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During the past decade the U.S. dairy market has been subject to periodic swings in dairy commodity and milk prices. The U.S. All Milk price reached an historic high of $21.90 (nominal dollars) per hundredweight in November, 2007 before retreating to a low of $11.30 recorded in June of 2009. This rapid decline in milk price has become the focal point for the claim of 'excess volatility' in milk prices and a call for the introduction of a federal government mandated supply management program for U.S. dairy production sector. This program, if adopted, would be included in the next dairy title of the 2012 agricultural farm legislation, and is outlined in two bills, the Costa bill HR5288 and the Sanders bill S-82010. The intent of these proposed programs would be to greatly diminish this perceived 'volatility' in milk price. The research approach will be to use modern time-series modeling techniques to determine the nature of the 'volatility' versus 'variability' in milk and dairy product prices over the past ten years. The empirical analysis will assess the variability for both dairy commodity prices (butter, cheese, nonfat dry milk, and whey), and a proxy for the Federal Order 33 Blend Price. The results of this empirical investigation reveal that while dairy commodity prices exhibit significant periods of volatility and volatility spikes, there is no evidence that this volatility is growing over time. Following upward swings in volatility dairy prices and the farm milk price return to lower levels represented by the long run variance for each price series.

Keywords: dairy prices, GARCH, volatility, supply-management, long-run variance

Introduction

Beginning with the first futures contract for milk, offered on the New York Coffee, Sugar and Cocoa Exchange back in 1993, to the present wide array of offerings on the Chicago Mercantile Exchange, the U.S. dairy industry has been witness to a growing portfolio of price risk management tools. These include both physical and cash settle futures contracts, options contracts on a wide variety of dairy commodities and milk, and forward pricing arrangements offered through dairy cooperatives and dairy product manufacturing firms. In addition to these price risk mitigation tools, the USDA Risk Management Agency announced the availability of a new insurance product, Livestock Gross Margin – Dairy, (LGM/D) in June 2008, which became available for purchase beginning with August 2008. Beginning in December 2010 LGM/D price risk management tool was modified to include a premium subsidy to make it even more attractive to dairy producers. LGM/D has become so attractive, that, after almost a non-starter for the first two years of the product offering, the LGM/D contract sold out its underwriting capacity in the first three months of 2011. Dairy producers purchased over 1,400 contracts, insuring their margin on 46 million hundredweight of milk for 2011 at a premium cost of 24.9 million USD. The federal subsidy came to 10.7 million on this total premium.

During the past decade the U.S. dairy market has been subject to periodic swings in dairy commodity and milk prices. The U.S. All Milk price reached an historic high of $21.90 (nominal dollars) per hundredweight in November 2007 before retreating to a low of $11.30 recorded for June of 2009. Prior peaks in price occurred in May of 2004 at $19.30 and December 1998 at $18.10. A review of the maximum prices achieved in a given year and the minimums shows that price peaks are more pronounced than price troughs. This is due to the truncation on lower prices from the Federal dairy price support program. While numerous periods of price run-ups followed by price declines can be identified over the past 30 years, it is the perception that there was an unprecedented rate of decline in milk price from the November 2007 peak to the January 2009 trough which has become the focal point for the claim of 'excess volatility' in U.S. milk prices. This view that there exists excessive volatility has raise a call for the introduction of a federal government mandated supply management program for U.S. dairy production sector by a number of dairy groups. An example of most extreme type of program proposed as a basis for inclusion in the next dairy title of the 2012 agricultural farm legislation, is outlined in two bills, the Costa bill HR5288 and the Sanders bill S-8210. A less extreme version of supply management is the National Milk Producers Association Foundations for the Future proposal. The intent of these supply management programs would be to greatly diminish the perceived 'excess volatility' in milk prices by imposing severe price penalties on milk marketed and deemed to be in excess of those required to meet demand.

It is clear that dairy producers and dairy product manufacturing firms could have accessed the large portfolio of available price risk tools, and could have gained significant protection from adverse price change but most chose not do so. It is also well documented that individual dairy producers do not utilize these resources to any great extent and in fact regard these tools as price risk enhancing. (Thraen and Shoemaker). It is estimated that no more than five percent of the annual production of milk is protected from adverse price changes using the available market pricing tools.

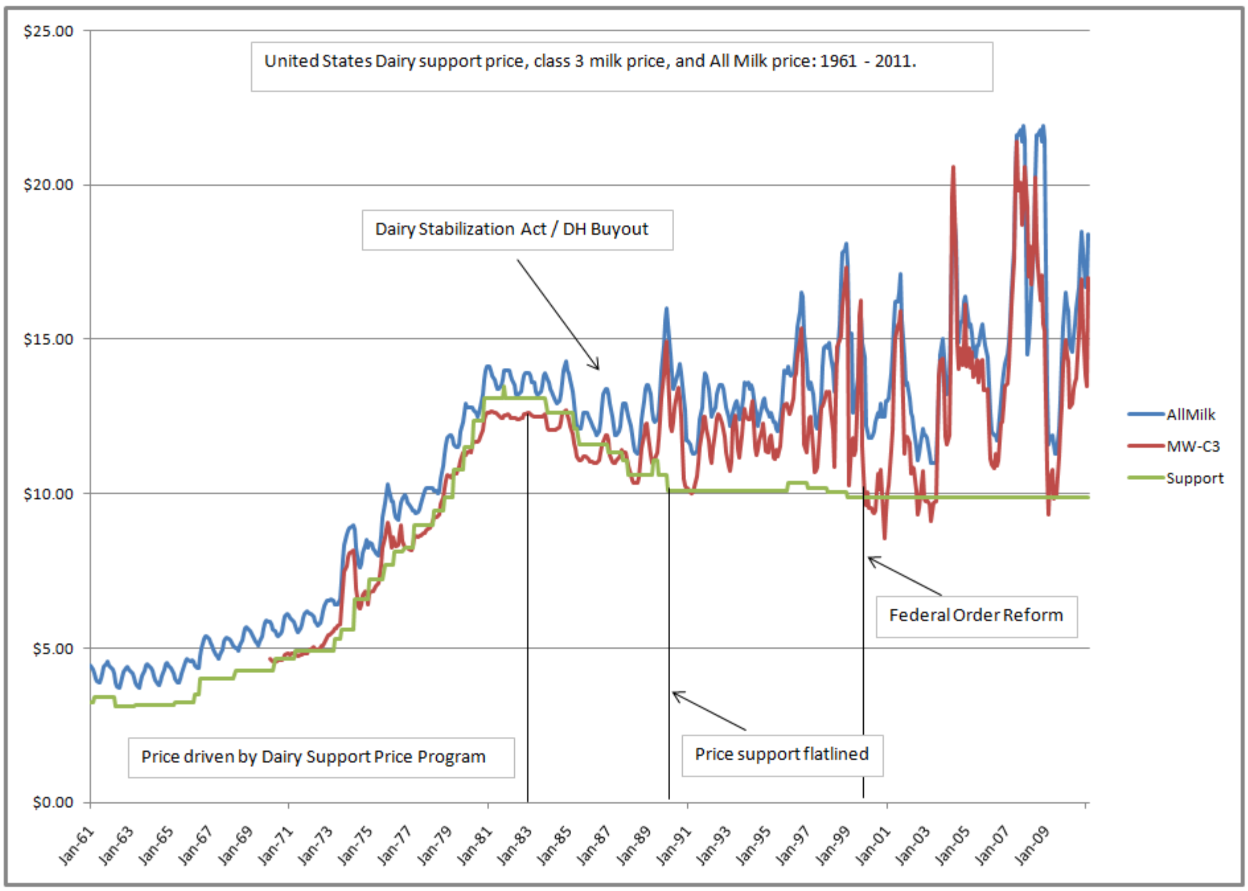
This research approach will be to use modern time-series modeling techniques to determine the nature of the 'volatility' versus 'variability' in milk and dairy product prices over the past ten years. In this paper I will take a look at the variability for dairy commodity prices (butter, cheese, nonfat dry milk, and whey), and a proxy for the Federal Order 33 Blend Price. This paper attempts to tackle the question of variability and sources of variability in the milk price, and what is being proposed at the national level to mitigate or manage this variability. The work in this paper follows the existing literature assessing the question of commodity price volatility. The work of Dehn, 2000, Swaray, 2002, and Moledina and Roe, 2002 influences the time-series modeling followed in this paper.

United States Milk Prices: A short historical background

Figure 1 shows the time-series for three key milk prices; i) the United States Dairy Support price, ii) the Class 3 milk price (price based primarily on the cheddar cheese market), and iii) the All

Milk price (a use weighted average of all class milk prices). The time period for the data is from January 1961 through February 2011. The entire period is highlighted by four major policy developments. The first era is that of the Federal Dairy Price Support program. During this period milk prices are driven primarily by the concept of 'parity' and any price variation reflects seasonal components only. The second policy era is that which began in 1983 and ended in 1990. During this period, over-production was the issue and two pieces of federal legislation where enacted to remove perceived excess capacity from the industry. The first of these two legislative fixes featured a flexible support price adjuster to move the support price up or down (primarily down) based on supply and demand balance. The second piece of legislation authorized the purchase of complete dairy herds for the purpose of reducing perceived excess capacity.

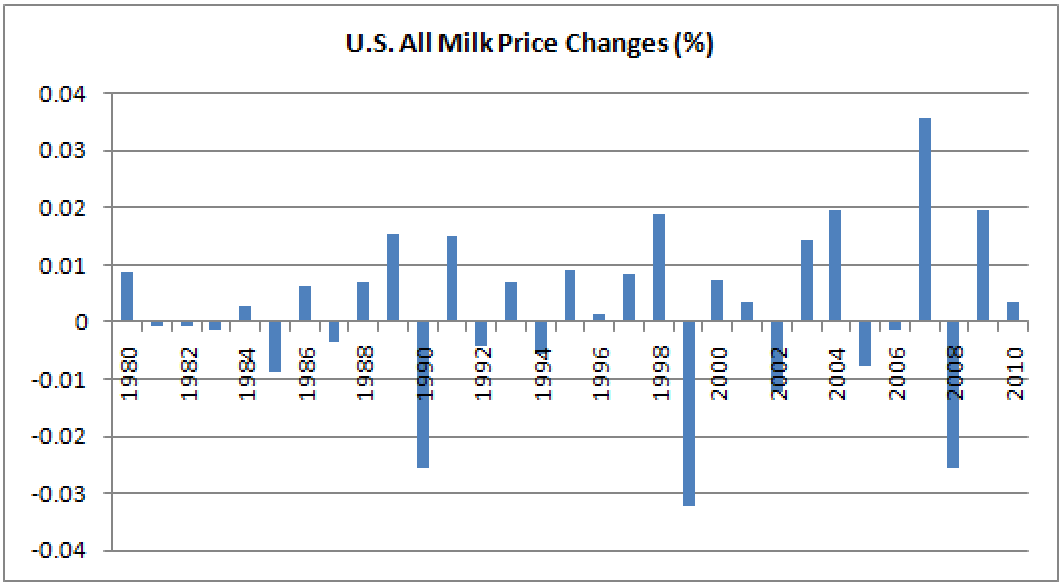
Figure 1. United States milk prices 1961-2011.



The third era for policy adjustment began with the passage of the 1990 farm legislation, and sought to remove the federal support price from the decision process by mandating a flat line support price into the future. The last piece of legislative change came about with the adoption of component based price calculations and the United States Federal Milk Marketing Order reform process. These new pricing rules began in January 2000 and continue today, with some modest modifications along the way.

It is not possible, looking at the time tracks for these three key prices, to miss the increasing variability in the price series over time. Clearly, this increased variability began in earnest in the late 1980's and appears to have become more pronounced over time. One way to observe this variability is to calculate the annual period to period percent changes. Figure 2 shows the year-to-year percent changes in the average value of the U.S. All Milk price. Each bar shows the month-to-month price changes averaged over a calendar year, 1980 – 2010. There does appear be an increase in the values after 1998. For example, the year 2000 shows the average price change to be a negative three percent. In 2007 the average price change was 3.5 percent. Most of the year show fairly small average values for the price change.

Figure 2. U.S. All Milk Price Annual Average Price Change (%).



On Variability vs. Volatility

We hear a great deal today about the excess 'volatility' in milk prices. As an illustration, consider the following quote from Charles Nicholson, agribusiness professor at California Polytechnic State University at San Luis Obispo, addressing the USDA Dairy Industry Advisory Committee meeting this past September. Dr. Nicholson states "There is an issue. There is a problem. There has been an extreme level of volatility and the length and depth of the increases and decreases will grow greater and deeper." The USDA Dairy Industry Advisory Committee final report makes a number of recommendations based on the view that dairy commodity prices and farm level milk prices are too volatile and corrective action needs to be expressed in the next farm bill. Specifically the committee recommended by a 17 to 0 vote that end-product pricing be eliminated. They also recommended that the industry should adopt a growth management plan on a 9 to 8 vote. The sentiment in this recommendation is to establish some variant of a supply – management program for U.S. dairy.[2]

Whether or not this view of 'excessive volatility' is correct and there is an extreme level of price volatility in the U.S. dairy market is an important question to address. Addressing this question necessitates a consideration of the difference between volatility and variability. It may well be that U.S. dairy prices have become much more variable, but they may not be more volatile. Certainly they are more variable relative to the earlier time period, pre-1995, when excess supply, minimum prices, government stock holding, and the U.S. dairy economy was a closed system with little connection to the international markets. However that is not the comparison that is relevant. The relevant comparison really begins with the mid-1990's, as depicted in Figure 1, when, as a policy decision, the United States Congress began the process of terminating price stabilization by stockholding and using burdensome government stocks to mitigate upward price movement.

That the dairy industry has experienced an increased level of price variability over the last 16 years is obvious. Increased volatility is not as obvious. Market price lows are at the safety net level, nominal or real, however the high price levels are historic. However, it is not clear that this translates into an increased level of volatility in milk prices. Volatility has a rather precise definition, and simply observing prices that vary, even vary substantially, over time, is not evidence that they are volatile, and certainly not extremely volatile.

Why is this distinction important?

It may appear that this is an unimportant issue. Dairy farmers, observing their market prices increasing, are naturally quite pleased. This is not excessive volatility or variability from the producer viewpoint. Of course if you are buyer of milk and not a seller, then this may indeed be viewed as excessive price change. When the market price declines substantially, as it did at the end of 2008 and into the first quarter of 2009, then this is taken as evidence of excessive price volatility. In response to this unwelcomed movement in market milk prices, those representing dairy farmers have called for an adoption of some variant of a national supply management program with the stated intention of stabilizing the milk price. While the Costa and the Sanders or the National Milk Producers Foundations for the Future approach differ in a number of their respective details, they are strikingly similar in the approach to manage price variability. To accomplish this end, these programs propose some type of supply-control programs to substitute market based signals with those coming from committees set up to penalize perceived excess production on the nations' dairy farms. These programs will substitute the collective reasoning of designated committees for market forces, and will attempt to manipulate milk supply in such a manner as to remove unwarranted or unwelcome price fluctuations, obviously defined to be price declines.

[2] The committee made 23 recommendations to address the excessive volatility in prices and low profitability.

Participants in the U.S. dairy industry have at their individual disposal a large array of market based price risk or price variability tools. These include a full array of futures and options products and a federally subsidized gross margin insurance product. The substitution of a mandated supply control program for these market based tools should not be undertaken without a vigorous exploration of the nature and causes of this variability. Especially so if it is correct that the fluctuations in market milk prices, which now are labeled as excessively volatile, are in fact nothing more than price fluctuations emanating from a well functioning set of domestic and international markets. Even if a stronger linking of the U.S. dairy economy with the international trade sector leads to more variable prices there are many other market based options for helping the dairy industry cope with this variability.

Methodology: Identifying the variability in the milk price

In the commodity markets price volatility is an extremely important concept. Market based price risk instruments, such as futures contracts and option contracts are priced with some notion of price volatility incorporated. The literature on measuring price volatility is extensive. A widely used measure of historical price volatility and one used by the Chicago Mercantile Exchange as an indicator of volatility is the standard deviation in the first difference of the logarithmic values for the price series. This value provides a measure of the volatility per unit time as measured by the original price series. For example, if the original price series is recorded on a daily basis, then the measure of volatility will be per day. To annualize this measure it is multiplied by the square root of the number of trading periods in the year. For example, daily data would be multiplied by the square root of 252, which is taken to be the number of trading days in a year. The CME reports these volatility measures for a number of agricultural commodities including Class 3 milk. Table 1 shows the CME historical price volatilities for eight agricultural commodities over the period 2003 through 2010 based on futures prices. Volatility in futures prices can be shown to directly reflect the volatility in the underlying asset (Fackler and Tian).

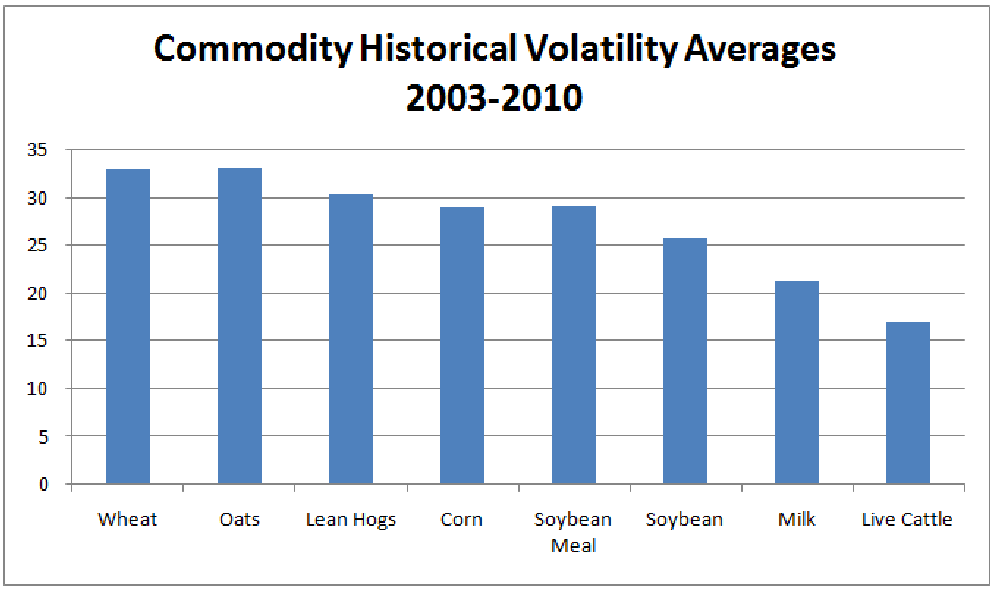
Table 1. Annual volatility for Agricultural Commodities: CME Futures prices.

	2003	2004	2005	2006	2007	2008	2009	2010
Wheat	26.8	26.9	23.7	30.4	32.7	50.6	37.9	35
Oats	34.5	31.9	29.5	29.2	30	37.9	36.7	34.4
Lean Hogs	36.5	31.2	25.8	27.4	24.6	34.5	37.1	25.9
Corn	20.1	21.7	21.9	28.8	31.4	41.3	36.8	29.1
Soybean Meal	23.2	31	27.4	18.9	25.6	40.4	42.2	24.4
Soybean	20.4	29.9	25.9	17.9	21.7	38.4	33.7	17.7
Milk	25.7	32.7	17.9	14.4	19.1	20.1	22.4	17.3
Live Cattle	21.6	22.9	16.3	16.5	15	16.1	14.5	12.2

Looking at the annualized volatility measures for milk, it is apparent that the Class 3 price was not the most volatile and in fact was not nearly as volatile as most other agricultural commodities reported on by the CME over the past eight years. In the period now viewed as a highly volatile period for agricultural commodities, 2008-2009, the milk price exhibited only a fraction of the volatility experienced by wheat, corn, soybeans, lean hogs, oats. The only agricultural commodity to show a lower level of annualized volatility during this period was live cattle.

Taking the entire time period, 2003 through 2010 and calculating the average annualized volatility Figure 3 shows the ranking for these eight agricultural commodities.

Figure 3. Average values for annualized volatility: Futures prices for U.S agricultural commodities 2003 - 2010.



The commodities are show from the most volatile (left) to the least volatile (right). Milk, as measured by the volatility on the Class 3 futures contract ranks seventh of the eight commodities. Milk shows an average annualized volatility of 21.2 percent, while the most volatile agricultural commodity is wheat with an annual volatility of 35 percent per annum.

Using the annualized volatility for the daily settle prices for agricultural commodities suggests that the milk price is not highly or excessively volatile when considered relative to other commodities. With an average annualized volatility of just over 21 percent, whether or not this is to be considered too much volatility, as experienced by members of the dairy industry is another question.

Price instability and price volatility

The question of measuring the instability in commodity prices goes back many years. For example, Offutt and Blandford (1986) reviewed the many possible measures of instability exhibited by time series and proposed a number of alternatives such as the standardized coefficient of variation. The role of stocks in determining dairy price volatility was investigated by Weaver and Natcher (1998). They use monthly data over the period 1970 to 1998 and incorporate product stocks in their statistical models. The reach the conclusion that beginning stock levels or changes in beginning stocks were not significant in determining price volatility. More recent work on commodity price volatility includes that of Dehn (2000), Moledina and Roe (2002) and Swaray (2002). Dehn builds on the work of Clements and Hendry (1998) to draw the distinction between unpredictability and uncertainty of a random variable. He proposes a Generalized Autoregressive Conditional Heteroskedastic (GARCH) times series approach, which, when the price series of interest is purged of its predictable elements leaves the variance of the residuals as a measure of uncertainty (volatility). Moledina and Roe, when examining the measurement of commodity price volatility and the welfare implications of eliminating volatility follow the approach taken by Dehn and utilize a GARCH time series methodology. Swaray also follows the GARCH approach when evaluating the volatility of nine commodities. Swaray extents the work of Dehn and Molidina and Roe by also estimating variants of the GARCH model, e.g., I-GARCH, E-GARCH and T-GARCH models of volatility.

In this paper the general GARCH approach is used to evaluate the volatility in U.S. dairy commodity prices: butter, nonfat dry milk, cheese, and whey, and a farm level milk price (Hull). The statistical process followed is to i) check for stationarity of the price time series, ii) make any required transformations to the time series to assure stationarity, iii) estimate the GARCH(1,1) model, and iv) examine the standard deviation of the conditional variance for any indication of excessive and growing volatility.

Data and Descriptive Statistics

The dairy commodity prices of interest are those reported by the United States Department of Agriculture, National Agricultural Statistical Service, NASS, for use in calculation of the Federal Order Milk Market (FMMO) prices. The products reported on are Butter, Nonfat dry milk (NDM), cheddar cheese, and whey protein concentrate. Dairy product prices are reported in USD per pound. In addition to these dairy product commodity prices, the analysis will also use a proxy for the Federal Order 33 uniform or blend price, which are reported in USD per hundred pounds.[3] Table 2 provides the descriptive statistics for the weekly prices, calculated over the time period 1999 through April 30, 2011. All price series are nominal. The total number of price data points in each weekly series is 591.

[3] This is a proxy as Federal Order blend prices are not reported by week, however they can be approximated to a close degree using the Federal Order pricing rules and weekly NASS dairy price data.

Table 2. Descriptive statistics for U.S. dairy commodities and milk price, by week.

Dairy commodity	Mean	Minimum	Maximum	Std. Dev.
Butter	1.407e+00	8.555e-01	2.304e+00	3.192e-01
Cheese	1.452e+00	1.011e+00	2.231e+00	2.870e-01
NDM	1.048e+00	8.021e-01	2.086e+00	2.860e-01
Whey	2.900e-01	1.363e-01	7.894e-01	1.281e-01
FO33UP	1.450e+01	1.017e+01	2.211e+01	2.947e+00

Time series behavior for the selected prices

In this analysis the monthly time series will be analyzed with respect to the question of variability vs. volatility. In order to investigate the question of variability vs. volatility, we first start with a graphical view for each price time series. For each selected price, the series divided by its overall standard deviation and the difference series is provided in Figures 4 - 6.

It is useful to focus first on the behavior of the nonfat dry milk series, Figure 4, bottom panel. Over the time period 2000 through most of 2006, NDM prices were at the United States mandated minimum under dairy price support policy. This shows up in the figure with NDM running about 3.5 times its overall standard deviation. After 2006, the world-wide boom in commodity prices is evident, fueled by a shortage of milk protein in international markets. During the period 2007 and the first half of 2008, NDM price rose to seven times its standard deviation. Leading the world-wide recession and commodity price bust in the last half of 2008 and into 2009, NDM returned to is normal value of 3 to 3.5 times its standard deviation. With the current economic recovery, NDM price is once again on the rise, trading at about 5 times the standard deviation.

The most variable dairy commodity price, by visual inspection, appears to be the cheddar cheese price. There are four periods of rising cheese price, reaching as much as seven times its overall standard deviation before returning to a more normal multiple. While the butter and whey prices contribute to the computation of the Class 3 milk price, it is primarily the cheddar cheese price which determines the Class 3 price. The proxy FMMO blend price, FO33UP_std shows similar time series behavior, with somewhat more subdued fluctuations over time. This is a result of the fact that FO33UP_std incorporates all of the FMMO class prices and pricing rules in its calculation.

Figure 4. Butter, Nonfat Dry Milk price series: level and 1st difference.

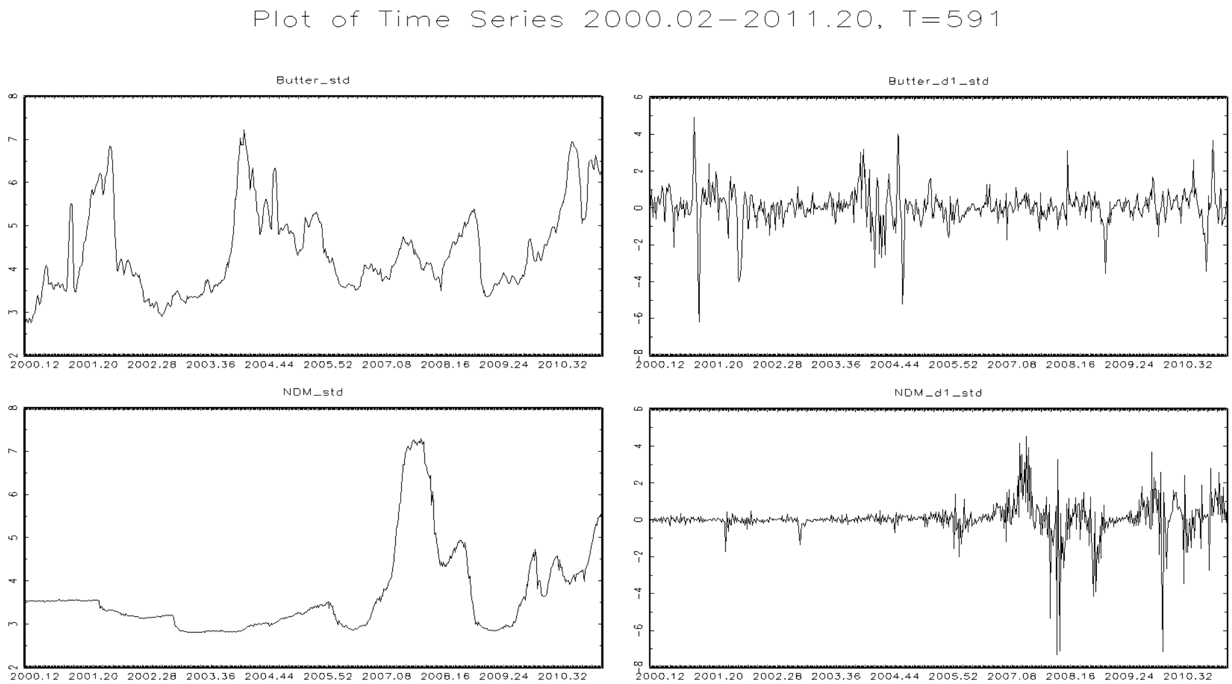


Figure 5. Cheese and Whey price series: level and 1st difference.

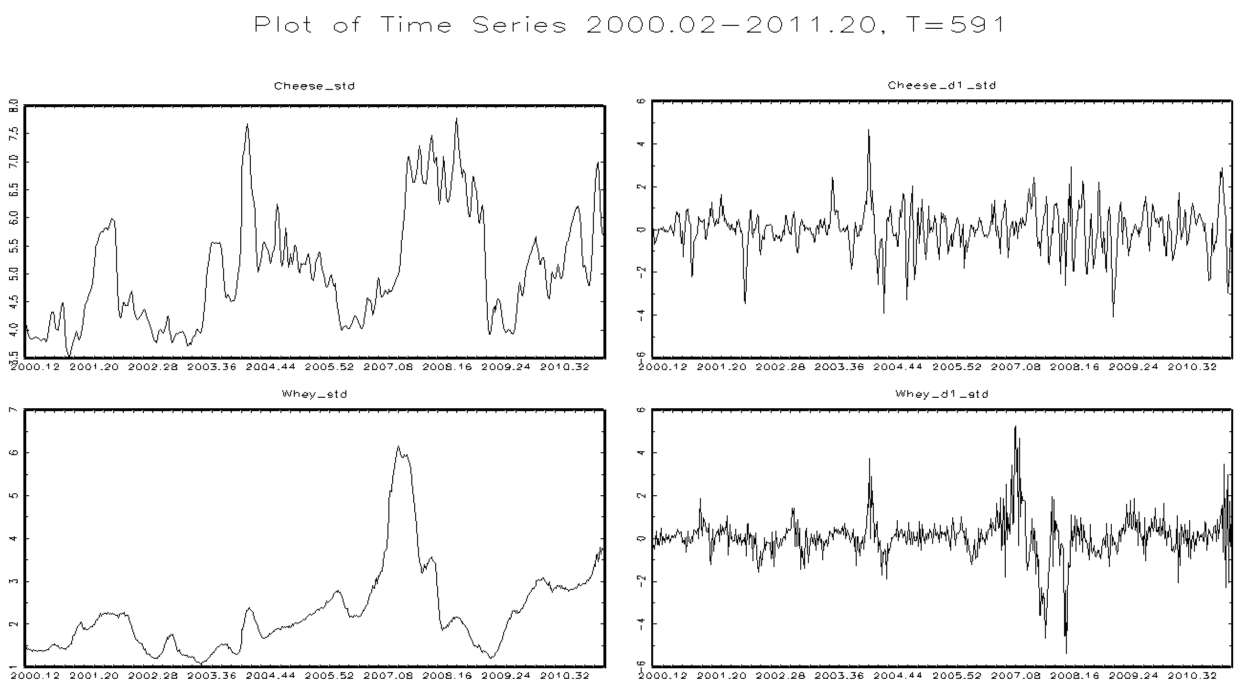
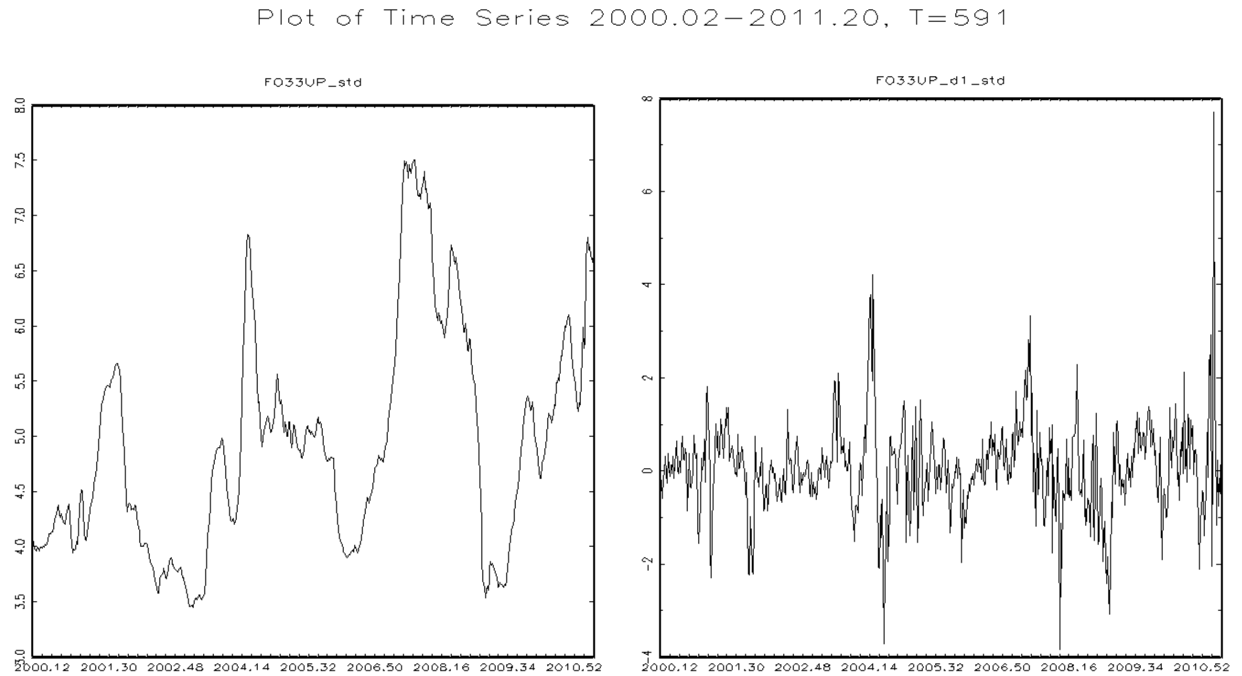


Figure 6. Proxy Federal Order 33 Blend price series: level and 1st difference.



Turning to the right-hand panels for Figures 4-6, the time series behavior for these prices is shown as weekly first differences. These are the changes in price from one week to the next. The panel depicting first differences for nonfat dry milk, NDM_d1_std, shows the pattern of stability during the support period discussed above. After 2006, the increase in price variability is obvious. As for the other dairy products, butter and whey appear to exhibit the least stability from week to week.

The focus of concern with respect to volatility is on the U.S. All Milk price series. However this series is a constructed weighted average price which no producer actually receives. Given the operation of the Federal Order pricing system, farm level prices are derived prices based on formula converting the NASS dairy commodity prices into farm level milk prices. In order to narrow the focus, an OLS regression was estimated linking the proxy FO33UP price to its component dairy commodity prices. The variables were transformed to logarithms. The most significant relationship is that which exists between FO33UP and the cheese price. The estimated elasticity is +0.959, followed by NDM +0.63, butter +0.58 and whey +0.325. With the log transform, the estimated coefficients are elasticities showing the percent change in the FO33UP price given a 1% change in each of the dairy commodity prices. These elasticities provide a measure of the influence of each price series on the proxy FO33UP price series.

Unit Roots, stationarity and GARCH(1,1)

The dairy price time series are checked for stationarity using a series of unit root tests (Augmented Dickey-Fuller and KPSS). The unit root specification includes a constant and no trend. The results of this testing suggests that these series are stationary and do not process a unit root. To error on the conservative side, each series is transformed to a first difference in logarithms for further evaluation. The results of the GARCH(1,1) estimation for each of the dairy commodities is given Table 3.

Table 3. GARCH(1,1) models for dairy commodity prices.

GARCH(1,1) Models: U.S. dairy commodity prices						GARCH(1,1) Models: FO33UP price		
Cheese			**Nonfat Dry Milk**			**FO33UP (Proxy)**		
variable	coefficient	t-statistic	variable	coefficient	t-statistic	variable	coefficient	t-statistic
intercept	1.16E-04	6.04	intercept	6.49E-05	6.81	intercept	4.76E-05	7.19
gamma(1)	7.99E-01	8.13	gamma(1)	2.82E-01	5.81	gamma(1)	4.29E-01	5.08
beta(1)	1.81E-01	3.74	beta(1)	6.96E-01	16.87	beta(1)	4.60E-01	7.9
Butter			**Whey**					
variable	coefficient	t-statistic	variable	coefficient	t-statistic			
intercept	1.17E-04	6.45	intercept	8.59E-05	4.49			
gamma(1)	4.46E-01	8.87	gamma(1)	3.10E-01	6.25			
beta(1)	5.16E-01	17.65	beta(1)	6.06E-01	11.86			

An important measure of stability in the GARCH(1,1) model is the sum of the ARCH and GARCH parameters, gamma's and beta's in Table 3.[4] A variance stable process, one that does not exhibit volatility growing without bound, is evidenced by gamma(1) plus beta(1) strictly less than 1. These values for the dairy prices and the proxy FO33 price are shown in Table 4.

Table 4. Stable GARCH parameter values.

Stable GARCH parameter values: U.S. dairy commodity prices and proxy FO33 price series					
Cheese	9.80E-01	NDM	9.78E-01	FO33UP*	8.89E-01
Butter	9.62E-01	Whey	9.16E-01		

As these values are all less than one, each series exhibits mean reversion. The variance is pulled back toward the long run average variance level. The closer the values shown in Table 4 are to one, the slower any deviations in variance (volatility) from the long term variance return to this long term variance. A series exhibiting a tendency toward unbounded growth in volatility would not exhibit mean reversion.

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[4] The presence of an asymmetry in error innovations was check using the TGARCH model as proposed by Glosten, Jagannathan, and Runkle, (1993). The model results did not support the hypothesis that there was an asymmetry in the error process for each of the price series. This analysis reported on in this paper does not consider volatility spillovers or linkages between the dairy commodities and the farm level milk price as reported on by Tejeda and Goodwin. The federal order pricing rules specify a direct linkage between the dairy commodity prices and the farm level milk price making the modeling of this linkage unnecessary.

Standard Deviation of the GARCH error process

The measure of volatility examined in this paper is that of the standard deviation in the GARCH(1,1) error process. These error processes are shown in Figures 7 through 11.

Figure 7. The standard deviation of the GARCH(1,1) error process for U.S. cheese prices 2000:1 – 2011:20.

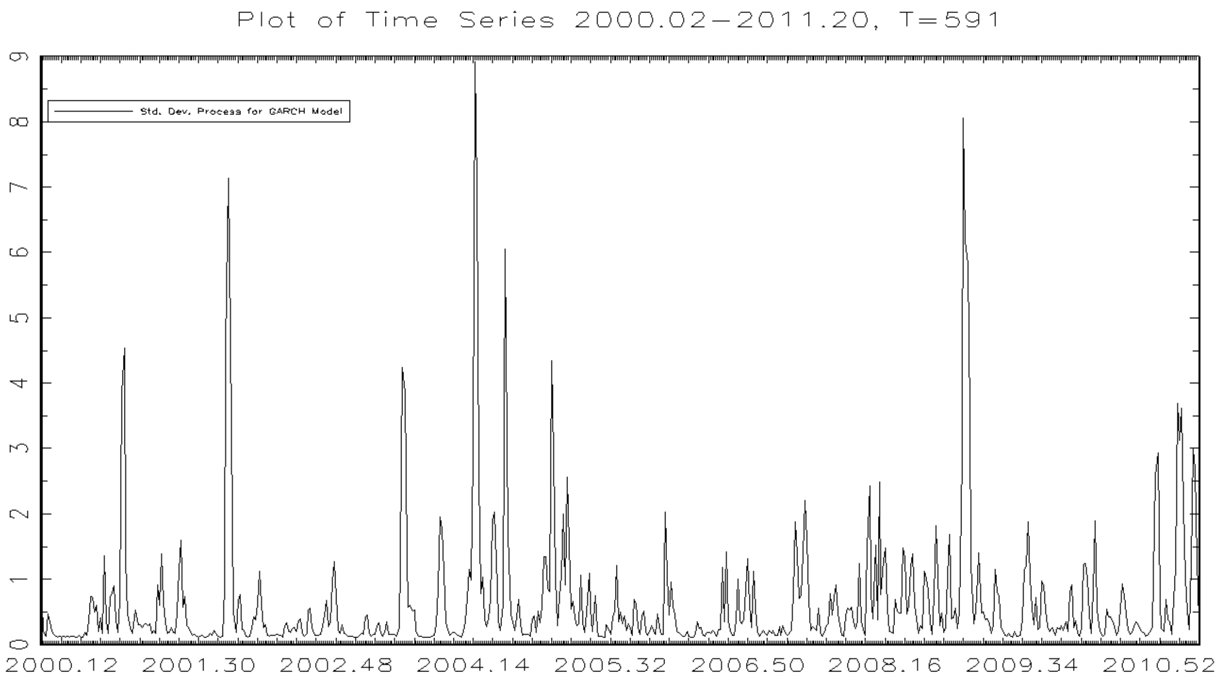


Figure 8. The standard deviation of the GARCH(1,1) error process for U.S. butter prices 2000:1 – 2011:20.

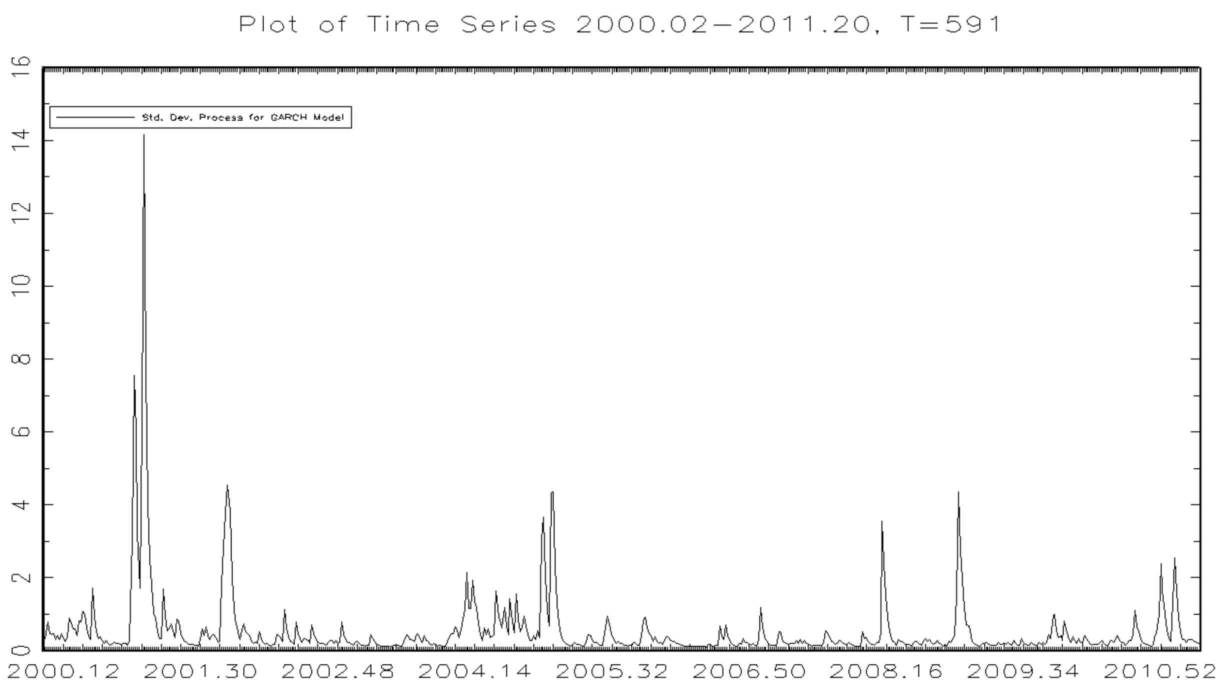


Figure 9. The standard deviation of the GARCH(1,1) error process for U.S. NDM prices 2006:1 – 2011:20.

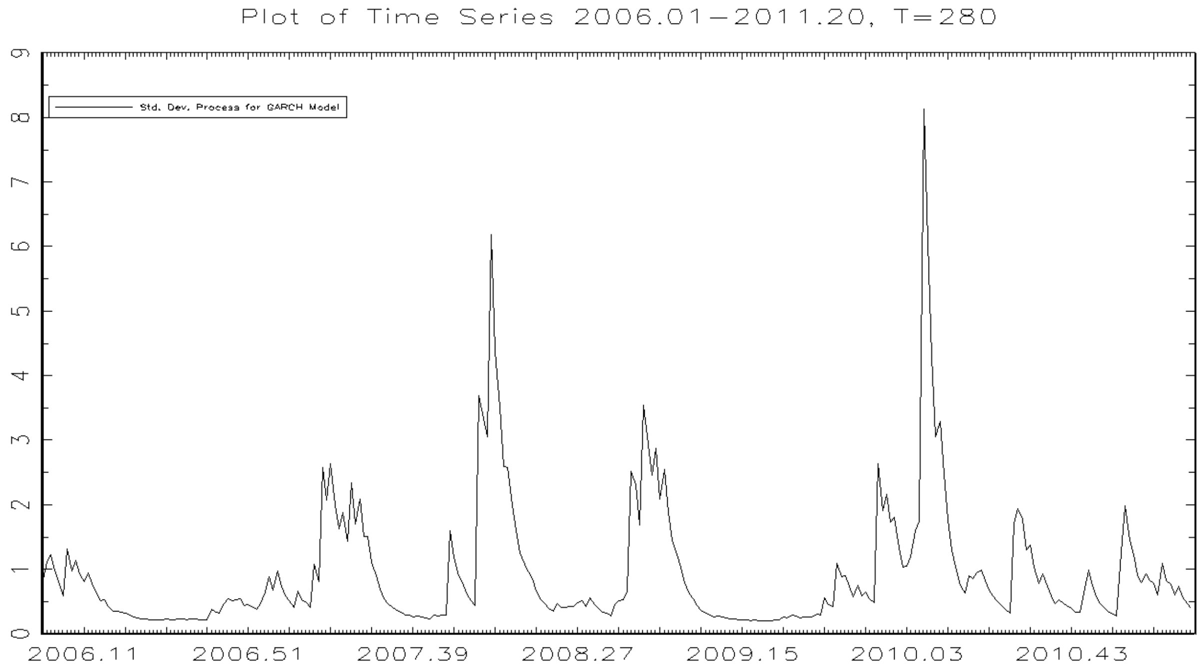


Figure 10. The standard deviation of the GARCH(1,1) error process for U.S. whey prices 2000:1 – 2011:20.

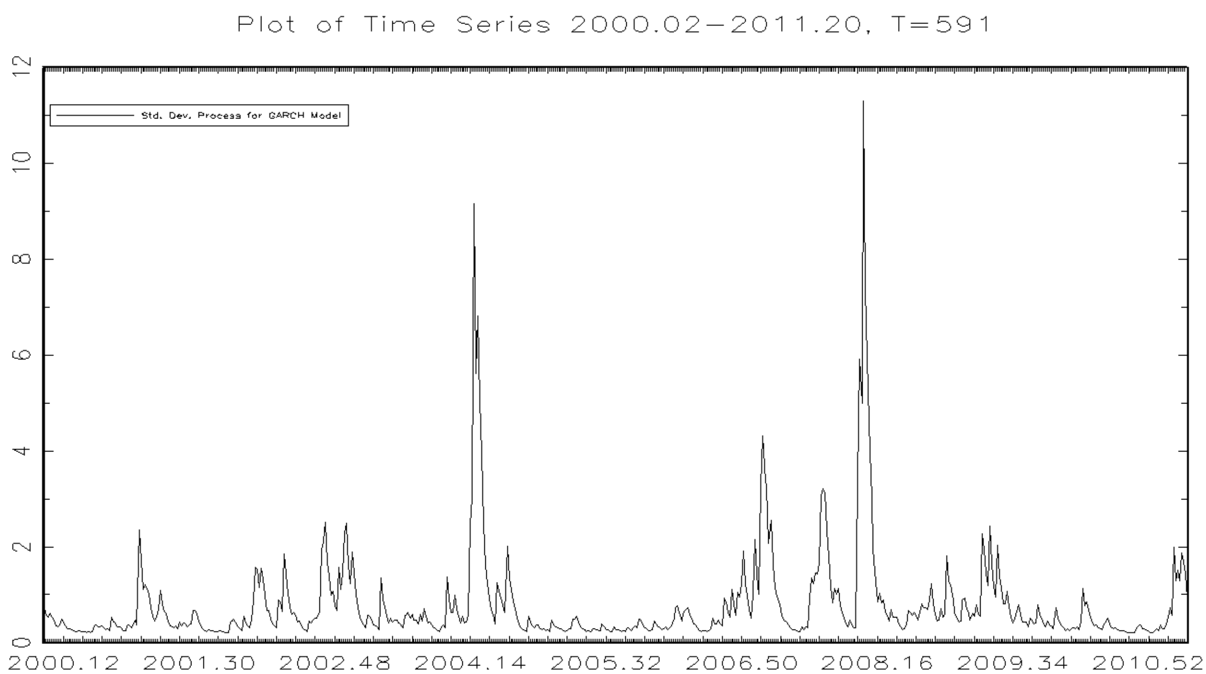
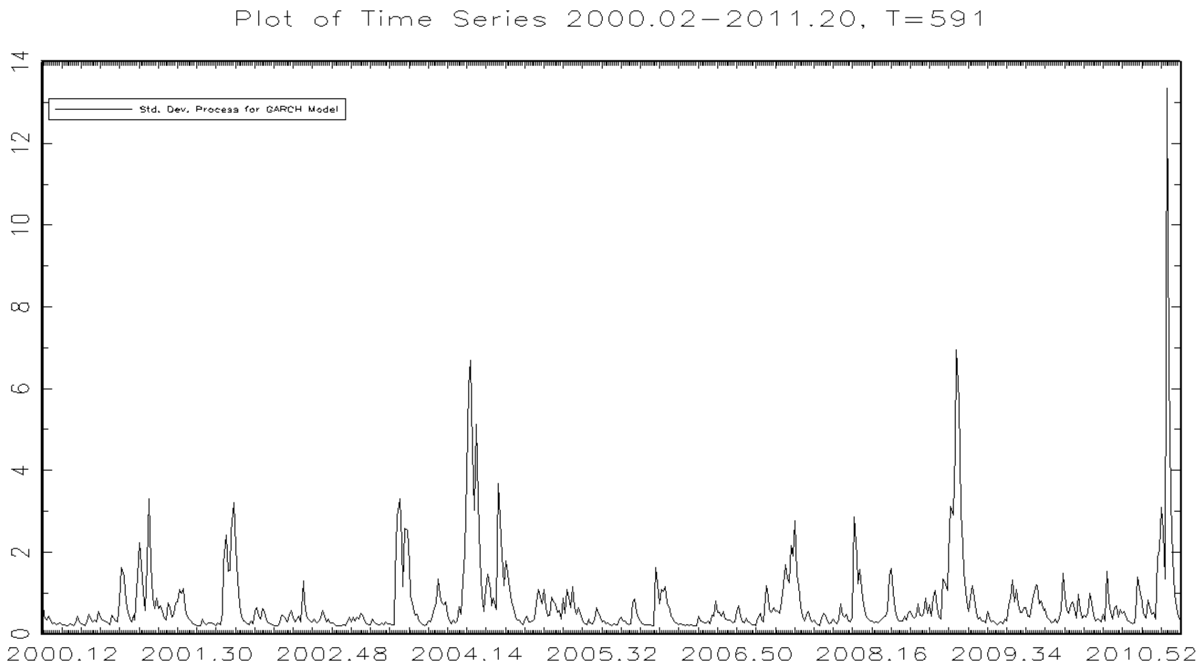


Figure 11. The standard deviation of the GARCH(1,1) error process for FO33UP(proxy) prices 2000:1 – 2011:20.



Examination of the conditional standard deviation for each of the price series shows periods of volatility clustering. Some of these indicate substantial volatility in the weekly price series. As an example for the cheese price series there are three extended periods over the past 11 years with significant volatility spikes: 2000/2001, 2004/2005, and late 2008/2009. Butter shows much less volatility over the time period. There are two periods of large volatility; 2000/2001 and 2004/2005. Overall the butter price series exhibits only modest volatility and does not suggest any evidence of growing volatility over time. Nonfat dry milk shows four periods of high volatility; three occurring between 2007 and 2008 and then again in 2010. These spikes may be related to stock-outs in the domestic and international supply of skim milk powder (nonfat dry milk). Whey, which is a protein powder and trades in the same markets as skim milk powder shows a number of volatility spikes in the period 2000/2004 and then again 2006 and 2008. The proxy series for the Federal Order 33 blend price, exhibits a pattern of volatility spikes reflecting the influence of the cheese, NDM and whey prices and to a lesser extent the butter price.

Turning the question of excessive and growing volatility, while there is evidence in the presence of volatility in each of the price series, and substantial volatility spikes over the period, there is no evidence that this volatility is excessive nor growing. For each price series, after a volatility spike, the standard deviation of the error process returns to the long run unconditional variance. For each price series the unconditional long run variance is low. These variances are provided in Table 5.

Table 5. Long run unconditional variances of the price series.

Long run unconditional variances for the price series.					
Cheese	5.80E-03	NDM	2.95E-03	FO33UP*	4.29E-04
Butter	3.06E-03	Whey	1.02E-03		

The volatility per week for each price series can be calculated by taking the square root of these long run average variance. These are shown in Table 6.

Table 6. GARCH volatilities for the dairy price series.

Volatility of the dairy commodity and FO33 price series (% per week)					
Cheese	7.62%	NDM	5.43%	FO33UP*	2.07%
Butter	5.53%	Whey	3.20%		

As observed with the plotted volatilities, the cheese price series exhibits the greatest amount of volatility followed by the butter, NDM, and whey series. The proxy farm milk price series, FO33UP exhibits the least amount of volatility. As observed in the volatility calculations from the CME futures price series for Class 3 milk, the volatility of just over 2% for the FO33UP price does not appear to be excessive.

Summary and Conclusions

Based on the examination of the price series for cheese, nonfat dry milk, butter and whey, and a proxy for the Federal Order 33 uniform price, there is no evidence that the movement of the prices over time exhibit excessive volatility. Nor is there any evidence that the volatility present in these price series is growing without bound. Clearly there are periods of substantial volatility spikes in each of the price series and this volatility can cause serious repercussion for the industry, it is also apparent that this volatility is not persistent and that there are also periods of much reduced volatility. In fact for each price series examined in this research, the volatility quickly reverts toward its long term unconditional volatility between the spikes. Whether or not the pattern and magnitude of price volatility in the price series and the milk price series warrants a remedy as severe as an adoption of a supply-managed dairy production system is a more difficult question to address. If the adoption of such a system is predicated on the idea that price volatility is excessive and in some sense 'out of control' then the research presented in this paper does not find support for that position. To the contrary, what is suggested is that end-product pricing, that is, having wholesale prices for dairy commodities translated quickly and directly back to dairy producers as price signals for butterfat, protein and other solids works as it was intended to do so when this end-product pricing system was adopted in 2000.

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