 52.5 versus 60, while imports would increase by the amount Q3 Q5 plus Q4 Q6 (Fig 22). Thus, as demonstrated in this particular analysis, ad valorem tariffs result in increased price volatility when compared with specific tariffs.

6.8 Price Volatility and Export Subsidies

Export subsidies in general, such as EU export refunds, DEIP in the US and private sector equivalents such as under CWT(Export Assistance Program), have the effect of stabilizing prices on the internal market as they have a countercyclical effect in their application in the context of changing world market prices as demonstrated in various economic textbooks[35]. In the absence of these export subsidies, price volatility would be increased in the internal market and reduced in the world market.

[35] Matthews A: Supply and Demand Applied to Agriculture; in Norton D. Economics for an Open Economy; Oak Tree Press.

Figure 22: The Effect of Fixed and Ad Valorem Tariffs on Price Volatility



6.9 Summary and Conclusions

Price stability in EU dairy markets was a key feature of policy prior to the Luxembourg Agreement, however the reduction of price support to the much lower "safety net" level has left EU internal markets much more exposed to price volatility. In the US the Agriculture Secretary has recently announced a high level Dairy Industry Advisory Committee to seek "to avoid the boom and bust cycle" and help build "a more stable market for dairy producers for years to come".

The effect of some specific policies on price stability were analysed in detail including milk quota policy, policy towards product inventories and import tariff policies. It was shown that an inflexible milk quotas policy accentuated price volatility. The recent accumulation of public stocks has meant that the European Commission now has a de facto policy instrument, the management of which can have significant consequences for price volatility. The adoption of a buffer stocks policy approach was analysed in detail. Finally the advantages of a specific tariffs policy compared with an ad valorem tariffs policy as a means of maintaining greater price stability in the internal EU market was demonstrated.

7 Lessons from other sectors

7.1 Introduction

Each of the agricultural sectors may be considered unique with its own individual characteristics. For example in the case of the EU dairy sector the following characteristics help to distinguish it. Raw milk which is produced throughout the year is perishable and thus requires immediate processing. The organisational structure differs in the dairy sector as it consists of farmer co-operatives to a greater extent than other sectors. With regard to the production cycle, much of the crops sector has an annual harvest while the cattle cycle is relatively longer term. While it may be possible to increase or reduce milk supply in the short run by altering the level of feed concentrates consumed, in the dairy sector structural adjustment is slow. The dairy sector also has few private market led responses to price risk management. Expansion in dairying requires a high level of capital investment, particularly in recent years due to additional environmental compliance requirements.

While some sectors may share some of these characteristics none share all. This makes a direct comparison with other sectors difficult, however some general trends along with comparative levels of volatility may be established. This section now proceeds with a review of two recent studies which consider price volatility in commodity markets, followed by a brief discussion of futures markets in other sectors**.**

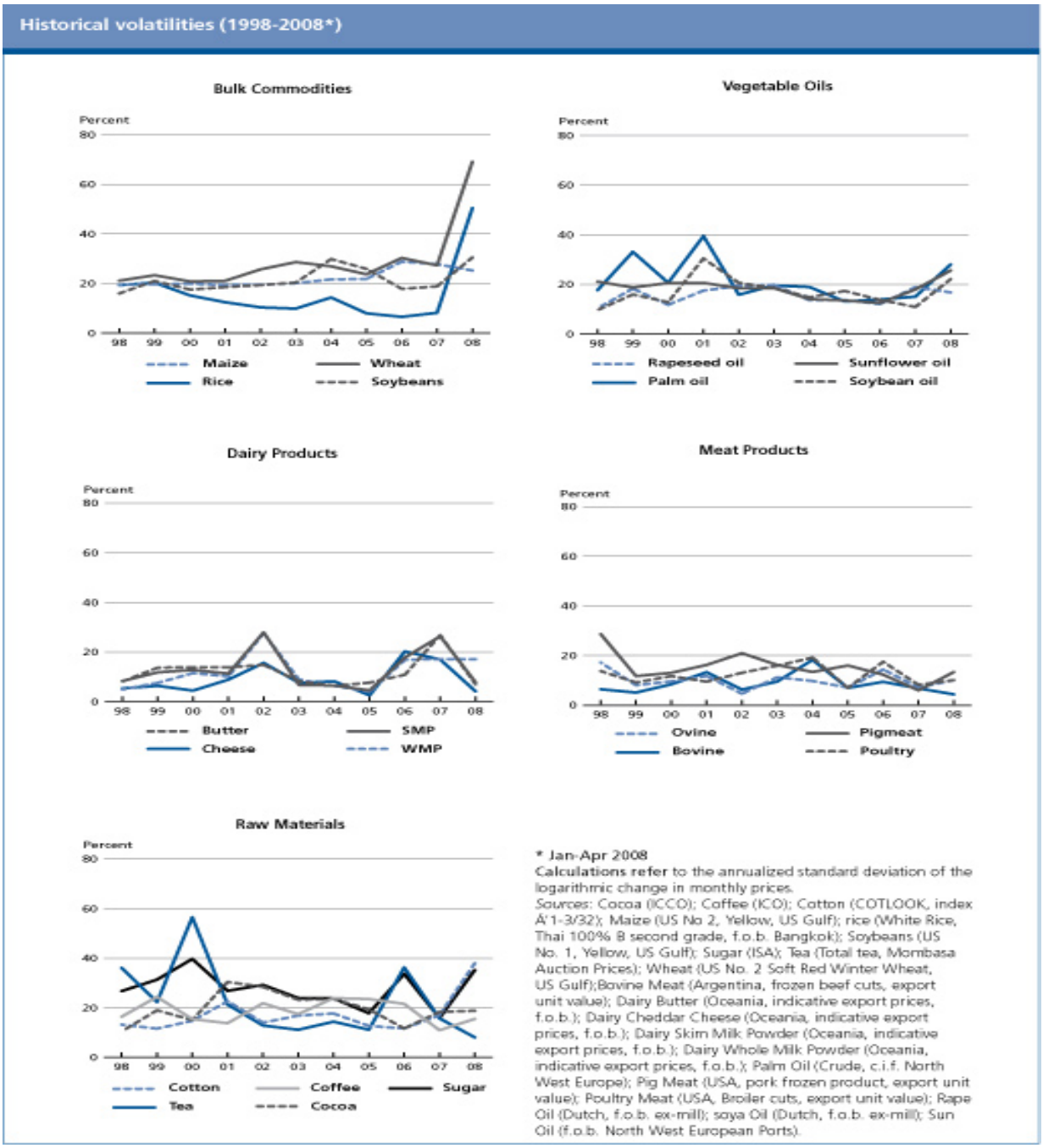
7.2 Comparisons of Volatility between Sectors

In June 2009 the FAO published a special feature titled "Volatility in Agricultural Markets" as part of its Food Outlook Global Markets Analysis. This report considered both the historic and implied volatility of a number of agricultural commodities. As historic volatility is calculated from past data, caution is required with regard to any inferences for the future as changes in market dynamics may limit the benefits from such analysis. The future is rarely a carbon copy of the past. Implied volatility represents the market's expectations of how the price of a commodity is likely to change in the future. These expectations can only be inferred from the prices of derivative contracts such as "options". So implied volatility measures the uncertainty around these estimates of the prices of these "options" at some future date. In this FAO report the historic volatility is computed in technical terms as the annualised standard deviation, while the Black Scholes option pricing model is used to compute the implied volatility[36].

The evolution of the historic volatility of a number of agricultural commodities is presented in Figure 23. A closer examination of these graphs reveals that the volatility of the dairy commodities is relatively low (below 20%) for most of the period examined (1998-2008), with SMP considered the most volatile.

[36] The Black-Scholes option pricing model is a complex mathematical formula created by Fischer Black and Myron Scholes, used to calculate the theoretical present value of a financial option at the grant date using variables such as stock price, exercise price, volatility, and expected option term to exercise.

Figure 23: Historic Volatility of Selected Commodities.



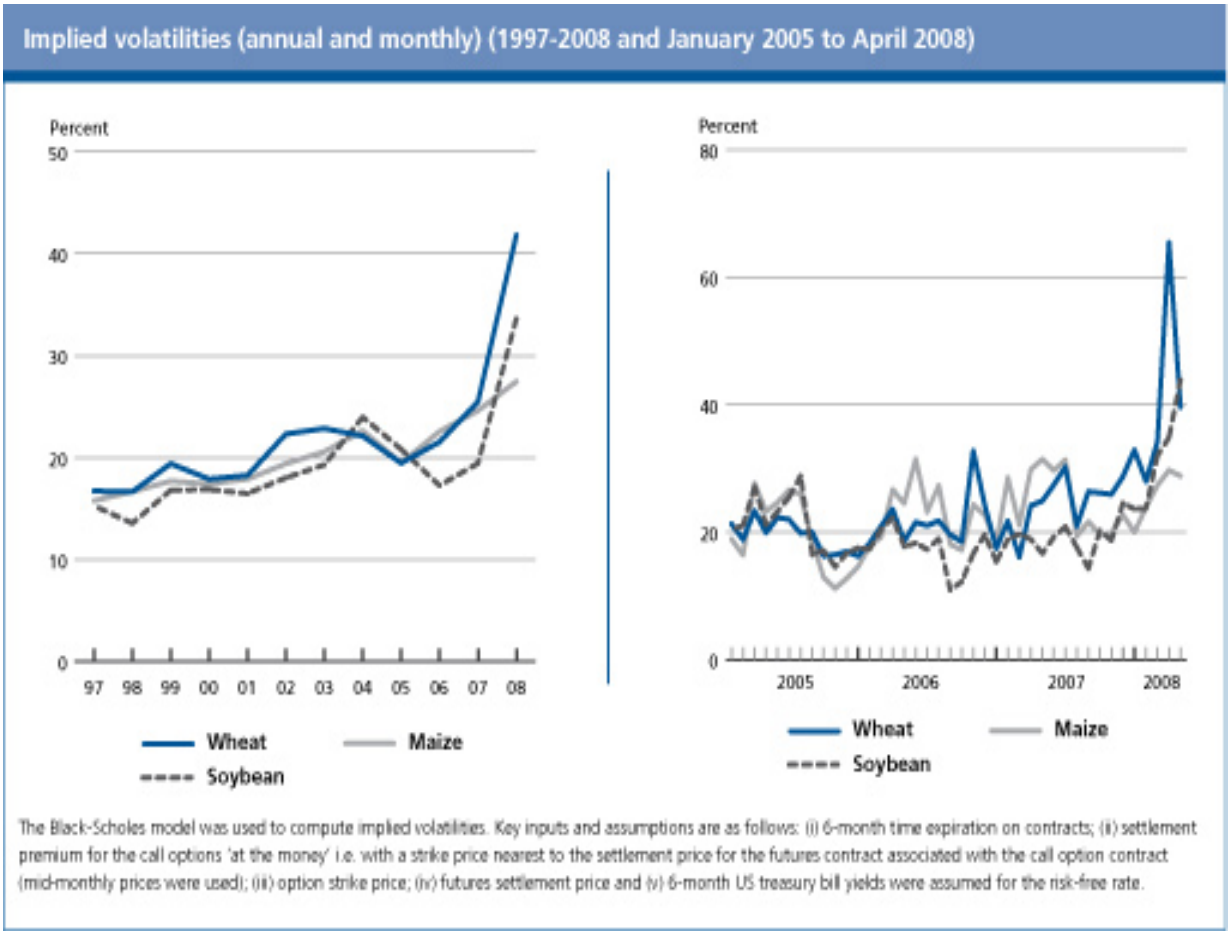
Source FAO: Food Outlook (2009)

The levels of volatility experienced for dairy products were generally similar to that of meat products. In relation to the previous discussion on product substitution, it is interesting to note the consistent (even) levels from 2002 to 2006 for the vegetable oils. These oils, which were quite volatile before this period, appear to have experienced a

degree of resurgence in volatility post 2006. Likewise the relatively high levels of volatility in the raw materials (sugar, tea, coffee, etc) should be noted.

In the case of implied (future) volatility, the evolution of implied volatility of wheat, maize and soybeans traded on the Chicago Board of Trade (CBOT) is presented in Figure 24. These graphs show that the implied volatility has been increasing steadily. The chart on the right gives a more detailed view of more recent volatility and highlights the recent increases, with volatility exceeding 30% for most of this recent period and peaking at over 60% for wheat in March 2008.

Figure 24: Implied Volatility of Selected Commodities.



Source: FAO Food Outlook (2009)

These percentages are a measure of deviation in the futures prices (six months ahead) from the underlying expected values. As the report states**,** under reasonable assumptions one can say that the market estimates with 68% probability that prices will rise or fall by the stated percentage in six months time[37]. The report then gives an example of how

[37] Based on the assumption of a normal probability distribution where approximately 68% of observations lie within the range of the mean plus one standard deviation to the mean minus one standard deviation.

traders in wheat had underestimated volatility in April 2007 when the implied volatility suggested that they were 99% certain that the wheat price would not rise by more than half its value yet six months later prices had doubled.

The second report referred to at the outset is contained in chapter 12 of the European Commission's Agricultural Commodity Markets Outlook 2009-2018 published in July 2009. This report again considers the historic volatility of a number of non dairy commodities traded on the Chicago Board of Trade (wheat, maize and soybean oil) and milling wheat and rapeseed on the MATIF (Marché à Terme International de France), France's futures exchange. Again the annualized standard deviation is employed to measure the historic volatility. As expected all commodities show a marked increase in volatility in the second part of the current decade. For US wheat it is possible to identify four distinct periods, with volatility decreasing from 1980 to 1990, then rising in early 2001 followed by a stable period to 2006 before the dramatic increase from 2007 as stated earlier. The volatility of US wheat and maize is then compared graphically with the volatility of crude oil prices. While the oil series in general displays greater volatility, there is greater convergence from the mid part of this decade, with maize in particular following a similar path to oil. This greater convergence is attributed to the fact that maize is the main ethanol feedstock. The relationship between prices, volatility and stocks is also explored in this report. While no straightforward relationship was observed between the CBOT prices and global stocks, an inverse one could be seen at times between US stocks and the prices of maize and soybeans.

7.3 Futures Markets and Risk Management in Other Sectors – Recent Developments

While this important area cannot be explored in depth at this point, two further important reports have recently been published which discuss both EU and US markets.

EU

A report published in 2008, Berg et al "Income Stabilisation in a Changing Agricultural World: Policy and Tools" reviewed many of the policy instruments currently available or being considered within the EU to manage risk and stabilize incomes. Its focus however was primarily at farm level. It discussed in particular:

- The potential consequences of policy changes for risks and uncertainties with respect to farm production, revenue and income
- The opportunities for efficient policy instruments for risk management and income stabilization, both with respect to crisis risk and normal business risk

While much of the discussion is of interest, its primarily farm level focus limits its relevance for this study.

Note that approximately 95% of observations should then lie in the range of the mean plus two standard deviation to the mean minus two standard deviations.

US

A very relevant report has just recently been published in the US by the ERS of the USDA (August 2009) "Traditional Role and Use of Futures Markets: Factors That Support Increased Trading of Agricultural Futures Contracts".

The report notes that the past five years have seen large increases in trading of corn, soybean and wheat futures contracts by nontraditional traders, a trend that coincided with historic price increases for these commodities. It observes that these events have raised questions about whether changes in the composition of traders participating have contributed to movements in commodity prices beyond the effects of market fundamentals. It suggests evidence that the link between futures and cash prices for some commodity markets may have weakened (poor convergence), making it more difficult for traditional traders to use futures markets to manage risk. It discusses the role and objective of new futures traders compared with those of traditional futures traders and seeks to determine if the composition of traders in futures markets has contributed to convergence problems. It examines market activity by focusing on positions of both traditional and new market traders, price levels, price volatility, and volume and open interest trends. Convergence of futures and cash prices is also examined, along with implications and prospects for risk management by market participants. The report also discusses the implications for market performance and the regulatory response of the Commodity Futures Trading Commission. Its conclusions are as follows:

"The emergence of commodities as an asset class has caused a structural change in the level of open interest and composition in futures markets. New players, such as commodity funds, index funds, managed funds, and swap dealers trading with commercial funds have altered the mix of participants in commodity futures markets. The performance of futures markets in their traditional roles of risk transfer and price discovery has been called into question as cash and futures markets have experienced convergence problems in recent years. Issues surrounding price levels, price convergence, and price volatility have caused commercial users of futures markets, such as elevators, merchandisers, and producers, to re-evaluate their pricing and risk management strategies.

The question remains: Are the recent changes in futures market participation and price performance transitory or permanent? The managed and index funds built long positions as prices increased, but their long positions have declined in recent months as prices have declined and become less volatile. These traders do not typically have positions in the underlying cash commodity market, although this too could change. Evidence does show that the link between futures and cash prices has weakened, but market participants continue to use futures markets as a price discovery mechanism. Risk managers have encountered difficulties in managing their price risk due to changing market conditions, but elevators and merchandisers have adapted to the new conditions and have resumed providing risk management products. Regulatory agencies and exchanges have implemented modifications to contract specifications and have acted swiftly to identify the performance problems and discuss or enact solutions. Time and further research are needed to assess whether performance concerns will continue or dissipate in futures markets and whether further modifications in contract design and market regulation are warranted."

7.4 Summary and Conclusions

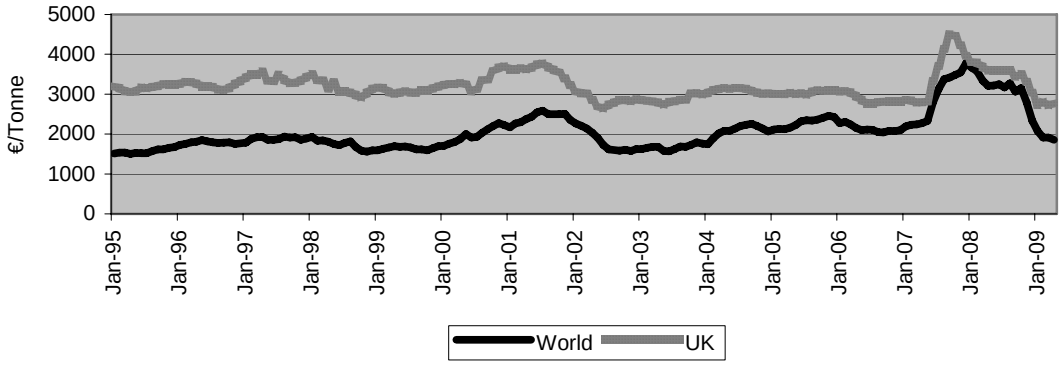
While the dairy sector has many unique characteristics, price volatility for dairy commodities is fairly similar to that of a number of other food commodities. Where more free market conditions have obtained for some other commodities, successful futures markets have evolved over time. As the EU dairy sector is now emerging into a more free market situation, it is likely with appropriate support that a successful futures market can evolve for dairying also. This would be of considerable benefit to industry participants in facilitating enhanced risk management at a time of increased price volatility. However a successful futures market for dairy commodities is likely to require considerable nurturing and support in its initial stages, both from institutional authorities and from the industry itself. Further study of the evolution, success and risks attached in the development of futures markets in other sectors and their consequences for the EU dairy sector is recommended.

Appendix 1 Volatility of cheese prices

Cheese.

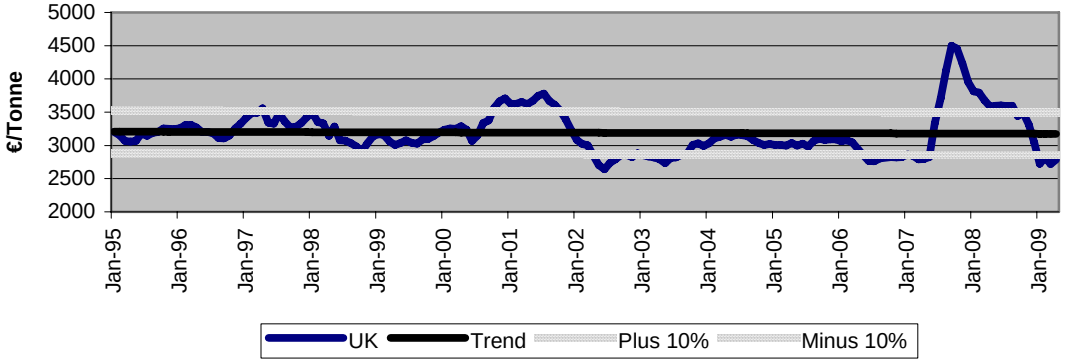
For the current analysis the world cheddar cheese price is taken as the Oceania series as published by the USDA Agricultural Marketing Service, in its Dairy Markets News. This is a bi-weekly series which has been converted to a monthly series. The comparable EU prices used are UK mild cheddar price series sourced from MDC Datum[38]. These series were converted to their Euro values as the world series was originally quoted in dollars with the UK series in pounds sterling. Figure A1 shows the comparable monthly world and UK cheese prices from January 1995 to April 2009. On visual inspection it is difficult to determine whether or not the world series displays significantly greater volatility.

Figure A1: World and UK Wholesale Cheese Prices



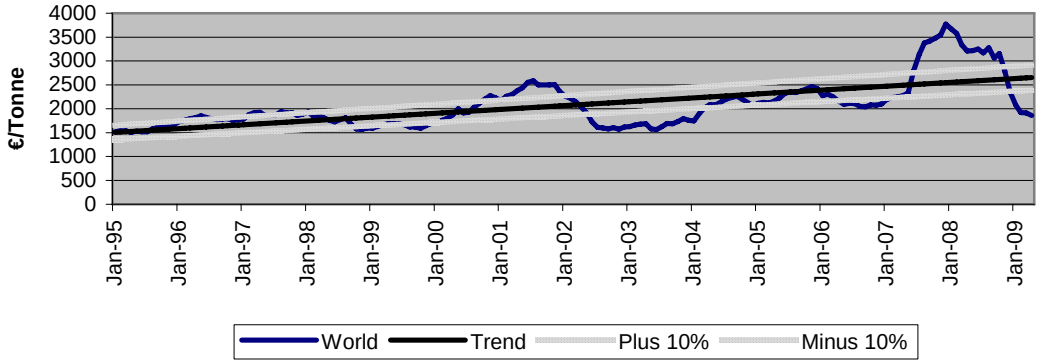
When the 10% bands are added (Figures A2 and A3) two periods of significantly high prices in the UK are identified during 2001 and late 2007/early 2008. These events are also evident for the Oceania series along with a protracted period of low prices from mid 2002 till late 2004 (Figure A3).

Figure A2: UK cheese, Trend and 10% Band



[38] http://www.mdcdatum.org.uk/ProcessorDataPrices/ukwholesaleprices.html

Figure A3: World Cheese, Trend and 10% Bands



A clear trend towards increasing volatility over time is presented in Tables A1 and A2. Over the entire period almost two thirds (64.5%) of the UK observation could be considered as stable while less than half (46.4) could be considered as stable in the current decade (Table A1). In the case of the Oceania series this trend is less pronounced. Indeed the CVs in Table A2 suggest that volatility has deceased very slightly for this series while it has marginally increased for the UK series (10.27 to 12.34).

Table A1: Frequency of Volatile Observations (Cheese).

	UK	Oceania
Jan 1995- April 2009		
Within 10% range	64.5	45.9
% Above trend + 10%	16.9	25.6
% Below trend - 10%	18.6	28.5
Jan 2000- April 2009		
Within 10% range	46.4	38.4
% Above trend + 10%	25.0	27.7
% Below trend - 10%	28.6	33.9

Table A2: A comparison of World and UK cheese prices 1995-2008

Jan 1995- April 2009	**UK**	**Oceania**
Mean	3189.45	2076.10
Standard Deviation	327.68	502.45
Coefficient of Variation	10.27	24.20
Jan 2000- April 2009		
Mean	3180.50	2264.10
Standard Deviation	392.44	527.22
Coefficient of Variation	12.34	23.39

Appendix 2 Summary of paper presented at the 113th seminar of the European Association of Agricultural Economists Chania Greece September 2009

Measuring Volatility in Dairy Commodity Prices.

Declan O'Connor, Michael Keane and Edel Barnes

Abstract. *The policy environment facing the EU dairy industry continues to undergo considerable change under WTO and CAP reform. Movement away from supply management by the EU and a more liberal global agricultural trading system will involve greater price volatility for dairy commodities. It is anticipated that EU dairy prices will more closely align with world prices. World prices are both lower and more volatile than EU prices and it is further assumed that this increased volatility will be transmitted to EU prices. Price volatility is a concern for a number of reasons as it adds challenges for business planning, debt repayment, and, in some cases, solvency. Representative EU and world butter and SMP (Skim Milk Powder) prices are considered and using the ARMA and GARCH framework their volatility is quantified.*

Keywords: Price Volatility, ARMA, GARCH, Butter, SMP, Dairy Policy

Introduction

In the past the EU have employed a suite of policy instruments with the aim of isolated internal EU dairy prices from the greater volatility associated with world prices. Intervention purchasing placed a floor on prices while other measures such as production quotas, export refunds, import tariffs and subsidized consumption measures were used to ensure higher and much less volatile prices than those pertaining in world markets. This desire to maintain stable prices should translate to EU dairy commodity prices displaying constant variances which in turn should allow these prices to be modeled within the general ARIMA (AutoRegressive Integrated Moving Average) framework. In contrast one may posit that world dairy commodity prices should not display a constant level of variance. These markets are largely unregulated and subject to shocks such as climatic events, economic events and policy events. In addition economic theory suggests that price stabilization policies in one region which trades with others will make prices in the less regulated region more volatile (Johnson 1975 and Matthews 1994). Furthermore the price inelastic nature of global dairy commodity supply and demand suggests that the prices associated with these commodities may be subject to sudden and relatively large price adjustments. This characteristic of these markets is amplified by the fact that global markets are considered thin, with only 7% of output traded and four major countries accounting for more than 80% of supply. Hence relatively small changes to supply or demand often lead to relatively large price fluctuations. Prices which display time varying level of variance are better modeled as GARCH (Generalised AutoRegressive Conditional Heteroskedasticity) processes in a univariate context.

The issue of price volatility in EU dairy markets has assumed critical importance in recent times in the context of further market liberalisation. One of the major arguments advanced against this trade liberalisation is that it would lead to transmission of international price volatility into domestic markets. The merit of this argument can only be judged by a detailed empirical analysis of price volatility in EU and international dairy markets. This study is a step in that direction.

Methodology and Data

A number of approaches have been utilized by economists to model the time-varying pattern of agricultural commodity prices. Of these the moving average (MA) model, autoregressive (AR) model, or the more general, autoregressive integrated moving average (ARIMA) model, was usually fitted to identify the structure of a time series (Box & Jenkins, 1976). In more recent times more complete but complex price models have been developed with models such as the autoregressive conditional heteroskedasticity (ARCH) model (Engle,1982), and generalized ARCH (GARCH) model (Bollerslev, 1986) receiving the

most attention. ARCH models allow the shocks in more recent periods to affect the current volatility positively while the GARCH models, which generalizes the ARCH model, postulates that not only previous shocks, but also previous volatilities affect current volatility. These models are now described in more detail.

ARMA models

The general form of the ARMA(p,q) model may be presented as:

$$Y_t = X_t'\beta + \sum_{i=1}^{p} \phi_i Y_{t-i} + \varepsilon_t + \sum_{j=1}^{q} \theta_j \varepsilon_{t-j} \quad (1)$$

where Y_t is the dependent variable; Y_{t-i} for i = 1,2,. . .,p are lagged dependent variables; X_t denotes the explanatory variable vector (column vector); ε_t is the error term and assumed to be white noise; ε_{t-j}, j = 1,2,. . .,q are lagged error terms; t denotes the time period; β (a column vector), ϕ_i and θ_j are parameters. It is important to note that in this model the error terms are assumed to be a Gaussian process with a mean of zero and a constant variance σ^2.

Conditional heteroskedasticity models (ARCH and GARCH)

To describe data series with time-varying volatility, ARCH or GARCH models are utilised. These models allow the variance of error terms to change over time. An ARCH(q) model is commonly defined as:

$$Y_t = X_t'\beta + \varepsilon_t \quad (2)$$

where

$$\varepsilon_t \mid \Omega_{t-1} \sim N(0, h_t)$$

$$h_t = \omega + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 \quad (3)$$

where ε_t is the error component in the ARCH model; h_t is the time-varying variance of the error; Ω_{t-1} is the information set available at t-1; ω, α_i for i = 1,2,. . .,q and β are parameters. ε_t's are not serially correlated, however, their dependency lies on the evolution of the variance.

A GARCH(p,q) model may be presented in the same manner except that lagged terms of the variance are now included and may be represented as follows,

$$h_t = \omega + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \gamma_j h_{t-j} \quad (4)$$

with γ_j for j = 1,2,. . .,p as additional parameters.

The basic ARCH (q) model is considered a short memory process in that only the most recent q residuals have an impact on the current variance. The GARCH (p,q) model however allows a longer memory processes, in which all the past residuals can affect the current variance either directly or indirectly through the lagged variance terms. In this model the sum of $\alpha i + \gamma i$ gives the degree of persistence of volatility in the series.

In this study the USDA North European FOB (Free On Board) wholesale skim milk powder and butter prices are taken as representative world prices[39], while the EU prices are ex-dairy factory Dutch price series sourced from Agra Europe. In studies of price volatility it is common practice to consider the log return of

[39] The USDA publishes a monthly high and low quotation and the series considered in this analysis is the mid point of these quotations.

the time series rather than the price series in levels. The log return (growth rate) for each series in this study is calculated as $Ln\left(\frac{P_t}{P_{t-1}}\right)$.

Results

The summary statistics show that all series display the classical signs of volatility as they exhibit excess kurtosis and non normal distributions while both of the butter series are skewed. Furthermore all of the series may be considered stationary and it is thus appropriate to use the Box- Jenkins methodology to determine the values of p and q in the ARMA (p,q) process. Initially data from 1990 to 2009 is considered and while the estimated coefficients of these models are significant at the 5% level and the residuals were found to be free of autocorrelations they clearly display non normal residuals and ARCH. This clearly highlights the need to model the mean and variance of the series simultaneously as GARCH processes.

The results of modelling the series as GARCH processes show that both of the world series are well specified indicating that ARCH models are appropriate. The EU series are less well specified as they show evidence of autocorrelation along with non normality in their GARCH (1,1) specifications. The standard deviation of the SMP models is presented in graphical form in Figures 1 and 2. These graphs clearly show the greater volatility of the world prices both in terms of its level and frequency. Furthermore these graphs highlight the extreme nature of the volatility experienced in 2007/08. In the case of the EU series there is relatively low levels of volatility prior to this period. This fits with the a priori expectation that the series should display a constant variance. In light of this it was considered appropriate to re-estimate the EU series as ARMA processes for the period up to April 2004. This date coincides with the implementation of reforms contained in the Luxembourg agreement and in particular the lowering of intervention prices and the quantities automatically accepted into intervention stores.

Now the EU SMP series is particularly well modeled as an ARMA process as it displays normal errors which are free from autocorrelation and ARCH. The absence of ARCH in the error terms implies that the variance of the series may be considered constant up to mid 2004 and provides clear evidence that the Commission achieved it aim of stable prices. The standard deviation of the SMP series for this period was 0.018. In the case of the butter series the evidence is less clear as there is some evidence of ARCH at the lower order along with non normality. The standard deviation of this series was 0.012.

Conclusions and discussion

In summary it is possible to conclude that up to recent years the EU policy framework has served to maintain producer prices at a higher and more stable level than that which would apply in an unregulated market by providing a number of market support measures. World prices, which are less regulated, are thus more volatile as they are not protected to the same degree from local and global shocks. The results also show that the volatility experienced in 2007/08 is extreme from the perspective of both EU and world wholesale butter and SMP prices.

However the simple GARCH models considered in this study may not fully capture the dynamics of the series considered and alternative specifications of these models such as TGARCH (Threshold GARCH) AGARCH (Asymmetric GARCH) or any of the many alternatives outlined in Tsay (2005) or Enders (2004) may be more appropriate. The non normality recorded in many of the models may point to an omitted variable problem. For example it is felt that the EU policy decisions such as intervention purchasing had the effect of placing a floor under prices and the build up of stocks therein delayed price recovery in world markets. Likewise the use of export restitutions may have delayed price recovery and response in global markets. Thus models which explicitly capture these dynamics may be more desirable.

It should be noted that some volatility in commodity prices is desirable as it reflects the process of markets adjusting to changes in supply and demand conditions. However as more recent events show the level of volatility in dairy markets can be greater than anticipated and price volatility which cannot be offset by suitable price risk management strategies can create problems for all market participants. Investment may be postponed and consumers may substitute with cheaper alternatives. Furthermore the expected abolition of the milk quotas and the envisaged increase in production at farm level will require greater specialization

and this will require that farmers and manufacturers place greater emphasis on risk management in the EU if they are to survive and compete in this new environment.

With regard to future developments it is reasonable to assume that the policy environment facing the EU dairy industry in the EU will continue to undergo considerable change due to WTO and CAP reform. Movement towards lower levels of CAP support prices, reduced intervention and a more liberal global agricultural trading system will involve greater price volatility for dairy commodities as prices align more closely with World prices. When considering the future form of world and EU commodity prices the following observation from Harvey may be considered,
"Although a freer world market is expected to be less volatile than one characterised by high insulation rates, it is unlikely to be as stable as the protected domestic market it replaces" (Harvey 1997).
Such a view suggests that future prices will be characterised by periods of volatility comparable to those displayed by world prices in the earlier period of this study. However if the following view as expressed by Adriaan Krijger (Chairman, International Dairy Federation (IDF) Standing Committee) proves more accurate
"*Shorter and deeper cycles may well be the future. The real issue now is the increase in volatility and the challenge of how to cope with it"*
then the response of EU dairy industry participants and policy makers may require a paradigm shift. In order to deal with these increased levels of volatility private market instruments such as futures markets and insurance products may be desirable, while price smoothing policy instruments may be required if a large exodus from the industry is to be avoided.

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Figure1: World SMP Conditional Standard Deviation (Jan 1990 to February 2009)

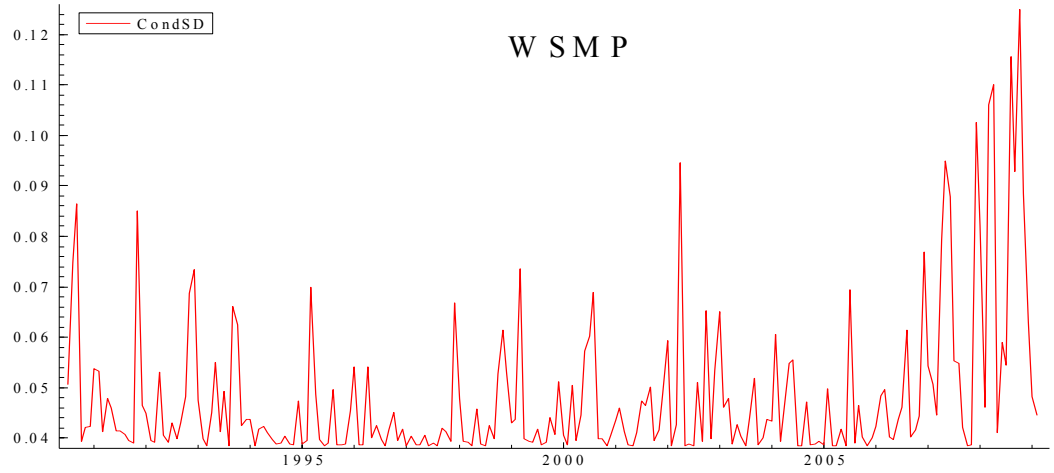
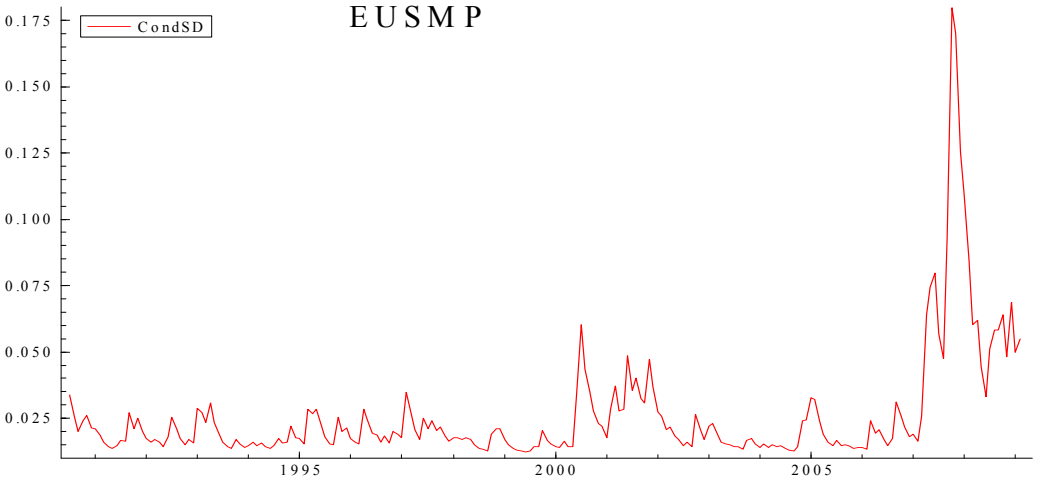


Figure1: EU SMP Conditional Standard Deviation (Jan 1990 to February 2009)



Appendix 3 Questionnaire

Q1. Dairy markets have experienced extreme price volatility in recent years. Could you please list in order of importance the main consequences for your firm of increased price volatility.

Q2. In the case of the three highest ranked consequences could you please elaborate in more detail on what the consequences of price volatility are for your firm.

Q3. What mechanisms if any does your firm use at present to offset the adverse consequences of extreme price volatility?

Q4. Are there any instruments or tools that your firm would like to see developed which would help alleviate the negative effects of extreme price volatility?

(i) At industry level

(ii) At government / EU policy level

Q5. Extreme price volatility has particular consequences for business to business / retail contracts. If you engage in such contracts,

(i) what is the typical duration of such contracts?

(ii) how are prices established within the contracts?

(iii) have you any suggestions on how contractual agreements could be better structured in times of extreme price volatility?

Appendix 4 Summary of Responses to Industry Survey

A. Consequences of Price Volatility

Overall Risk Related Issues including Milk Supply
"It creates a crisis of confidence at both producer, processor and consumer levels."

"Farming satisfaction is essential. Dairy farming is a long term investment and we are not able to give any price indication for the future. It's a risky business to invest in dairy farming and we are afraid there will not be enough investment in our country. No raw milk for processing, no dairies or product development".

"Viability of milk production is now in question with consequences for processors"

"Difficulties with farmers who are not able to cope with such variations.
Threats to milk supply in some regions where farmers are not competitive"

"Dairy farmers are not used to price volatility like for instance pig breeders or market gardeners"

"Instability bad for business: forecast and anticipation being difficult"

Consumer Issues
"It results in a negative consumer/customer reaction."

"The extremely high prices have had a serious negative impact on demand. We have seen a contraction of the market following the 2007 boom".

"Dairy products have a strong image of healthy products, a strong capacity of innovation, and as the raw material has such big (price) changes, the lack of price stability is not good from a marketing or investment policy. It is dangerous on a long term perspective".

Finance/Profitability/Investment issues
"Major finance and credit risk implications"

"Fluctuating working capital requirements, in the case of high prices we need more working capital, and in the opposite case much less"

"Very good and flexible relationship required with banks"

"Difficulty in forecasting future returns, and therefore undermining investment confidence. As a result, it is harder to follow consistent, consumer-investment strategies"

"Stock "profits" and "losses" occur as a result of a lag between input costs and output pricing. This has a significant impact on overall profitability and clouds assessment of

the underlying financial health of the business. This can therefore influence external valuation, with impact on share prices".

"Without clarity of future returns it makes it more difficult to plan future investment. This is an issue at both producer level, as well as within our business. This lack of future clarity undermines the ability of branded players to follow a consistent consumer-investment strategy and means that the category develops less added value".

"Volatility of profits, price increases to retailers lag cost increases"

"Unpaid invoices"

Retailer Issues
"Challenge for premium brands to hold market share, shot-in-the-arm for hard discounters"

"Big changes in our price policy. Very difficult to manage with retailers. Big changes in prices to consumers who are disturbed by these changes, and risk to increase the market share of private labels and best offer products."

"The increases in prices to retailers and consumers are a clear threat to a brand policy. It accelerates the long-term trend for consumers to buy private labels and undifferentiated products"

"Retailer can force producers to reduce prices in a surplus situation, without reducing consumer prices accordingly. In a shortage situation price increases are (almost) completely passed on to consumers"

"Retailer is using its margin, presentation of products in the shops and early knowledge of what producers of branded products want to offer to consumers, to stimulate consumption of retail brands, whether or not copied from A-branded products"

Product Substitution Issues
"Dairy product substitution occurred and now very difficult to reverse"

"Buyers especially of food ingredients are actively searching for dairy alternatives that have more predictable pricing"

"The high prices drive part substitution of dairy products by addition of vegetable fat in "pizza toppings" etc thus diluting the dairy franchise"

"Milk fat is substituted by vegetable fat in times of high butterfat prices by industrial and professional users in their recipes; in times of lower butterfat prices part of the recipes remain unchanged in view of the structural lower prices of vegetable fat; the same applies to dairy proteins"

"Use of analog ingredients – vegetable protein, vegetable fat"

Policy Issues
"Renewed reliance on institutional supports despite policy change to "hands off" approach"

"New reliance on intervention" and "growth of stocks internationally"

"3rd country business very difficult, availability of funds/insurance, inadequate export refunds, very vigorous competition from N Z and US"

"Opens market to new competition from countries with lower milk prices, both internally in the EU as countries vary in pace of price adjustment process and externally from 3rd countries"

Other Issues – Processing, Product Portfolio
"Creates plant capacity issues, sometimes underutilized and sometimes very tight"

"Increases the absolute necessity of a decrease of share of industrial products in turnover. The European dairy industry cannot continue to have such a dependence on basic industrial products"

"It is clear that the EU dairy industry has worked a long time while being protected, and this has led to an unfavorable mix of products, some regions having a too high level of industrial products"

B. Mechanisms to Offset Price Volatility at Present

Product related
"Vigorous marketing and sales strategy. Mix of forward and spot business. Increased attention to market research and root-and-branch review of all existing and potential market segments. Larger spend on promotion in key markets".

"branding, branding, branding"

"Internationalise sales to increase the share of consumer products"

"Seize the opportunity of added value products"

"New interest in B2B sector of contracts linked to some sort of independent measure/quotation".

"Maintain a broad portfolio which has businesses which benefit in the up cycle but others which benefit in the down cycle"

"Adjust product portfolio as far as possible"

"Growth (merger) promotes the stabilizing effect within company (spreading of risks in product portfolio and geographic sales)"

"Conduct research, develop new innovative products. Greater emphasis on retail market and exports"

" Increased focus on innovation"

"Taking buying and selling positions of dairy raw materials (SMP, WMP and butter(oil)) and finished products"

"Try to operate different contract lengths; 1 month, 3 months and 6 months"

"Increased use of intervention".

Farm Related
"Adjust milk price paid to farmers to market developments (indirectly; time-lag").

"Renegotiation if milk price goes up or down by more than 5 to 10 percent in the final product"

"More variable milk price paid to farmers"

"Summer-levy / winter-bonus"

C Instruments that your firm would like to see developed to alleviate price volatility problems

Private
"Implementation of futures trading where risks can be hedged. This is normal in other volatile commodity industries".

"It seems that the US market has always been much more volatile than the EU market but also that there is a much faster supply response. Maybe these differences should be looked into. Is it because the US has a more "industrial" mentality when it comes to milk production rather that the EU "family" income mentality".

"Maybe we have to try to put in place some systems, which look like futures, both on milk supply and on ingredients markets. Due to the relatively small size of international markets for dairy products, it is not so simple. But we have to work on "long term" contracts with our farmers in order to secure their income".

"It is dangerous to put in place a system where the industrial products are managed at a national or European level, because we need flexibility in our raw material supply, depending on different supply conditions in different countries (quantities delivered by farmers, climate conditions, increases in sales of different products). Any collective system is dangerous".

"Contract between farmers and industry on volume and price; one volume corresponding to manufactured products for consumption bought at a relatively stable price, another

one corresponding to industrial products (butter in bulk, powders) with a price fluctuating with quotations"

"Acceptance of the need for further consolidation"

Public

"Basically the policies are sound. Most important is that political decisions are made well in advance (3-5 years) allowing the industry and the milk producers to plan forward".

"The quota policy is dead, and we cannot think to come back. The only efficient policy is to help non competitive farmers to quit dairy production, or favour for them a specific quality products policy such as PDO systems which, if they are well managed (not so simple), may bring added value".

"The main problem for European dairy industry is not its companies, but the price level that we have to pay to non competitive farmers".

"Study new mechanisms to stabilize revenue for producers (contra-cyclic, pooling) and which allow flexibility and reactivity in milk price".

"The European dairy market has come from a situation of very limited volatility (a managed market situation) due to planned production (quotas), limited imports, an intervention buying system and an export refund system and is now in a transition phase to a free markets system like what is happening in other industrial and agricultural sectors. The global commodity boom exacerbated the situation in 2007. There will be volatility in the future due to the planned deregulation".

"The existing tools as PSA for commodities seem satisfying, not expensive and efficient
Restitutions have one more time shown their limit, due to the fact that

- *Our competitors have a higher capacity for decreasing their prices. Any increase in restitutions leads to a decrease in world prices.*
- *The European companies will be confronted with newcomers on the markets in the future. We cannot compete with some of them, and the EU Commission has only small budgetary margins".*

"Long term policy. Special support for milk farmers is needed also in the future (not only decoupled subsidy)".

"Improved correlation between consumer prices and producer prices"

" Improved administration of export refunds, PSA, intervention, etc.

"Keep safety net (intervention):Strategic policy regarding stocks: Use PSA butter scheme: Use refunds without dumping: Internal sales: only SMP in CMR, if users want to: No butter in bakery, ice-cream etc,: No skimmed milk in casein;Implement Health Check decisions

D Contracts and Price Volatility

Duration of Contracts

A number of dairies claimed that contracts had become shorter following recent price volatility, for example:

"Was 1 year, now mostly 4 months"

"Business/retail were in general for 1 year, now mostly 6 months. Business/business also now shorter and for less quantity"
"Buyers are looking for 12 months contracts in the current low market, whereas they were buying shorter during peaks"

"We shortened the contract periods with the retail sector"

Some other responses:

"1, 3, 6 months, rarely 12 months"

"typically 3-4 months, occasionally 1 year, sometimes stretched through PSA"

"6 months to 1 year"

"1 year for branded/private label, 3 months for others"

"from months to 3 years"

"12-18 months with 6 month revision clause"

Price in Contracts

There was substantial diversity among respondents with some linked to external quotations but also various other mechanisms

Linked to External Quotation; examples

"Increasingly linked to (external quotation source supplied) with a charge for extra quality or service provided. The increased use of indexed purchasing drives volatility when more and more prices are interlinked"

"Either fixed or linked to "official" quotation"

"Spot negotiation or occasionally linked to "independent" quotation or occasionally intervention"

Some other responses:

"It is very different according to the retailer and the country. With retailers there is unequal negotiating power"

"Renegotiation when milk price is up or down 5 to 10%"

"Ad hoc negotiation"

"Fixed for duration"

Could Contracts be better Structured given Price Volatility
There was a variety of responses; for example

"Establish a well functioning transparent futures market with producer participation"

"In theory you can establish all sorts of caps and risk sharing, but they never work in the real market. The problem is that the customers must stay competitive at any given time and the dairy processors must be able to generate a competitive return re milk price to their shareholders/suppliers. If that is not happening switching costs are close to zero for both customers and milk producers and either the customer or the dairy company can go out of business in a matter of weeks/months".

"Contracts with farmers : long term price fixed contracts for a certain share of milk delivery (consumer products) with the other part of milk volume linked to commodities prices (not so easy to put in place, but workable…(Needs no more quotas in order to allow the farmer to have his own quantity policy and think in marginal costs terms). The American system is dangerous because the price variations are higher than in Europe".

"bind selling price to purchase price of raw material"

Appendix 5 Benefits of Diversification

Diversified enterprises are ones which engage in a number of different activities. Such enterprises are often considered less risky based on the rationale that poor returns in one activity are compensated for by better returns in other activities thus giving a more steady (less volatile) income stream than a specialised enterprise. This reduction in volatility is best achieved where the returns from the different activities are negatively correlated. This process is clearly demonstrated in the accompanying textbox "*How Diversification Leads to Risk Reduction*".

Taken to its logical conclusion a risk averse enterprise would engage in activities which are perfectly negatively correlated or as close to that state as possible. To take a trivial example this would suggest that an ice cream manufacturer would consider manufacturing umbrellas or thermal clothing as ice cream sales are low on cold wet days while umbrellas and thermal vests sell better in such conditions. However such diverse enterprises are not standard. In order to compete, enterprises tend to specialize and build scale in order to benefit from economies of scale thereby reducing costs. An ice cream manufacturer may produce excellent ice cream at a healthy profit but repeating this success in a different industry may not be within its core skills and any investment may be better spent in its core activity. However this specialization creates the risks associated with volatile prices.

How Diversification Leads to Risk Reduction

In this section the outcome of combining individual returns into a portfolio are discussed. In order to facilitate this analysis the following notation is followed and the analysis limited to two commodities. Let,

P_1 *and* P_2 = the price of commodity 1 and 2 respectively

$EP_1 \equiv \alpha_1$ = the expected price of commodity 1

$EP_2 \equiv \alpha_2$ = the expected price of commodity 2

σ_1 = the standard deviation of commodity 1

σ_2 = the standard deviation of commodity 2

x_1 = the proportion of income derived from commodity 1

x_2 = the proportion of income derived from commodity 2

The price of a simple two commodity portfolio is a weighted average of the individual prices and may be expressed as,

Eq 1 $$P = P_1 x_1 + P_2 x_2$$

With the expected return given as

Eq 2 $$EP = EP_1 x_1 + EP_2 x_2$$

Or in abbreviated form as

$$= VAR(P_1 x_1) + VAR(P_2 x_2) + 2COV(P_1 x_1, P_2 x_2)$$

$$= x_1^2 \sigma_1^2 + x_2^2 \sigma_2^2 + 2 x_1 x_2 COV(P_1, P_2)$$

Eq 3 $$\mu = \alpha_1 x_1 + \alpha_2 x_2$$

Where μ is mean of the portfolio.

The variance of this portfolio may be derived as follows,

$$VAR\ (P) = E(P - EP)^2 = E[(P_1 x_1 + P_2 x_2) - (\alpha_1 x_1 + \alpha_2 x_2)]^2$$

$$= E[(P_1 x_1 - \alpha_1 x_1) + (P_2 x_2 - \alpha_2 x_2)]^2$$

$$= E[(P_1 x_1 - \alpha_1 x_1)^2 + (P_2 x_2 - \alpha_2 x_2)^2 + 2(P_1 x_1 - \alpha_1 x_1)(P_2 x_2 - \alpha_2 x_2)$$

This variance is more usually written as

Eq 4 $$\sigma^2 = x_1^2 \sigma_1^2 + x_2^2 \sigma_2^2 + 2 x_1 x_2 \sigma_{12}$$

The coefficient of correlation (ρ) between P_1 *and* P_2 is defined as follows

$$\rho_{12} = \frac{COV(P_1, P_2)}{\sigma_1 \sigma_2}$$ hence, $$COV(P_1, P_2) = \rho_{12} \sigma_1 \sigma_2$$

The variance of the portfolio may now be stated as

Eq 5 $$\sigma^2 = x_1^2 \sigma_1^2 + x_2^2 \sigma_2^2 + 2 x_1 x_2 \rho_{12} \sigma_1 \sigma_2$$

The standard deviation σ may now be expressed as the square root of the variance σ^2.

From Eq 5 it is clear that the standard deviation of the portfolio is dependent on all five parameters. It may also be seen that a negative correlation between the commodity prices will reduce the standard deviation below that of the individual commodities. However depending on the weights significant reduction in volatility may be observed even where there is a positive correlation.

Setting $P_1 = 1500,\ P_2 = 2000,\ x_1 = 0.6\ , x_2 = 0.4\ , \sigma_1 = 120$ *and* $\sigma_2 = 150$ the relationship may be presented as in Figure . Indeed it is possible to eliminate all variation (i.e. achieving a standard deviation of zero) where the commodity prices are perfectly negatively correlated and by setting the weights x_1 and x_2 as follows,

Eq 6 $$x_1 = \frac{\sigma_2^2}{\sigma_1^2 + \sigma_2^2},\quad x_2 = \frac{\sigma_1^2}{\sigma_1^2 + \sigma_2^2}$$

Figure 25 Relationship Between Portfolio Standard Deviation and Correlation Coefficient