Irish Business Journal

Volume 8 | Number 1 Article 3

2013

Measurement of the Effect of Policy Changes on Volatility in Dairy Markets1

Eoin Kelly

Declan O'Connor

Michael Keane

Measurement of the Effect of Policy Changes on Volatility in Dairy Markets[1]

Dr Eoin Kelly, Dr Declan O'Connor and Dr Michael Keane

Abstract

Volatility in dairy commodity markets has become a major concern for many in the dairy supply chain and is likely to remain so in the future. Changes to the Common Agricultural Policy (CAP) over the past decade have more closely aligned EU and World prices and their associated volatilities. The aim of this paper is to measure volatility at farm level in Ireland over time, identify possible reasons for the increased volatility and identify ways of reducing volatility. Statistical measures such as coefficient of variation (CV) and annualised standard deviation are used to provide measures of past volatility and its evolution over time. Family Farm Income (FFI) data, input data and farm gate milk prices are used to highlight historical farm level volatility. As farm level prices should be based on dairy commodity returns, the links between these prices and the farm gate prices are explored. Monthly wholesale prices for Skim Milk Powder (SMP), whole milk powder (WMP), and butter between January 1997 and March 2012 are used for this analysis. The time period is divided into two sub periods to quantify changes in volatility pre and post the Luxembourg Agreement. The results highlight that both commodity price and farm gate volatility has increased dramatically post 2007. Volatility will become a more inherent part of the dairy industry as policy changes cause prices to become further aligned with world prices. The findings of this research highlight that risk management strategies are desirable for the long term success of the dairy industry.

Keywords: Dairy, Volatility, Milk Price, Ireland

Introduction

The Irish dairy industry produces over 5.4 billion litres of milk annually processed by 16 different processors from across the country (Leslie, 2012). The seasonal nature of milk production has resulted in a high output of commodities such as butter, skim milk powder (SMP), whole milk powder (WMP) and cheese with approximately 80% of production exported. Exports of Irish dairy products and ingredients were valued at €2.66 billion in 2011 which accounts for 30% of agricultural exports, (Department of Agriculture, Food and the Marine (DAFM, 2012). As Ireland is a member of the European Union (EU) the dairy industry is subject to the Common Agricultural Policy (CAP) and any change in this policy is likely to have an effect on the Irish industry. Keane and O'Connor (2011) show that current CAP instruments have served to stabilise dairy commodity prices and revisions should be carefully considered as reduced market supports contribute to the higher levels of volatility associated with international markets. Indeed, the rationale for the policy shift from market price support to a direct income payment at farm level is recognition of the consequences of increased volatility.

[1]The support received through the Stimulus Fund of the Irish Department of Agriculture, Food and the Marine for this research is gratefully acknowledged.

This payment was introduced with the dual purpose of compensating for lower prices while stabilising income.

A certain degree of price variation is desirable for the provision of market signals and highlights changing market conditions which lead to changes in allocation of resources (Thorne *et al.* 2011). However, large decreases in prices can potentially affect the overall liquidity of the business whereas large increases can lead to product substitution particularly for manufacturers and consumers. Furthermore, price hikes can lead to threats to food security particularly in developing countries. For example, supply shortages, diminishing stocks, and reduced production in 2007 led to an extreme rise in food prices (Gilbert, 2010). High levels of price volatility can lead to problems for producers, processors and consumers.

There are a number of reasons that lead one to expect that Ireland may be more exposed to dairy price risk than other EU countries. First, the highly seasonal nature of production can magnify the effect of short term international price changes. Second, the sector has a dependence on markets from developing countries which are subject to greater volatility than the mature EU dairy market. Third, the sector has an exposure to currency fluctuation given the importance of the UK (sterling) and the international (dollar) markets. Fourth, the grass based nature of Irish milk production which is conditioned by weather variations is another factor that is quite specific to milk production in Ireland. Finally, the anticipated expansion post quota abolition in 2015 will increase specialisation, and thus risk, while increasing working capital and finance commitments, along with accentuating the previously mentioned factors.

The objectives of this study were to measure volatility over a period of time and identify possible reasons for the volatility. This study provides a brief overview of volatility in the next section followed by a results and discussion section. The final section discusses the implications of the findings and potential future work.

Price volatility

Price volatility can be defined as a directionless measure of the extent of the variability of a price (Gilbert, 2010). Similarly, Ott (2012) describes volatility as the dispersion of price around a deterministic component such as a constant, price trend or seasonality. Volatility is traditionally attributed in agricultural commodities to low price and income elasticity, shocks such as unpreventable/unforeseen weather and the different nature of the agricultural planning process (Starleaf, 1982, Kemény *et al.* 2012). Past volatility may influence the productive decisions of farmers and therefore may influence agricultural markets (Kemény *et al.* 2012).

Policy changes

Thorne *et al.* (2011) found milk price volatility on Irish dairy farms and wheat prices on tillage farms increased particularly from 2007 onwards and noted policy changes such as the Luxembourg Agreement and unanticipated shocks in supply as key drivers of volatility.

Amongst the stated objectives for agriculture in Article 39 of the treaty of Rome was "to stabilise markets". The European Commission's proposals for milk and milk products were incorporated into Regulation (EEC) No 804/68 which set out the common organisation of the market in milk and milk products. In this and subsequent regulations the EU has sought to regulate its dairy market by intervening primarily in its butter and SMP markets. In order to establish a common market with common prices, the CAP relied on a system of market interventions. Foremost amongst these market interventions are intervention buying, market protection (import levies), market development (export subsidies), and subsidised consumption.

The introduction of the milk quota system in 1984 placed a restriction on EU milk production to create a balance between production and consumption. Following this, the McSharry reforms in 1992 introduced direct payments as compensation for cuts in the intervention prices, however as dairy escaped these price cuts at that time the impact on dairy farms was modest. Dairy intervention prices and price supports were significantly reduced in the Luxembourg Agreement signed in June 2003. The cumulative percentage declines in the butter and SMP intervention prices were 25% and 15% respectively phased in over a four year period beginning in 2004. These price cuts are partly compensated for by a newly introduced milk premium[2]. In Ireland this premium has been incorporated into a single farm payment (SFP) along with other historic entitlements.

Reform of the milk quota regime continued in the "Health Check" (November 2008) where it was agreed that quotas will expire by April 2015. In order to ensure a 'soft landing', quotas will be increased by one per cent every year between 2009/10 and 2013/14[3]. In the press release which accompanied this reform it stated that policy reform should be one which "converts market intervention into a genuine safety net[4]". To this end for butter and SMP all sales to intervention are now by tender and optional above a limit of 30,000 tonnes for butter and 109,000 tonnes for SMP. Furthermore, sales to intervention will only be allowed between March and August each year. Such a position implies that intervention would be used as a measure of last resort in times of crisis rather than creating a floor price. The private storage aid for cheese was abolished along with the disposal aid for butter for pastry and ice cream and for direct consumption. While some market support is proposed to continue, such as the private storage aid for butter, the skimmed milk powder for animal feeding allowance, and the aid for casein production is now optional and at the discretion of the Commission to decide if and when it should be applied. This aid may be fixed in advance or by means of tendering procedures.

These reductions in price supports and gradual expansion of the quota system therefore mean that producers are becoming more exposed to world market changes with the principles of supply and demand determining price.

Measuring volatility

Many methods are used to quantify volatility ranging from econometric Generalised AutoRegressive Conditional Heteroskedasticity (GARCH) type modelling techniques to simple descriptive statistical analysis. In this study volatility is firstly highlighted by an analysis of annual and average monthly prices over time. Then standard deviation (SD) and coefficient of variation (CV) are used following common practice in volatility studies such as Thorne *et al.* (2011) and O'Connor and Keane (2009). The CV of a price series expresses variation in the series relative to the mean value of the series with this ratio then multiplied by 100. This measure provides an indication of long run price volatility across years. A further measure of volatility is given by the mid 90% range which is generated using the range between 95% and 5% percentiles for the data. Finally the annualised standard deviation is presented. Many authors (e.g. FAO (2009) and European Commission (2009)) have used this measure of the change in price to compute historic volatility. This approach is commonly used to compute historic volatility (O'Connor and Keane, 2011). It may be represented as follows:

---

[2] In Ireland this premium was set at 1.2cent per litre in 2004 rising to 3.6cent litre in 2006

[3] For Italy, the 5 per cent increase will be introduced immediately in 2009/10.

[4] http://europa.eu/rapid/pressReleasesAction.do?reference=IP/08/1749&format=HTML&aged=0&language=EN&guiLanguage=en

$$\text{AnnStdDev}(r_1 \ldots . r_n) * \sqrt{Num\ Periods\ Per\ Year}$$

where $r_1 \ldots, r_n$ is a return series, i.e., a sequence of returns for n time periods.

So the annualised standard deviation is the standard deviation multiplied by the square root of the number of measurement periods per annum which in this instance is the square root of 12 as monthly data is considered.

To account for changes in policy, volatility was measured firstly for the whole sample period followed by a pre and post Luxembourg implementation analysis. These measures are applied to farm gate milk prices, dairy commodity prices and product return prices which are now presented in detail.

Data analysed

Data used in this analysis was provided from a number of sources. Firstly, National Farm Survey (NFS) data was utilised to measure farm income volatility. The NFS is undertaken annually by Teagasc[5] and provides detailed information on the financial performance of farms with different enterprises, different sizes and located in different regions across the country. Farms are assigned into six farm systems on the basis of farm gross output and for the purpose of this analysis only income from the dairy system is considered. In the following analysis variation in annual Family Farm Income (FFI) data was used to measure farm income volatility. FFI is calculated in NFS by deducting all the farming costs from the value of farming gross output and is a representation of the financial reward to all family members who work on the farm and this includes labour, management and investment. It must be noted however that FFI does not include income from non-farm sources and therefore may not be equal to household income. FFI provides a measure of dairy farm volatility from year to year however at farm level volatility from month to month is most important. However, it is difficult to source actual monthly farm input costs. Therefore monthly feed and fertiliser prices from the Central Statistics Office (CSO[6]) were used.

In terms of farm level output the CSO reports monthly farm gate price for two series. The first series reports actual farm gate milk prices (hereafter referred to as Actual) while the second is a series which is based on a fixed milk fat and milk protein content of (3.7% and 3.3% content respectively) to ensure that products of identical quality are priced in successive periods (hereafter referred to as Standardised). This latter series also allows comparison with imputed milk prices series based on dairy commodity return. In this study, two such imputed series are considered. The first is based on the gross combined return for skim milk power (SMP) and butter while the second is based on the return for whole milk powder (WMP).

[5] Teagasc is the agriculture and food development authority in Ireland. Its mission is to support science-based innovation in the agri-food sector and the broader bioeconomy that will underpin profitability, competitiveness, and sustainability.

[6] For more information on CSO milk prices see www.cso.ie

These imputed series can be expressed as a cent per litre gross return. In order to generate the imputed series wholesale Dutch Skim Milk Powder (SMP), Whole Milk Powder (WMP) and butter prices were sourced from Agra Europe. These series are available from January 1997 until March 2012. As prices were not quoted in euro until 1999 they were converted from national currency to Euro using exchange rate sourced from the Central Bank of Ireland. The volatility of these individual commodity prices is presented along the volatility of the farm prices and imputed series. Finally, as stated, the data was divided into two sub periods to quantify changes in volatility pre and post the Luxembourg Agreement.

Results and discussion

Figure 1 below shows Family Farm Income (FFI) for specialist dairy farmers in Ireland between 1997 and 2011 and highlights the importance of direct payments to these farmers. It is clear from this graph that direct payments significantly assisted FFI particularly since 2005 which as mentioned above saw the introduction of the SFP and the receding of price supports and intervention prices in line with the Luxembourg Agreement. This increase is quantified in Table 1 with average direct payments of just under €8,000 in the period prior to 2005 rising to more than €20,000 post 2005.

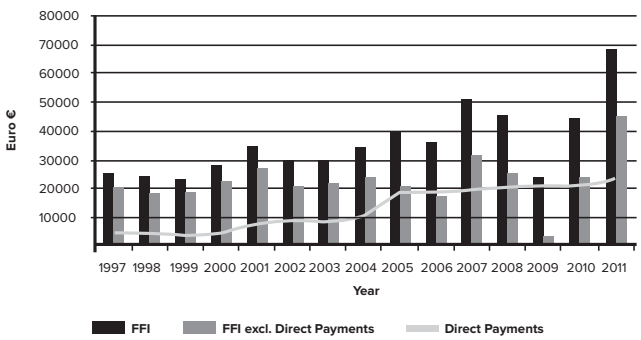

Figure 1: Family farm income (€/farm) on specialist dairy farms in Ireland 1997 to 2011
Source: *Teagasc NFS*

	FFI	Direct Payments	FFI excl. Direct Payments
Years 1997 - 2011			
Average	35926	13016	22603
Standard Deviation	12479	7424	8786
CV[2]	35	57	39
Years 1997 - 2004			
Average	29914	7966	21438
Standard Deviation	5514	4816	2742
CV	18	60	13
Years 2005 - 2011			
Average	44207	20357	23850
Standard Deviation	13825	1548	12913
CV	31	8	54

Table I: Changes in FFI[1] 1997-2011

[1] Family Farm Income
[2] Coefficeint of variation

In Table I the volatility in family farm income (FFI) with direct payments and FFI without direct payments, is clearly highlighted. Volatility increased from a CV of 18 (including payments) and 13 (excluding payments) prior to December 2004 to a CV of 31 for FFI including payments and a CV of 54 for FFI excluding payments post December 2004. This highlights the importance of direct payments in maintaining stable farm incomes since 2005 which may be an indicator of policy agreements such as the decoupling of direct payments and the compensatory payment of the dairy premium in the form of the SFP. It also highlights an increased dependence on direct payments due to mounting price pressure and increasing input costs. For example, dairy farmers in 2009 experienced a dramatic drop in commodity prices compared to 2008. However, according to Donnellan *et al.* (2011) the introduction of the SFP post 2005 counteracts increases in income volatility associated with greater variability in output and input prices.

Input price volatility was also measured. The costs of inputs at farm level have increased dramatically in recent years with feed and fertiliser costs considered very important inputs as they account for the majority of direct costs. According to Connolly *et al.* (2008) purchased concentrate and fertiliser accounted for 43% and 19% of total direct costs on Irish dairy farms in 2008. Monthly input prices between 1997 and 2012 for feed and fertiliser sourced from the CSO are given in Figure 2 and 3 respectively. From both graphs it is clear that feed and fertiliser prices experienced increased volatility over time. Focusing on feed prices from Figure 2 rolled barley and soybean meal experienced increased price changes from 2005 onwards with soybean having more price increases compared to rolled barley which dropped in price in 2010 but also rose dramatically from 2011 onwards. From Figure 3 it is seen that fertiliser prices increased over the whole time period and similarly feed prices experienced a more dramatic rise particularly from 2005 onwards.

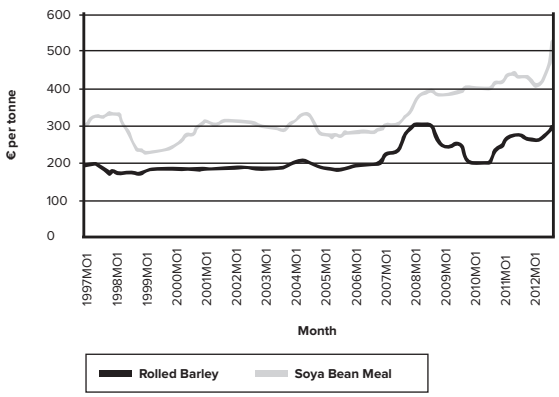

Figure 2: Rolled barley and soya bean meal prices 1997 – 2012 (Source CSO)

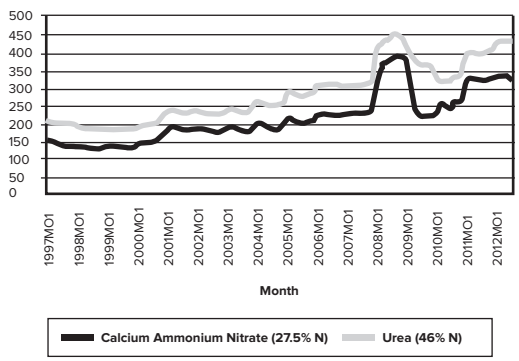

Figure 3: Fertiliser prices 1997 – 2012 (Source CSO)

Table II and III contain input price volatility results between 1997 and 2012 for feed and fertiliser respectively. From Table II it is highlighted that feed price volatility was between two and four times higher between the years 2005 and 2012 compared with the 1997 to 2004 period for almost all the feed types analysed.

	Rolled barley	Soya bean	Barley meal	Maize meal	Calf meal[1]	Dairy nuts[2]	Dairy nuts[3]	Milk Replacer
1997 - 2012								
Average	213	329	216	262	266	236	213	1857
St Dev	38	61	42	38	29	34	33	148
CV	18	19	19	15	11	14	16	8
95% Percentiles	297	434	304	338	336	298	285	2114
5% Percentiles	175	236	178	215	231	195	185	1654
1997 - 2004								
Average	188	294	187	238	250	212	193	1748
St Dev	8	32	10	17	12	11	8	81
CV	4	11	5	7	5	5	4	5
95% Percentiles	204	333	207	268	269	230	213	1841
5% Percentiles	174	233	178	213	231	194	183	1649
2004 - 2012								
Average	239	365	247	287	286	261	240	1971
St Dev	40	62	40	38	31	32	35	112
CV	17	17	16	13	11	12	15	6
95% Percentiles	305	442	317	342	346	305	292	2121
5% Percentiles	186	277	196	238	252	217	191	1813

Table II: Feed price volatility 1997 - 2012

[1] 16-18% protein
[2] 13-15% protein
[3] 16-18% protein

The results of fertiliser price volatility between 1997 and 2012 are reported in Table III. Similar to feed price volatility it is highlighted that volatility has increased particularly from 2005 onwards with higher CV for CAN, Urea, potash, phosphate, and all compound fertilisers between 2005 and 2012 compared to between 1997 and 2004. For example, potash is almost nine times more volatile and CAN just under two times more volatile post 2005 compared to pre 2005. Compound fertilisers such as 10-10-20, 24-2.5-10, 27-2.5-5 follow similar volatility patterns to CAN, Urea, and phosphate.

	CAN[1]	Urea[2]	Potash	Phosphate[3]	10-10-20	24-2.5-10	27-2.5-5
1997 - 2012							
Average	222	288	311	320	312	288	283
St Dev	70	81	139	103	107	93	91
CV	32	28	45	32	34	32	32
95% percentiles	373	436	624	561	500	469	462
5% percentiles	140	189	208	252	212	196	192
1997 - 2004							
Average	169	220	219	265	232	218	214
St Dev	24	24	9	9	16	18	19
CV	14	11	4	3	7	8	9
95% percentiles	197	259	234	278	251	241	238
5% percentiles	138	189	208	251	211	194	190
2005 - 2012							
Average	277	359	407	390	394	360	354
St Dev	60	55	146	124	98	83	81
CV	22	15	36	32	25	23	23
95% percentiles	389	445	664	592	547	507	494
5% percentiles	212	287	230	275	269	257	253

Table III: Fertiliser cost volatility 1997 - 2012

1 27.5% nitrogen
2 46% nitrogen
3 16% phosphorus (Granular superphosphate)

Output price volatility in terms of milk price is also measured. Firstly, Figure 4 below highlights the percentage change in monthly milk prices compared with the same month of the previous year for both standardised and actual milk prices between 1997 and 2011. It is quite clear that milk price changes based on this measure have increased considerably as evidenced particularly by comparing prices pre 2005 and post 2005. The mean change in actual milk price is 0.26% pre 2005 and 5.72% after 2005. However the range changes dramatically from a decrease of 10.28% and an increase of 8.04% pre 2005 to a decrease of 43.52% and an increase of 56.49% post 2005. The results here are a clear indication of the changes in milk price due to reduced price support from 2005 onwards and highlights that the volatility of milk prices has greatly increased.

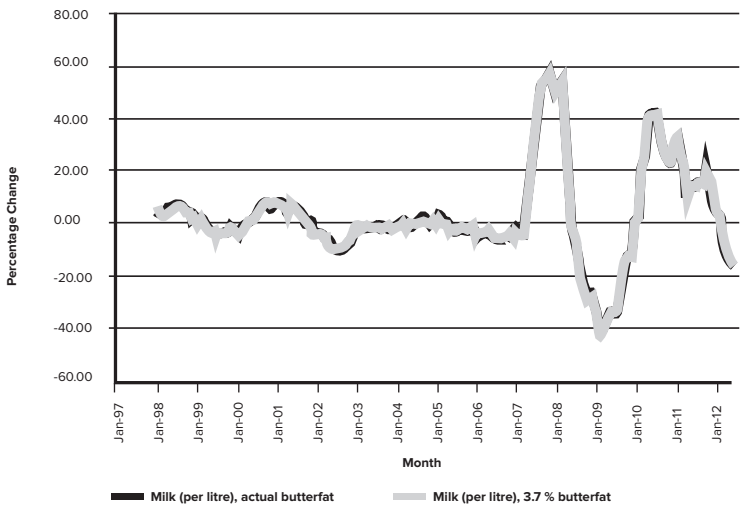

Figure 4: Percentage change in monthly milk prices compared with the same month of the previous year

The increased volatility in dairy farm output prices, in the form of the farm gate milk price, is now presented (Table IV). From 1997 until 2012 the CV was 14 and 12 for actual and standardised milk price. Volatility was lower between 1997 and 2005 with a CV of 6 and 4 respectively for both milk prices rising to 18 and 17 post 2004. Focusing on the range in values, the mid 90% range fluctuated from 27c/l – 31c/l for both actual milk price and adjusted milk price between 1997 and 2005. This increased to 22c/l – 40c/l for actual milk price and from 22c/l to 39c/l for adjusted milk price between 2005 and 2012 indicating a large increase in volatility at farm gate level.

	Actual Milk Price (c/l)	Standard milk price (c/l)
1997 - 2012		
Mean	0.30	0.29
Standard Deviation	0.04	0.04
CV[1]	13.65	12.40
95% Percentile	0.38	0.37
5% Percentile	0.25	0.25
1997 - 2004		
Mean	0.29	0.28
Standard Deviation	0.02	0.01
CV	6.36	4.09
95% Percentile	0.32	0.31
5% Percentile	0.27	0.27
2005 - 2012		
Mean	0.31	0.30
Standard Deviation	0.05	0.05
CV	17.48	16.62
95% Percentile	0.40	0.39
5% Percentile	0.22	0.22

Table IV: Milk Price volatility

[1] Coefficient of variation

Figure 5 shows the results of the annualised standard deviation for actual and standardised milk prices and for imputed milk prices. The average annualised standard deviations for actual, standard, imputed butter and SMP and imputed WMP prices increased more rapidly post 2005 to pre 2005. It is therefore very evident from the graph that volatility was at a much higher level post 2005 compared to pre 2005.

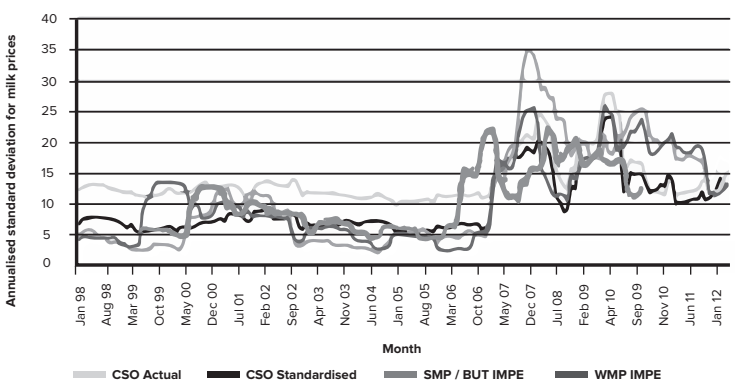

Figure 5: Annualised standard deviation for milk prices

	Butter	SMP[1]	WMP[2]	Butter and SMP[3]	WMP[4]
1997-2012	€/tonne	€/tonne	€/tonne	(c/l)	(c/l)
Average	3084	2186	2640	32.89	35.20
St Dev	457	357	341	4.56	4.54
CV5	15	16	13	13.86	12.91
95%	3997	2756	3176	39.53	42.35
5%	2308	1709	2144	25.46	28.58
1997-2004					
Average	3149	2144	2642	32.80	35.23
St Dev	165	212	158	2.22	2.11
CV	5	10	6	6.77	5.98
95%	3445	2726	2914	38.42	38.86
5%	2984	1956	2424	30.44	32.32
2005-2012					
Average	3015	2230	2638	32.98	35.17
St Dev	626	459	461	6.13	6.15
CV	21	21	17	18.58	17.47
95%	4157	3369	3545	45.34	47.27
5%	2157	1647	1872	24.09	24.96

Table V: Commodity Price Volatility

1 Skim Milk Powder (SMP)
2 Whole Milk Powder (WMP)
3 Imputed milk price butter and SMP
4 Imputed milk WMP
5 Coefficient of variation

The results in Table V show a CV of 15, 16, and 13 between January 1997 and August 2012 for Dutch wholesale butter, SMP and WMP respectively. In comparison with volatility between January 1997 and December 2004 volatility increased dramatically from a CV of 5, 10, and 6 to 21 for both butter and SMP, and 18 for WMP post 2005. Therefore, the largest increase in volatility for these commodities came post the Luxembourg Agreement between January 2005 and August 2012. This suggests the rise in wholesale price volatility was due to policy changes such as the lowering of price supports bringing the EU prices more in line with world market prices. Therefore, this leaves EU commodity prices more exposed to shocks on a world level and without the protection of intervention prices except at low price crisis levels. Focusing on the mid 90% range it is highlighted that 5% of observations had prices of above €4,157, €3,369, and €3,545 for butter, SMP and WMP respectively post 2005 while the corresponding figures pre January 2005 for these commodities were €3445, €2726 and €2914 respectively. Similarly, prices at the lower end post 2005 have moved into new territory with for example 5% of butter now trading below €2,157 while pre 2005 the comparable figure is €2,984.

The results also show that volatility increased from 7% between 1997 and December 2004 to 19% between January 2005 and 2012 for the imputed butter and SMP price. Similarly the volatility for imputed WMP price increased threefold approximately from 6 between 1997 and December to 18 between January 2005 and 2012.

Figure 6 shows the results of the annualised standard deviation between 1997 and 2012. It is clear that for all commodities tested the annualised standard deviation increases dramatically post 2005 which also highlights the effects of policy changes on volatility.

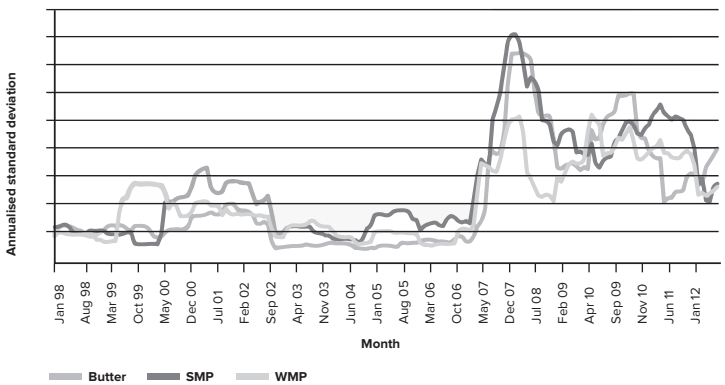

Figure 6: Annualised standard deviation for commodity prices

Implications

It is suggested in the literature that there are a large number of factors which contribute to volatility in agricultural commodity prices. These include low levels of inventory, inelastic supply and demand responses, climatic shocks, and sanitary and phytosanitary shocks (see Tangermann (2011; Gilbert 2010; and Keane & O Connor 2009). This paper adds to the literature as it also highlights farm level inputs and outputs contributing to price and income volatility. Feed concentrate price and fertiliser price volatility along with farm gate milk price volatility have been evident throughout the time period at farm level. As costs of production and gross output have experienced volatility over time the findings of this research highlight that it is necessary for producers to focus on utilising inputs more efficiently and minimising costs of production as a means of managing this volatility. Therefore to maximise efficiency and manage farm level volatility producers must focus on factors such as qualitative, productive and management factors for example which were found by Kelly *et al.* (2012) to be associated with greater levels of efficiency. According to Kelly *et al.* (2012) such factors include grassland management, calving date, milk quality, milk solids production, and land quality.

A consequence of adverse volatility is the effect it has on cash flow; therefore producers must undertake regular budgeting and financial planning to maximise profitability. Increased volatility makes this task more critical but also more difficult. Furthermore, Ireland unlike many other EU countries may be more exposed to volatility for a number of reasons. Firstly, one of the main targets of the Food Harvest 2020 report is to increase milk production by 50% and this will lead to large scale expansion with many new entrants. Therefore, this increase in production will leave many producers more exposed to the effects of volatility as they will have greater financial commitments and specialisation which means that diversification, a traditional method of managing volatility may no longer be an option. Secondly, the Irish

dairy industry is export dependent so new markets for our dairy output may be more volatile in terms of demand and may also increase exchange rate volatility. Finally, as Irish dairy production systems are predominantly grass based the seasonal nature of the industry makes climatic changes and weather variations risks a reality. For example, the fodder crisis of 2012/2013 due to adverse weather conditions in the summer of 2012 has placed extreme financial pressure on producers.

The findings of this study also support the view that EU policy changes such as the Luxembourg Agreement, which increased exposure of European producers to the global market, are major factors contributing to commodity price volatility. Similar conclusions were drawn by Thorne *et al.* (2011) who found volatility increased for wheat prices and farm gate milk prices due to policy reforms like the Luxembourg Agreement. Kelly (2012) also argues that the shift from production based supports to decoupled payments in 2005 with the introduction of the Single Farm Payment (SFP) may have resulted in an increased dependency of gross output on direct payments. Such is the dependence on direct payments over time, the results in this study highlight that there is a requirement for direct payments to offer an incentive to increase levels of technical efficiency to maximise production and ultimately manage risk such as price volatility. Previously in the EU intervention buying, export refunds, import levies, subsidised consumption, and aids to private storage were public options to manage volatility. However, these public options have been removed or reduced and the main public options at the moment are direct payments such as the single farm payment and crisis funds. Policy reform should focus on volatility management and O'Connor and Keane (2011) argue that current CAP instruments have served to stabilise prices and should be revised and improved in order to avoid volatility extremes in international markets. The consequences of increased volatility and the need to put in place measures to deal with crises is acknowledged at policy level as evidenced in the following paragraph which appeared in a Commission staff working paper:

..... Excessive volatility of prices makes it more difficult for farmers to undertake long-term planning, particularly if market fundamentals are not reflected in prices, as insecure income expectations mean that farmers undertake less long-term investments. As a result, high uncertainty about the future implies that farmers' competitiveness in the long-run is compromised. Excessive income fluctuation also means that farmers that in normal years are competitive and efficient may be forced out of business due to one disastrous event, which is often outside of their control.....

(EU Commission 2011)

In this document three options are outlined as possible policy responses to increased volatility and in particular market crises. These are:

- Extending the current framework for insurances and mutual funds
- The creation of an income stabilisation tool (IST)
- The creation of a crisis fund

The suitability of these instruments to the dairy sector is difficult to gauge without the specific details of how they may operate. However, their novelty in an EU dairy context suggests that it may be some time before they are in place and utilised by the farming community. In their immediate absence it should be noted that private market solutions are been explored and developed. These include options, over the counter contracts (OTC), mutual funds and insurance. Futures and forward contracts are also alternative private solutions to manage

volatility. In recent years a number of EU based dairy futures markets have been launched for Butter, SMP and Whey, such as the Eurex Exchange. In addition in Ireland some processors are now offering limited forward contracts, for example Glanbia Plc., initiated a forward milk pricing scheme in 2010. Forward contracts are relatively new in Ireland and are likely to be used among many more processors in the future. Another approach may involve the reallocation of risk among co-operative members (transfer of risk among co-operative members) similar to a study by Pedersen (2012).

Concluding remarks

The aim of this paper was to measure volatility over a period of time and to identify possible reasons for the volatility. Findings of this research have shown that commodity price and Irish farm gate price volatility has increased dramatically since 2005 due in part to policy changes and volatility will become a more inherent part of the dairy industry as prices become more aligned with world market levels. The findings have also shown that commodity price volatility has translated along the supply chain to farm gate prices, farm input prices and farm income. Volatility is a relatively new phenomenon for the Irish dairy sector however the increased level of volatility and its possible adverse consequences have been acknowledged by EU policy makers. Despite this the shift from commodity to income support continues and this shift implies that future measures will be designed to deal with crises rather than the “normal” market vagaries such as price fluctuation regardless of their magnitude.

The implications of this work highlight that risk assessment and management strategies must be considered in order to cope with adverse consequences of greatly increased volatility. This begins at farm level with a focus on maximising efficiency in utilisation of inputs and production of outputs, cash flow budgeting and risk management strategies such as engaging in forward contracts. From the processor side volatility can be managed by marketing of products, identification of markets and using private risk management solutions such as futures markets. Although some of the factors associated with volatility have been highlighted in this study, a more in-depth time series analysis such as a GARCH approach following Engle (2002) is required to explore in detail the causes and extent of volatility. Other factors such as seasonality, energy price volatility transmission to commodity price volatility should also be studied as a follow up to this study.

References

Connolly, L. Kinsella, A., Quinlan, G. & Moran B. (2008). *Irish National Farm Survey,* Teagasc, Farm Surveys Department, Athenry, Co. Galway, Ireland.

Department of Agriculture, Food and the Marine (DAFM) (2012). Annual Review & Outlook for Agriculture, Food and the Marine 2011/2012. http://www.agriculture.gov.ie/media/migration/publications/2012/ARO201112170912.pdf

Donnellan, T., Hennessy, T., Keane, M. & Thorne, F. (2011). Study of International Competiveness of the Irish Dairy Sector at Farm Level. Teagasc. June 2011.

European Commission (2011). Common Agricultural Policy towards 2020. *Commission Staff Working Paper.* http://ec.europa.eu/agriculture/analysis/perspec/cap-2020/impact-assessment/annex6_en.pdf

European Commission (2009). Agricultural commodity markets outlook 2009-2018. July. ec.europa.eu/agriculture/.../worldmarkets/outlook/2009_2018_en.pdf

Engle, R. (2002). Dynamic conditional correlation--a simple class of multivariate GARCH models. *Journal of Business and Economic Statistics* 20: 339 - 350.

FAO (2009) Food outlook volatility in agricultural markets. June. http://www.fao.org/docrep/011/ai482e/ai482e00.htm

Gilbert, C.L. (2010). How to understand high food prices. *Journal of Agricultural Economics* 61: 398 - 425.

Keane, M. and O'Connor, D. (2011). "Price Volatility" Presentation made at the Teagasc conference Outlook 2011 Economic Prospects for Agriculture, January 20 2011, Portlaoise, Ireland.

Kelly, E.M. (2012). An Application of Data Envelopment Analysis to analyse the productivity and efficiency of Irish dairy farms. PhD Thesis. University College Dublin, Ireland.

Kelly, E., Shalloo, L., Geary, U., Kinsella, A. & Wallace, M. (2012). An Application of Data Envelopment Analysis to Measure Technical Efficiency on a Sample of Irish Dairy Farms. *Irish Journal of Agricultural and Food Research* 51(1), pp 63 - 77.

Kemény, G., Fogarasi, J.,Varga, T., Orsolya, T. and Tóth, K. (2012) International wheat price volatility and the increasing export of Russia, Kazakhstan and Ukraine. Paper prepared for the 123rd EAAE Seminar "PRICE VOLATILITY AND FARM INCOME STABILISATION Modelling Outcomes and Assessing Market and Policy Based Responses" Dublin, February 23-24, 2012.

Leslie, B. (2012). Irish Farmers Journal (Sat 30th June 2012) Vol 65. No 27.

O'Connor, D. and M. Keane (2011). Empirical issues relating to dairy commodity price volatility. In: Piot-Lepetit, I. and R. M'Barek (eds) Methods to analyse agricultural price volatility. Springer, New York, Dordrecht, Heidelberg and London.

O'Connor, D. & Keane, M. (2009). Price Volatility in the EU Dairy Industry: Causes, Consequences and Coping Mechanisms. European Dairy Association, Brussels.

Ott, H (2012). Which factors drive which volatility in the grain sector? Paper prepared for the 123rd EAAE Seminar "PRICE VOLATILITY AND FARM INCOME STABILISATION Modelling Outcomes and Assessing Market and Policy Based Responses" Dublin, February 23-24, 2012.

Pedersen, M.F. (2012). Reallocation of price risk among members in marketing cooperatives. Paper prepared for the 123rd EAAE Seminar "PRICE VOLATILITY AND FARM INCOME STABILISATION Modelling Outcomes and Assessing Market and Policy Based Responses" Dublin, February 23-24, 2012.

Starleaf, D.R. (1982): Macroeconomic Policies and their impact upon farm sector. *American Journal of Agricultural Economics,* 64: 854:860.

Tangermann, S. (2011). Risk Management in Agriculture and the Future of the EU's Common Agricultural Policy. Working paper. *International Centre for Trade and Sustainable Development (ICTSD)* Issue Paper no 34,

Thorne, F., Hennessy, T., Hanrahan, K., Donnellan, T., O'Connor, D. and Keane, M. (2011). Volatility in agricultural markets: evidence, causes and possible solutions. T- Research Vol 6, No 1 Spring 2011.