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Backcasting Formula-Based Federal Order Class Prices

By

Ed Jesse

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Backcasting Formula-Based Federal Order Class Prices

Ed Jesse[1]

Major changes in federal milk marketing orders implemented in January 2000 included the adoption of common product price formulas across all orders to derive component and class prices. Previously, federal order class prices were based on reported farmer pay prices for Minnesota and Wisconsin plants making hard manufactured products. The Minnesota-Wisconsin Price Series (M-W), used from the mid-1960s until June 1995, was a direct measure of Grade B milk pay prices. It was replaced by the Basic Formula Price (BFP) which adjusted the M-W for month-to-month changes in commodity prices.

Using product price formulas to establish minimum federal order milk prices is fundamentally different from using a competitive pay price. Product price formulas generate milk prices that plants ***can afford to pay*** given reported commodity prices and assumed yields and make allowances. Competitive pay prices represent what plants ***have to pay*** to meet competition for the raw a milk supply. While plants' ability to pay and need to pay for milk would be expected to be correlated in the long run, they are distinctly different concepts and may lead to different prices in the short run.

This paper addresses the question of how actual federal order Class prices compare with the prices that would have been generated using the current product price formulas. Two-week and monthly average product prices were derived using the procedures and timing currently employed by USDA in administering orders. Then, imputed federal order Class prices from 1991 to March 2003, when current formulas were implemented, are "backcast" by applying current formulas to actual and estimated prices for butter, cheese, dry whey and nonfat dry milk.

[1] Professor and Extension Dairy Marketing Specialist, Department of Agricultural and Applied Economics, University of Wisconsin Madison/Extension. Assistance from Angela Geiger in assembling data for this study is gratefully acknowledged.

Evolution of product price formulas

As part of federal milk marketing order "reform" mandated by the 1996 farm bill, product price formulas have been used to establish minimum federal order component and Class prices beginning with milk priced for January 2000.[2] These formulas have been altered twice. The first change, effective January 2001, was in response to a Congressional mandate for USDA to review the formulas implemented with order "reform." USDA held a hearing in May 2000 to accept testimony on proposed formula changes and issued a tentative final decision in December 2000 to become effective with milk priced in January 2001.

Component Price ($/Lb.)	***Effective Dates***		
	Jan. 2000 – Dec. 2000	Jan. 2001 – March 2003	April 2003 -
Butterfat	(Butter Price – 0.114) ÷ 0.82	(Butter Price – 0.115) ÷ 0.82*	(Butter Price – 0.115) x 1.20
Protein	(Cheese price – 0.1702) x 1.405 + (((Cheese Price – 0.1702) x 1.582) – Butterfat Price) x 1.28	(Cheese price – 0.165) x 1.405 + (((Cheese Price – 0.165) x 1.582) – Butterfat Price) x 1.28**	(Cheese price – 0.165) x 1.383 + (((Cheese Price – 0.165) x 1.572) – Butterfat Price x 0.9) x 1.17
Nonfat Solids	(NDM Price – 0.137) ÷ 1.02	NDM Price – 0.14	(NDM Price – 0.14) x 0.99
Other Solids	(Dry Whey Price – 0.137) ÷ 0.968	(Dry Whey Price – 0.14) ÷ 0.968 Snubbed at zero	(Dry Whey Price – 0.159) x 1.03

* A different Class III butterfat price was defined January 2001, but its use was enjoined prior to implementation.
** The NASS moisture-adjusted barrel cheese price used to calculate the weighted average cheese price in the protein price equation was changed from 39 percent to 38 percent moisture in January 2001.

Most of the changes in the December 2000 decision entailed tinkering with assumed product yields and make allowances. However, USDA made a surprising major change in calculating the value of butterfat separately for Class III and Class IV. Class IV butterfat continued to be based on butter prices while Class III butterfat was tied to

[2] The product price formulas and Class price calculations noted here apply to the six federal orders utilizing multiple component pricing (MCP) to price milk to handlers and producers. Four orders (Florida, Southeast, Appalachia and Arizona-Las Vegas utilize skim-butterfat pricing, under which handlers account to their pools and producers are paid for skim milk and butterfat.

cheese prices. The protein formula was altered to base protein value exclusively on cheese prices. An additional change was to use advanced whole milk prices to determine the 'higher of" advanced prices for Class I skim milk and butterfat.[3]

These major modifications were strenuously opposed by a broad coalition of dairy interests, and in February 2001, a federal District Court enjoined USDA from using separate butterfat classes. The injunction occurred before the modified Class III butterfat and protein formulas were applied.

In response to the injunction, USDA reverted to a single Class III/IV butterfat formula and used a protein formula that was the same as the old formula except for a smaller make allowance and use of 38 percent moisture barrel cheese in the cheese price calculation instead of 39 percent moisture. The agency also revisited the revised formulas based on comments received from interested parties on the tentative final decision. In November 2002, USDA issued a final decision designed to conform to the injunction and be responsive to industry comments. After a favorable producer referendum, the revised formulas became effective in April 2003.

The Class prices in multiple component pricing orders are calculated as follows:

Class Price ($/Cwt)	***Component Combination***
Class IV	(Nonfat Solids Price X 9.0) X 0.965 + Butterfat Price X 3.5
Class III	(Protein Price X 3.2 + Other Solids Price X 5.9) X 0.965 + Butterfat Price X 3.5
Class II	Skim Milk: (Advanced Nonfat Solids Price X 9.0) + $0.70 Butterfat: Butterfat price + 0.007 Whole Milk: Skim Milk X 0.965 + Butterfat X 3.5
Class I	Skim Milk: Higher of Advanced Class III or Class IV Skim Milk + Class I Differential Advanced Class III Skim Milk = Advanced Protein Price X 3.2 + Advanced Other Solids Price X 5.9 Advanced Class IV Skim Milk = Advanced Nonfat Solids Price X 9.0 Butterfat: Advanced Butterfat Price + Class I Differential ÷ 100 Whole Milk: Skim Milk X 0.965 + Butterfat X 3.5

[3] Formula changes are described in detail in the following Marketing and Policy Briefing Papers: *Order Reform and Reforming Order Reform* (No. 71, December 2000); Federal *Milk Marketing Order Reform (Continued)* (No. 73, November 2001); and *Federal Milk Marketing Order Reform: November 2002 Final Decision* (No. 79, November 2002).

Unlike the component formulas themselves, the procedure for calculating Class prices from the product price formulas for milk components has not changed since formula pricing was adopted in January 2000.[4]

Advanced prices are announced on the Friday on or before the 23rd of the month before they apply. Monthly prices are announced on the Friday on or before the 5th of the month after they apply.

Backcasting Product Prices

The current federal order product price formulas (effective April 2003) were used to "backcast" Class prices from January 1991 through March 2003. In other words, Class prices that would have resulted from application of the current product price formulas were calculated for months prior to the adoption of the formulas.

In deriving Class prices through product price formulas, the Agricultural Marketing Service of USDA (AMS) summarizes product prices collected by USDA's National Agricultural Statistics Service (NASS) through a weekly survey of sellers. AMS calculates weighted average monthly and two-week (advanced) product prices using NASS weekly prices and production volume available on the announcement date.

NASS began reporting weekly prices for cheese in April 1997 and for butter, nonfat dry milk and whey in September 1998. Hence, NASS prices are only available for part of the backcast period, so it is necessary to use proxy product prices for earlier years. Moreover, AMS altered the moisture specification for barrel cheddar cheese beginning January 2001, which required adjusting the reported NASS cheese prices prior to then to make them consistent with the current specification.

The specific product prices used for the period January 1991 through March 2003 are outlined below.

January 2001 – March 2003:

For months since January 2001, applicable weighted average product prices have been published monthly by AMS. Accordingly, the current formulas were applied directly to the product prices reported by AMS in its price announcements.

January 2000 – December 2000:

For calendar year 2000, AMS prices for butter, nonfat dry milk, and dry whey were defined in exactly the same manner as the prices used in current product price formulas.

[4] Proposed changes in Class I skim milk and butterfat prices beginning January 2001 were never implemented because of the February 2001 injunction.

However, Cheddar cheese prices must be adjusted to represent barrel cheddar at 38 percent moisture. This adjustment was made by converting the reported weekly NASS barrel price to a value per point of dry matter using reported average moisture and multiplying the result by 62. Weekly NASS production volumes were then applied to the reported block prices and the adjusted 38 percent moisture barrel prices to calculate revised weekly and monthly cheese prices.

April 1997 – December 1999 (cheese) and September 1998 – December 1999 (butter, nonfat dry milk, and dry whey)

NASS began reporting weekly average U.S. cheddar cheese prices for blocks and barrels in April 1997 along with estimated sales volume underlying the prices. In September 1998, NASS started reporting weekly Grade AA butter, nonfat dry milk, and dry whey prices and associated sales volume. These reported prices are the same as the product prices that AMS began using to calculate component values in January 2000. Consequently, related monthly average product prices can be derived by appropriately weighting the NASS weekly prices for weeks corresponding to those that would have been used in the advanced and monthly price announcements.

Using the Friday on or before the 23rd of the preceding month, the NASS weekly prices and volumes for the two preceding weeks were used to calculate product price averages for the advanced price calculations. For example, if the 23rd of November fell on Tuesday, advanced prices for December would be announced by AMS on Friday, November 19, using weekly NASS prices for the weeks ending on the 5th and the 12th of November.

Similarly, the Friday on or before the 5th of the month was used to specify the applicable four or five weeks for using to calculate the monthly product price averages. Barrel cheese prices were converted to 38 percent moisture and average cheese prices (weighted block and barrel) were recalculated using the converted barrel prices.

January 1991 – March 1997 (cheese) and January 1991 – August 1998 (other products)

NASS did not collect or report weekly product prices in this period. Consequently, it was necessary to use proxy prices related to current NASS survey prices. The widely-reported market prices noted below were used as a basis for the proxy prices.

Product	*Specification*
Butter	Chicago Mercantile Exchange weekly average price for Grade AA butter as reported by Dairy Market News
Cheddar Cheese	Jan. 1991 through Apr. 1997: National Cheese Exchange weekly average prices for 40-pound block and 500-pound barrel cheddar. May 1997 - : Chicago Mercantile Exchange weekly average prices for 40-pound block and 500-pound barrel cheddar. Both series as reported by Dairy Market News.
Dry Whey	Central States whey powder, nonhydroscopic, midpoint of weekly price range as reported by Dairy Market News. Mostly range when reported.
Nonfat Dry Milk	Central States nonfat dry milk, midpoint of weekly price range as reported by Dairy Market News. Mostly range when reported. 1991-92: Extra Grade 1993- Extra Grade and USPH Grade A May 1998- : Low/Medium Heat (Jan. 2002 to date prices combine Central States with East)

For periods of reporting overlap through the end of August 2004, weekly NASS prices were regressed against the corresponding market prices. There were 312 matching observations for butter, nonfat dry milk, and dry whey, and 386 matching observation for block and barrel cheddar. Specifications involving lags of zero, one, and two weeks were estimated (i.e., the weekly NASS price was regressed against the contemporary week's market price and the market price from one and two weeks earlier). The results of the specifications demonstrating the highest R^2 values are shown below:

NASS Product Price	*Lag (in weeks)*	*Intercept*	*Coefficient*	R^2
Butter	1	-0.0144*	0.9984	0.9928
Block Cheddar	2	0.0050	0.9892	0.9857
Barrel Cheddar	2	0.0112	0.9993	0.9889
Nonfat Dry Milk	0	-0.0518*	1.0313**	0.9561
Dry Whey	2	0.0174*	0.9018**	0.9815

* Intercept significantly different from zero at 95 percent level of confidence.
**Coefficient significantly different from 1.00 at 95 percent level of confidence.

The results are interpreted as follows: For Grade AA butter, the NASS weekly price over the period September 1998 through August 2004 was, on average, equal to -$0.0144 per pound plus 0.9984 times the reported weekly CME Grade AA butter price per pound from the preceding week. For the cheese price equations, the best statistical fit over the period April 1997 through August 2004 was obtained by lagging the CME/NCE prices by two weeks. The NASS nonfat dry milk price is most highly correlated with the matching week Central States quote, but a two-week lag gave the best fit for dry whey.

Note the statistical significance of the intercept and slope coefficients based on hypothesized values of 0 and 1, respectively. In the butter equation, the intercept term is significantly different from zero but the slope is not significantly different from 1.0. This indicates that NASS butter prices run about 1.5 cents per pound under the one-week lagged CME price. The dried product relationships have significant intercepts and slopes. Over the range of nonfat dry milk prices, the NASS price is generally lower than the Central States price because of lower priced western powder included in the NASS series. For similar reasons, NASS whey prices tend to be under the Central States price. Neither the slope nor intercept terms of the cheese equations are significantly different from their respective hypothesized values, suggesting that the CME prices are very good predictors by themselves of the corresponding NASS prices two weeks later.

The R^2 values indicate a very strong correlation between the weekly NASS prices and the corresponding proxy market prices during the overlap periods. This is not surprising, especially for cheese and butter where CME prices are used extensively in procurement contracts. The high R^2 values for dry products (where Central States wholesale prices are used as proxies) reflect the national markets for these products.

For the period before NASS began reporting weekly product prices, the regression equations were used to predict NASS weekly prices. Current AMS timing of price

announcements was used to calculate advanced and monthly price averages. Since weekly production data were not available, the estimated NASS two-week and monthly product prices for butter and dry products were calculated as simple rather than weighted averages of applicable weekly prices. Week-to-week variation in sales volume within months does not appear to be pronounced or predictable enough to cause a significant difference between weighted and un-weighted averages.

Likewise, the absence of weekly sales weights for block and barrel cheddar cheese does not pose a serious problem in deriving two-week and monthly average prices for the respective varieties. However, the block-barrel weighting in the current AMS cheese price calculation weights barrel cheese significantly more than block cheese. Unfortunately, published monthly cheddar cheese production is not segregated by block and barrel. Accordingly, weights equal to the average proportions of block and barrel cheddar sales for April 1997 through December 2000[5] were applied in deriving the proxy NASS 2-week and monthly cheese prices.

Imputed Class Prices

The period January 1991 through March 2003 was separated into three time periods for purposes of comparing reported Class prices with the Class prices that would have resulted from applying current product price formulas to the actual and estimated product prices. January 1991 through May 1995 is designated the M-W sub-period, corresponding to the use of the Minnesota-Wisconsin Price Series as the Class III price and the Class I mover. Similarly, June 1995 through December 1999 is designated the BFP sub-period and January 2000 through March 2003 is designated the Class III sub-period.

Class I Price (Chicago)

Imputed Class I prices pertaining to Chicago (Chicago Regional order prior to January 2000; Upper Midwest order thereafter) averaged higher than actual prices in all three time periods. The Class I price formula yielded an average Chicago Class I price 48 cents higher than the reported price in the M-W sub-period, $1.42 higher in the BFP sub-period, and 10 cents higher in the Class III sub-period. The small difference in the most recent sub-period is due to changes in the Class III formula implemented April 2003 that raised Class III skim milk values and, hence, the Class I mover whenever the advanced Class III skim price exceeded Class IV.

[5] This abbreviated time period was used rather than the full overlap period (April 1997 – August 2004) because of an increasing trend in the proportion of barrel cheddar *vis a vis* block in the NASS survey.

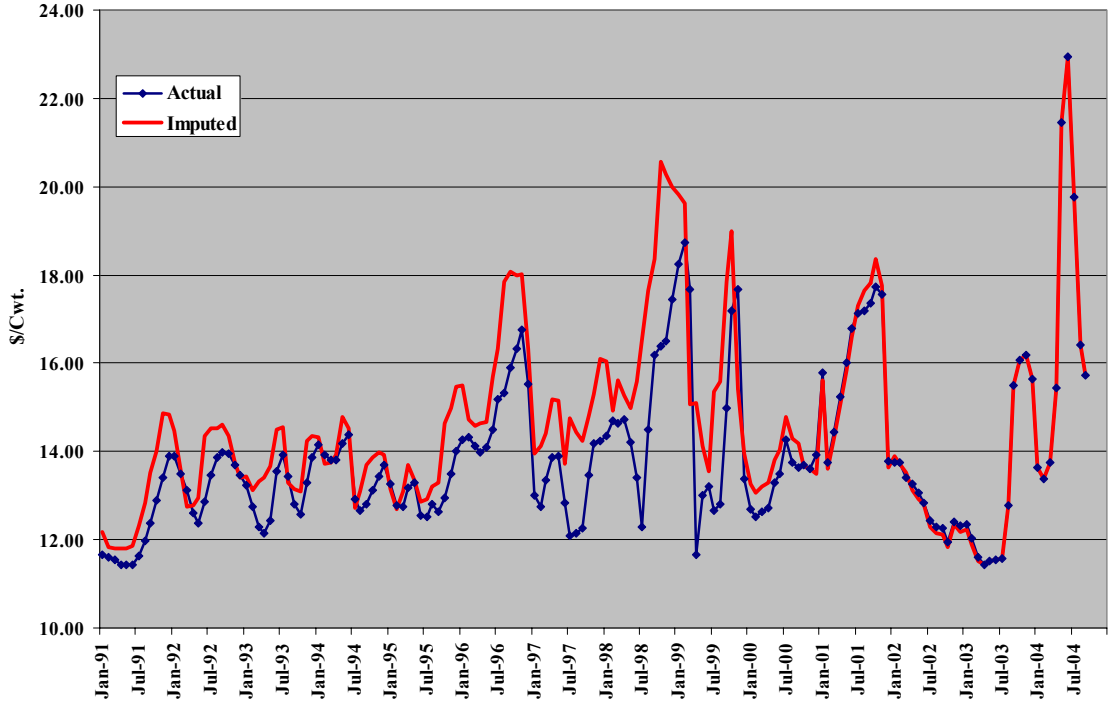
Actual versus Imputed Class I Price for Chicago				
Time Period		Actual	Formula	Actual Minus Formula
Jan '91 – Mar '03	Mean	13.76	14.50	-0.73
	St. Dev.	1.58	1.90	0.99
M-W	Mean	13.03	13.51	-0.48
Jan '91 – May '95	St. Dev.	0.82	0.86	0.45
BFP	Mean	14.36	15.79	-1.42
Jun '95 – Dec '99	St. Dev.	1.73	1.96	1.25
Class III	Mean	13.92	14.02	-0.10
Jan '00 – Mar '03	St. Dev.	1.75	1.83	0.31

Part of the difference between actual and imputed Class I prices before 2000 is attributable to the 40 cents/hundredweight increase in the Class I differential applicable to Chicago that became effective January 2000. Adjusting for the increased Class I differential, product price formulas generate Chicago Class I prices that are, on average, only 8 cents higher than the actual prices during the M-W sub-period but still more than $1.00 higher than reported prices during the BFP sub-period.

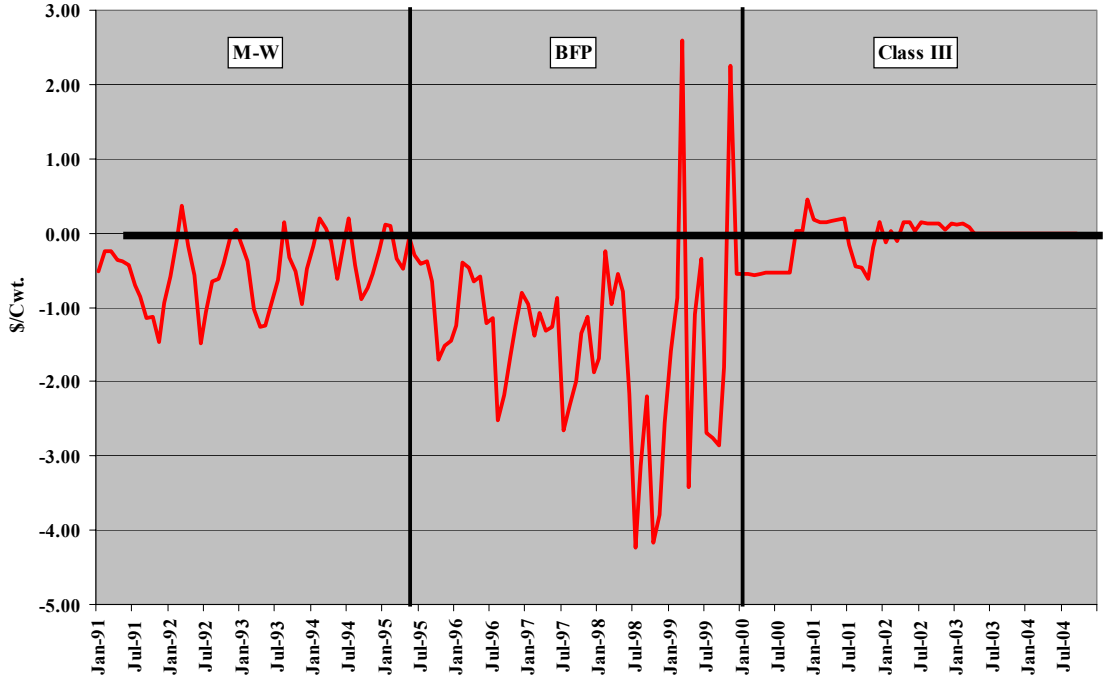
The relatively higher formula-based prices during the BFP sub-period come mainly from use of the "higher of" skim mover. For example, from November 1996 through September 1997, the imputed formula price was based on the advanced Class IV skim milk price, which exceeded the Class III skim value by an average $1.19 per hundredweight. For the 55 months during which the BFP served as the Class I mover, the current formula would have used the Class IV skim value in 27 months.

Prior to 2000, Class I prices were based on the Class I mover from two months earlier. The 2000 order "reforms" shortened the lag, which is clearly evident from comparing actual Class I prices with product formula prices. Formula Class I prices peak and trough earlier than actual prices. Also, the formula prices tended to both peak and trough at higher levels than actual prices.

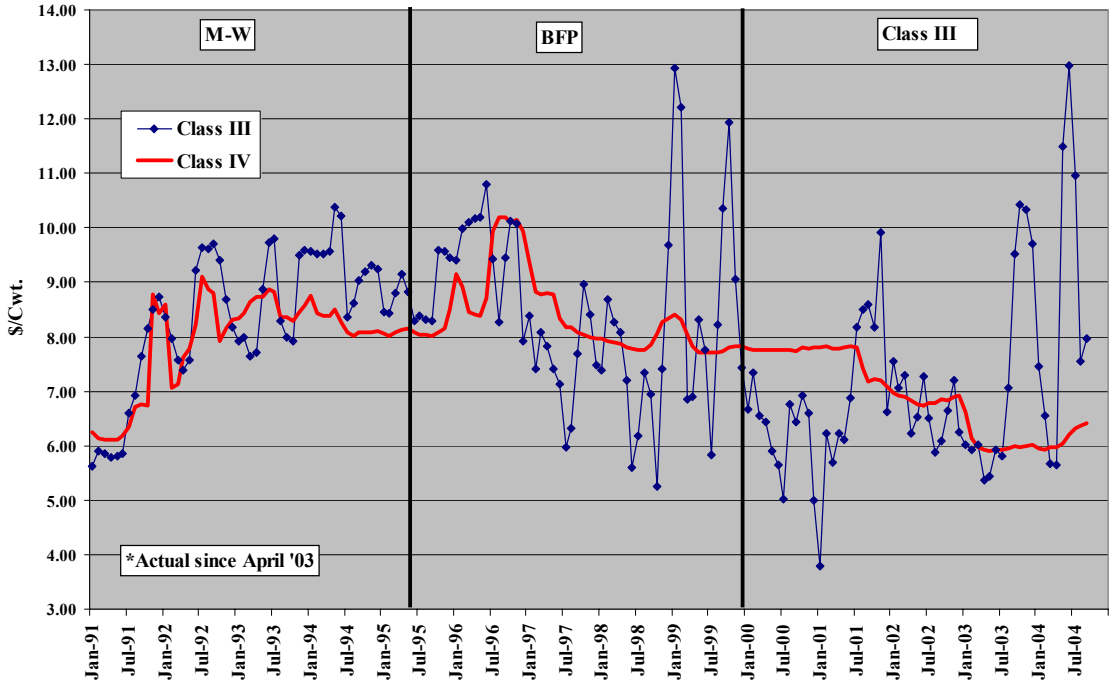
Chicago Class I Price: Actual and Current Formula



Chicago Class I Price: Actual minus Current Formula



Imputed Class III and Class IV Skim Milk Values*



Class II Price

In contrast to Class I, actual prices for Class II milk averaged higher than formula-based prices over the entire time period analyzed. But there are significant differences among sub-periods, and in the BFP sub-period, formula Class II prices averaged 25 cents per hundredweight higher than actual.

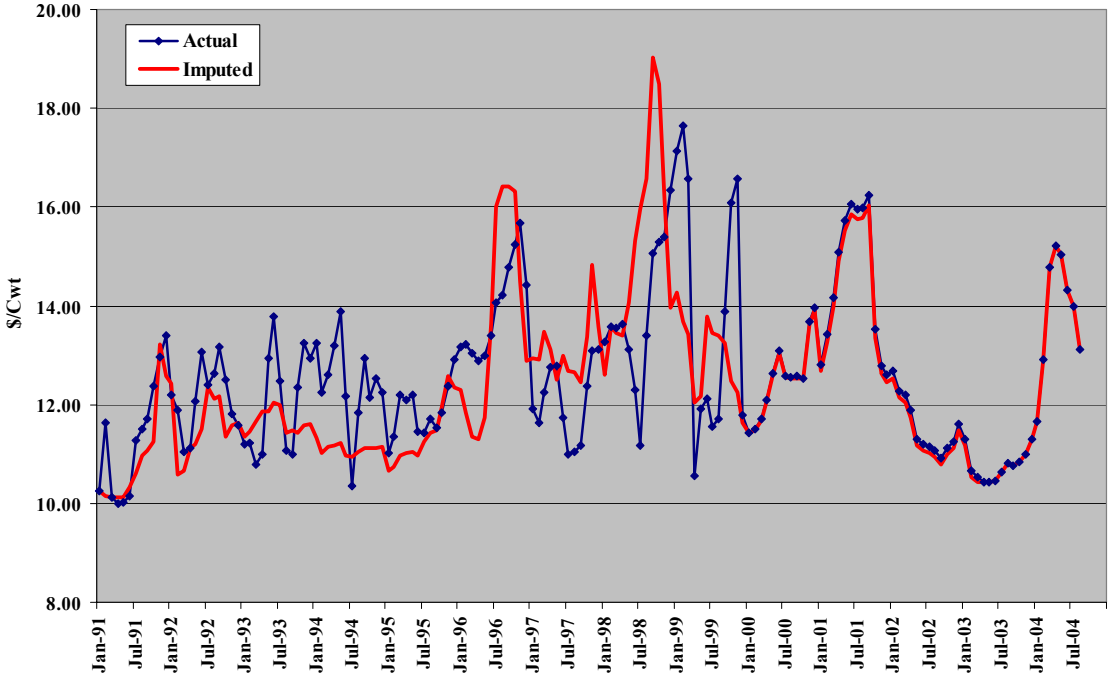
Differences among sub-periods partly reflect changes in how Class II prices were set under federal orders. Prior to 2000, the general procedure for setting Class II prices was to add a differential to the M-W Price or BFP lagged two months. But there were changes in the differential and the timing of the Class II price announcement. And even before adoption of the BFP, the M-W Price was adjusted for changes in product prices before applying the Class II differential.

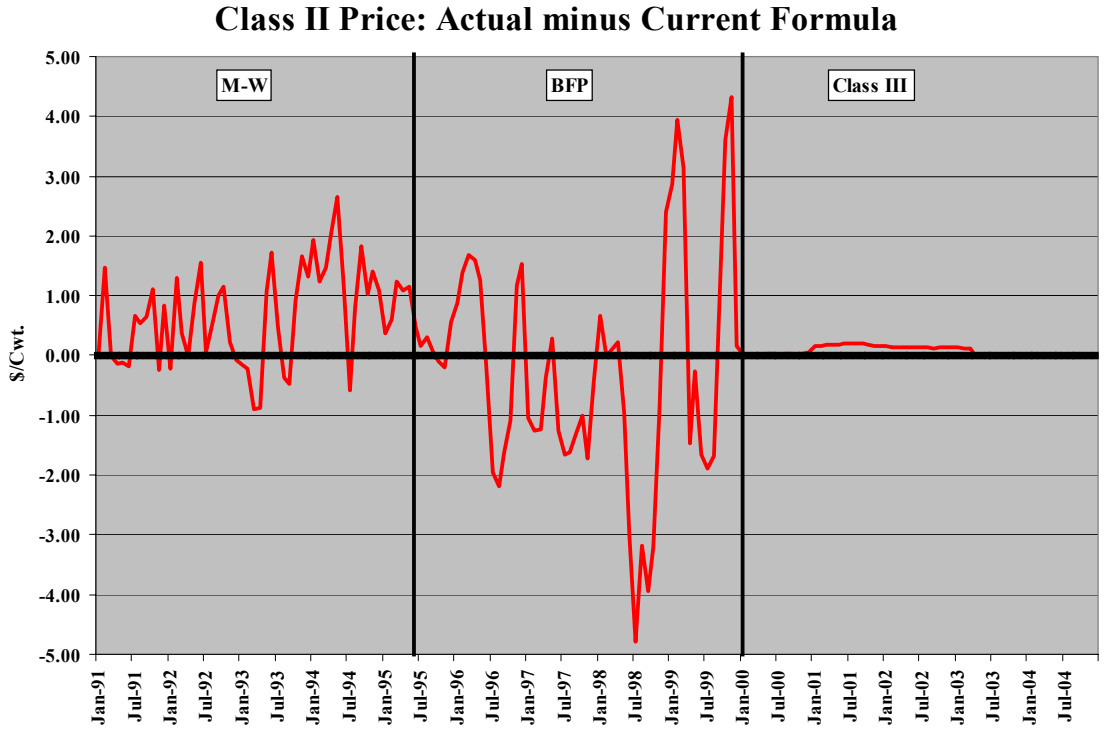
The range and variance of Class II price differences are large relative to the other classes. This is because the Class II price formula represents a greater departure from previous methods of setting federal order minimum prices. The Class II formula ties the skim milk portion of the Class II price exclusively to the price of nonfat dry milk. Before adoption of product price formulas, Class II prices were set in relation to Class III, which moves closely with the price of cheese.

Actual versus Imputed Class II Price*				
Time Period		Actual	Formula	Actual Minus Formula
Jan '91 – Mar '03	Mean	12.64	12.46	0.18
	St. Dev.	1.58	1.72	1.31
M-W	Mean	11.95	11.27	0.68
Jan '91 – May '95	St. Dev.	1.00	0.65	0.80
BFP	Mean	13.25	13.50	-0.25
Jun '95 – Dec '99	St. Dev.	1.74	1.80	1.89
Class III	Mean	12.72	12.60	0.11
Jan '00 – Mar '03	St. Dev.	1.63	1.60	0.06

*Applicable to the Chicago Regional and Upper Midwest orders

Class II Price: Actual and Current Formula





Class III Price

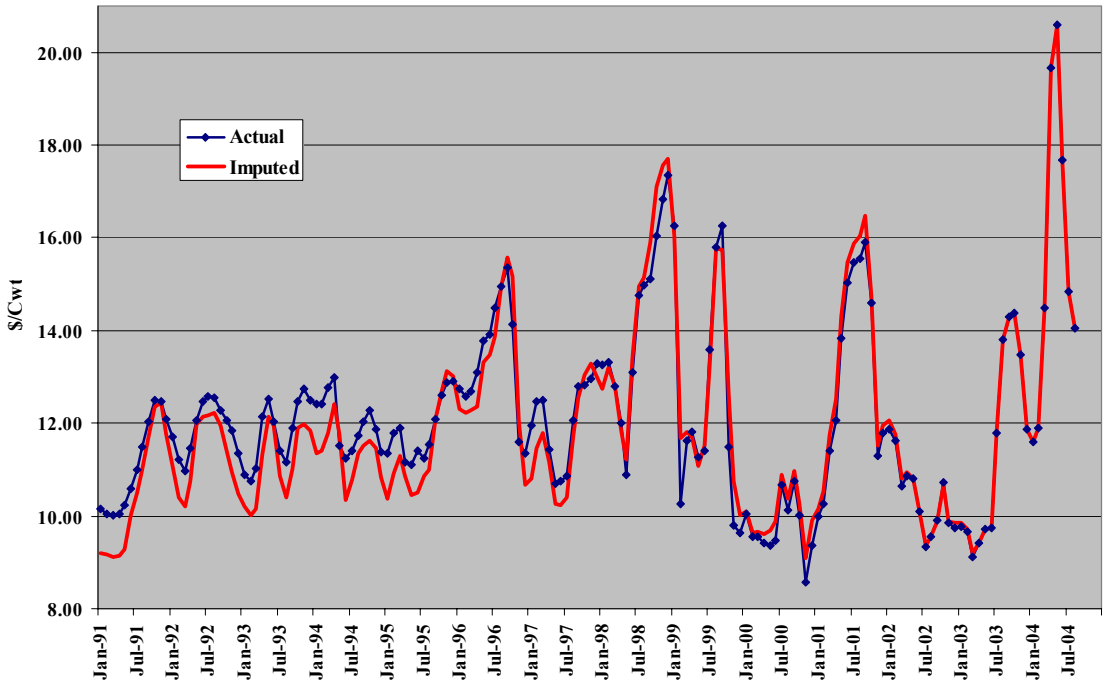
Actual Class III prices averaged higher than formula-based prices prior to adoption of product price formulas in January 2000. The difference between actual and imputed Class III prices was largest during the M-W sub-period, when the reported M-W price was higher than the formula price in all but one month (May 1994).

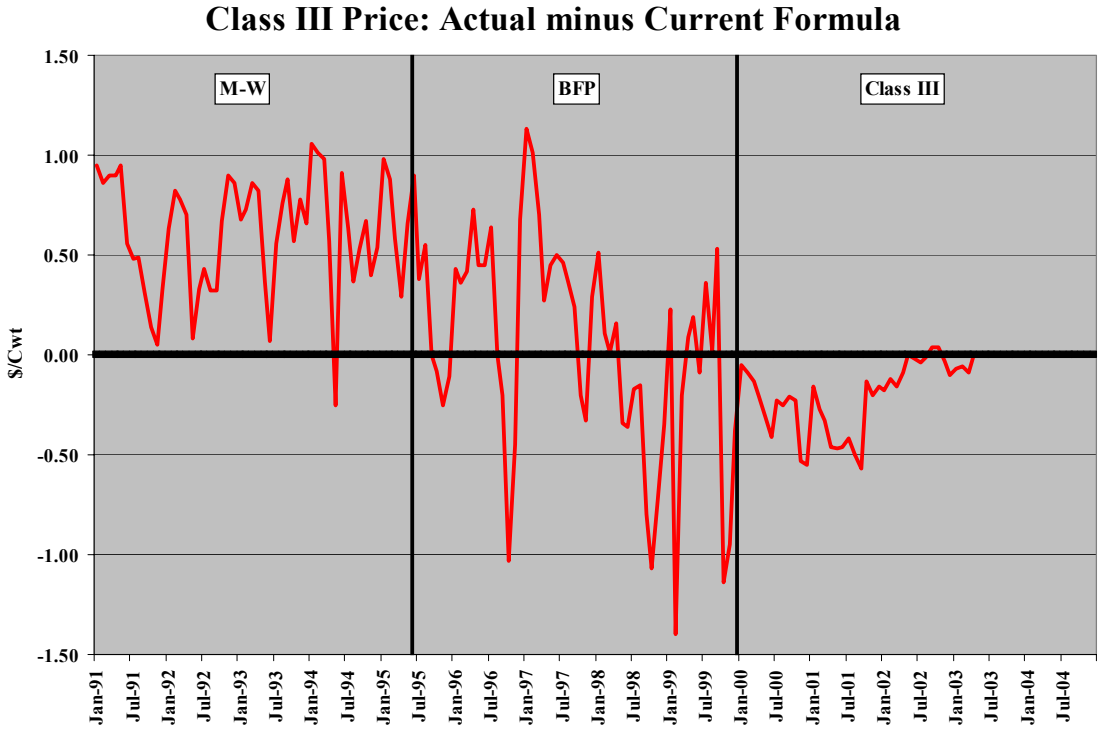
During the BFP sub-period, product price changes were used to adjust the M-W price in calculating the BFP. This adjustment yielded Class III prices that tended to increasingly match the formula prices. At the same time, the variability of the differences nearly doubled. This probably reflects the BFP "picking up" product price changes more slowly than the formula-based price, resulting in abrupt month-to-month differences between the two series.

The current Class III price formula has yielded higher Class III prices than earlier formulas used since 2000. This is because of the April 2003 change in the formula for computing protein value slightly increased Class III values.

Actual versus Imputed Class III Price				
Time Period		Actual	Formula	Actual Minus Formula
Jan '91 – Mar '03	Mean	11.94	11.76	0.18
	St. Dev.	1.75	1.88	0.52
M-W	Mean	11.66	11.05	0.61
Jan '91 – May '95	St. Dev.	0.77	0.91	0.29
BFP	Mean	12.90	12.85	0.05
Jun '95 – Dec '99	St. Dev.	1.81	1.95	0.55
Class III	Mean	10.97	11.18	-0.21
Jan '00 – Mar '03	St. Dev.	1.96	2.06	0.18

Class III Price: Actual and Current Formula





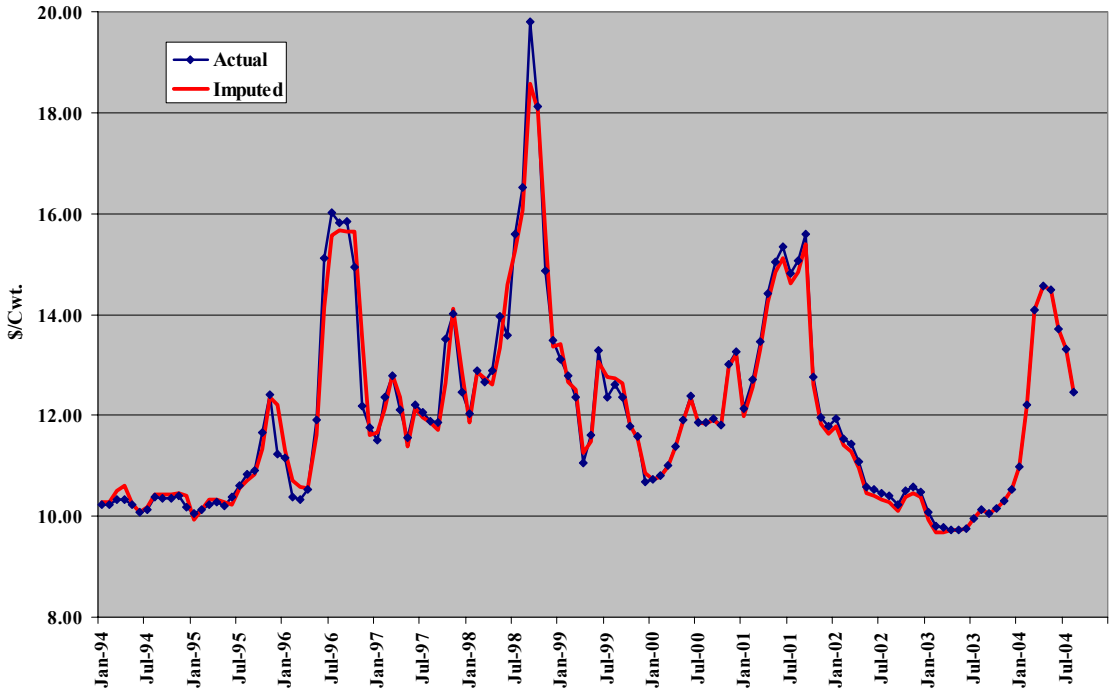
Class IV price

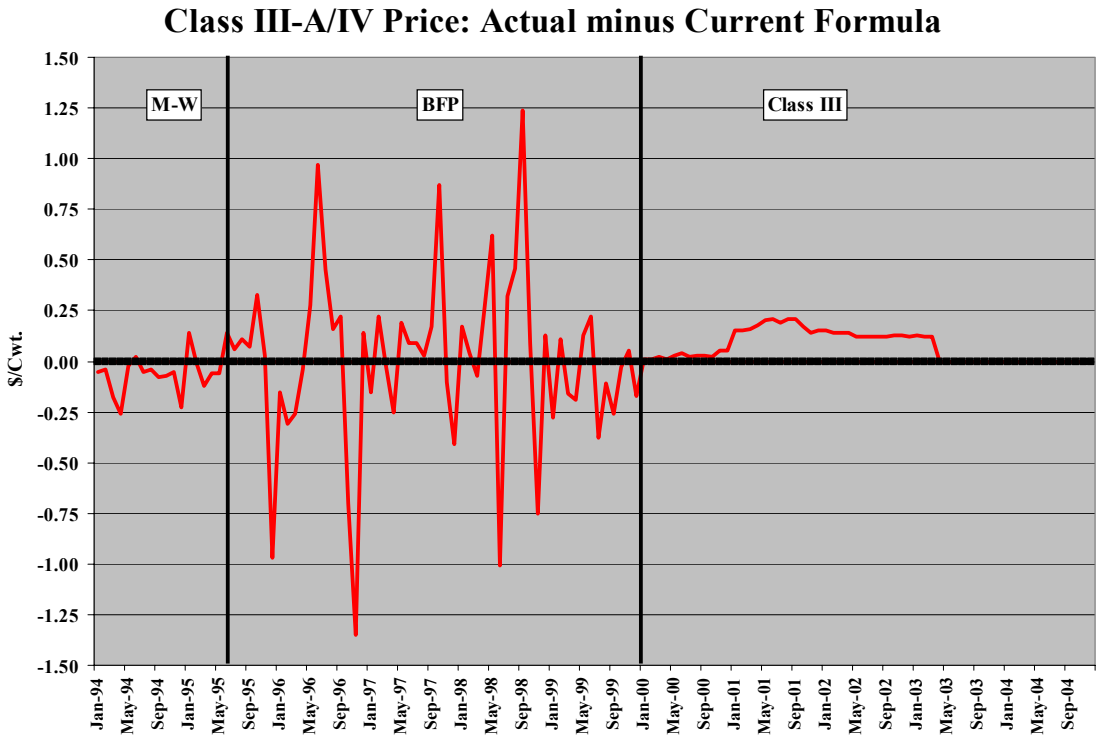
Class IV became a new federal order classification common to all orders in January 2000. However, all federal orders used Class III-A beginning in December 1993 and several orders began using the Class III-A designation before then. This analysis compares Class III-A prices with formula-derived values for the period January 1994 through December 1999.

Class III-A was a formula-based price tied to the price of nonfat dry milk and, indirectly, the price of butter (through the butterfat differential linked to the CME Grade A butter price). Consequently, the Class III-A price would be expected to correlate closely with the imputed Class IV price calculated using the current formula. The two prices are very close on average, but the variance of the monthly differences is quite large, especially during the BFP sub-period. The Class III-A price appeared to more quickly respond to month-to-month changes in nonfat dry milk and butter prices than the current formula price. This may be because the Class III-A formula was based on CME butter prices while the current Class IV formula uses NASS prices, which lag the CME quotes.

Actual versus Imputed Class III-A/IV Price				
Time Period		Actual	Formula	Actual Minus Formula
Jan '91 – Mar '03	Mean	12.10	11.76	0.03
	St. Dev.	1.90	1.73	0.32
M-W	Mean	10.27	10.61	-0.08
Jan '91 – May '95	St. Dev.	0.15	0.66	0.11
BFP	Mean	12.81	12.80	0.01
Jun '95 – Dec '99	St. Dev.	1.97	1.86	0.44
Class III	Mean	11.96	11.85	0.11
Jan '00 – Mar '03	St. Dev.	1.63	1.60	0.06

Class III-A/Class IV Price: Actual and Current Formula





Producer Prices

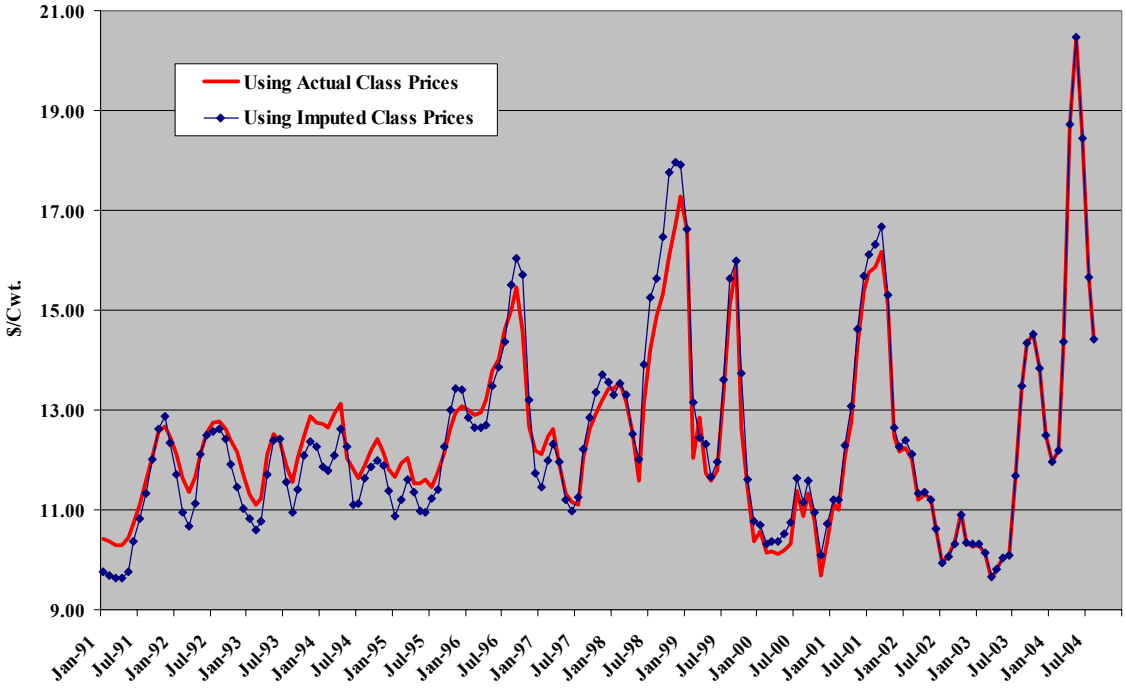
Federal order minimum prices to producers depend on market-wide utilization of milk by Class. To investigate how product formula pricing has affected producer prices, utilization for the Chicago/Upper Midwest order was fixed at the approximate averages experienced in 2001 and 2002 – 17.5% Class I, 3.5% Class II, 78% Class III and 1% Class IV.[6] These percentages were then applied to actual monthly Class prices and the imputed Class prices derived above.

Perhaps surprisingly, the resulting weighted average (blend) prices averaged nearly the same over the entire January 1991 – March 2003 time period. In other words, the Class prices generated by the current federal order product price formulas yielded, on average, the same blend price as actual Class prices.

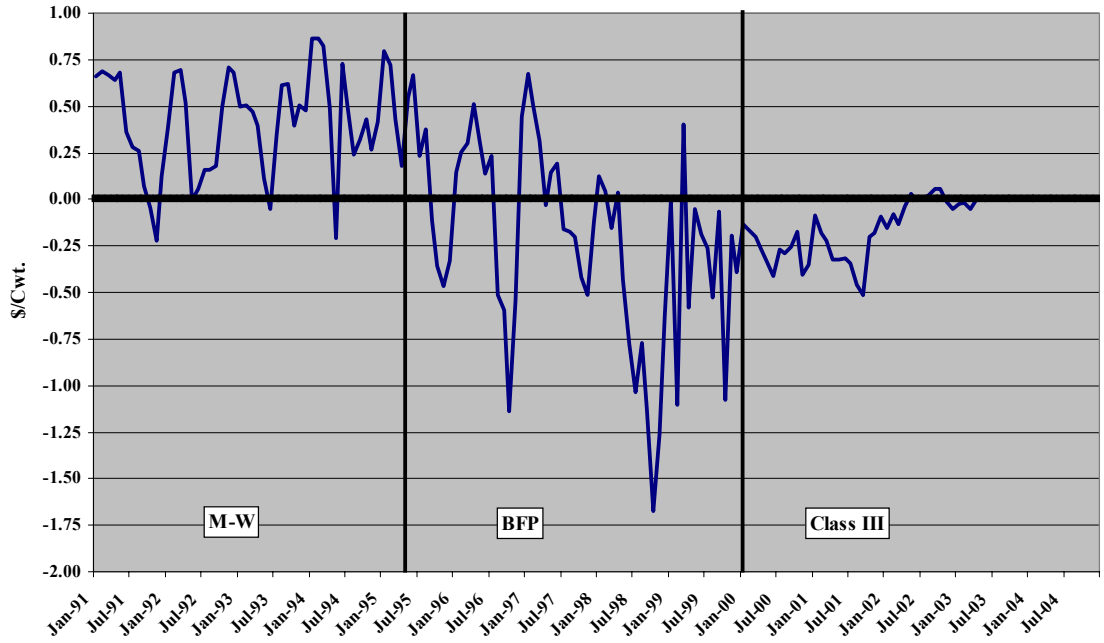
[6] Utilization percentages in 2003 and 2004 were heavily influenced by depooling. Using constant rather than actual utilization percentages allows separation of the effects of differences in Class prices from the effects of variation in utilization. However, the resulting weighted average prices using actual Class prices do not approximate actual producer blend prices.

Minimum "Blend" Prices: Fixed Utilization Applied to Actual and Imputed Class Prices				
Time Period		Actual Class Prices	Formula Class Prices	Actual Minus Formula
Jan '91 – Mar '03	Mean	12.28	12.26	0.02
	St. Dev.	1.57	1.81	0.47
M-W	Mean	11.91	11.49	0.42
Jan '91 – May '95	St. Dev.	0.73	0.85	0.27
BFP	Mean	13.17	13.39	-0.22
Jun '95 – Dec '99	St. Dev.	1.57	1.86	0.53
Class III	Mean	11.55	11.73	-0.18
Jan '00 – Mar '03	St. Dev.	1.86	1.94	0.15

Weighted Producer Milk Prices



Weighted Producer Milk Prices:
Actual versus Imputed Class Prices



There were differences among sub-periods. During the M-W sub-period, minimum blend prices calculated using actual Class prices averaged 42 cents per hundredweight higher than blend prices derived from formula Class prices. This difference is attributable to the 61 cents per hundredweight higher actual Class III price relative to the imputed Class III price. Formula-based blend prices during the BFP and Class III sub-periods averaged higher than blend prices calculated from actual Class prices. In all three sub-periods, the formula-based blend price was more variable month-to-month than its counterpart.

Summary

Adoption of product price formulas to set minimum federal order Class prices was a major departure from using a competitive pay price for milk. Consequently Class prices calculated by applying current formulas prior to their adoption would not be expected to match actual Class prices that were based on competitive pay prices for Grade B milk in Minnesota and Wisconsin.

In fact, the formulas did do a poor job of replicating actual monthly prices applicable to Chicago for all Classes of milk. The variability of price differences was large in nearly all cases. But overall *average* price differences were generally modest. Imputed average Class I prices were higher than actual, but much of the difference is due to an increase in the Chicago Class I differential in January 2000, not to adoption of product formula

pricing. Imputed Class III prices based on current formulas averaged significantly[7] lower than actual in the period January 1991 – May 1995, when the M-W Price was the Class III price, but the average difference declined to near zero in the period following adoption of the BFP. The same pattern was observed for Class II. Average imputed and actual Class IV prices were nearly the same across the three sub-periods analyzed.

A measure of monthly producer prices was calculated by weighting Class prices by fixed Class utilization. Over the entire January 1991 – March 2003 period, the mean weighted average price was the same whether using actual Class prices or imputed formula-based Class prices in the calculation. Weighted average prices using actual Class prices were higher than weighted average prices using imputed Class prices during the M-W period but lower in subsequent periods.

The bottom line is that adoption of product formula pricing does not appear to have made producers in the Upper Midwest worse off. While there are some significant differences between actual and imputed Class prices, particularly across time periods, use of product price formulas would have yielded minimum producer prices that were, on average, close to those actually experienced.

[7] The difference in means was statistically different from zero at the 99 percent level assuming unequal variance of the series.