MULTIPLE COMPONENT PRICING OF RAW MILK
MULTIPLE COMPONENT PRICING FOR RAW MILK

- Trend for about the last 15 years toward using multiple component pricing for milk
- From 1990 to 2000 was a period of transition where orders could experiment with component based pricing
- Prior to 2000 the payments for MCP had to fit into Fat/Skim price limitation
The Historical Pattern of Single Component Pricing is Changing

Component Pricing (CP) - A payment plan that prices the milk on the basis of volume + one major component - (e.g., butterfat differential).

Multiple Component Pricing (MCP) - A payment plan that prices milk on the basis of two or more component parts and in some cases quality standards (e.g., protein, fat, SCC).

- California has required MCP since 1962
- Fact Act (1990 Farm Bill) instructed USDA to invite MCP proposals in all Federal orders
### Average Composition of a CWT of Raw Milk

<table>
<thead>
<tr>
<th>Component</th>
<th>lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milkfat</td>
<td>3.67</td>
</tr>
<tr>
<td>Protein</td>
<td>3.20</td>
</tr>
<tr>
<td>Lactose</td>
<td>4.75</td>
</tr>
<tr>
<td>Minerals</td>
<td>.65</td>
</tr>
<tr>
<td>Water</td>
<td>87.73</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

Total solids = 12.27% of milk volume
Approx. 30% of total solids is typically fat
Approx. 70% of total solids is protein, lactose and minerals
The Historical Pattern of Single Component Pricing is Changing

• Component price was based on butterfat (Babcock Test) and skim

• But several long term market trends were forcing change
  – Volatile markets for butter and cream based products
  – Low fat milk demand increased
  – Low fat frozen and Class II product demand increased in late 1980’s and first half of 1990’s creating more interest in skim
  – Relatively strong world demand for nonfat dry milk powder

• Growth in cheese plant demand for milk
  – Competitive procurement premiums
  – Protein and quality premiums
  – Product yield pricing (improve competitive position)
Justifications for MCP

- Variation occurs in milk composition among
  - Individual cows
  - Herds
  - Breeds
  - Time of year

- Milkfat and milk protein are the most variable components
  - Lactose and mineral content more constant
  - SNF varies with change in protein content
  - On average 0.4% change in protein for each 1% change in fat
  - But there is a lot of variation around the average
  - Reliance on fat is therefore not effective

- Basing payments exclusively on fat may not reward protein value

- Paying on both fat and protein components (measured) creates proper economic incentives to produce for market demand
Higher protein content increases yield in manufactured products (Class III and Class II)

Breeding cows for milk volume alone (rather than more solids) can reduce the yield of manufactured products per cwt

Higher solids and protein content improves the nutritional value of fluid milk

But MCP does not provide for a higher price to bottler for fluid milk on retail side as an incentive to pay more

Beyond minimum 8.25% SNF standard, there is no return to cover higher producer payments for MCP or increase profit for bottlers

Market orders with a high Class I utilization showed little interest as a consequence
Other Factors

• Decreasing fraction of milk supply to fluid uses - 60% manufacturing vs. less than 40% fluid use

• Greater consumption of low fat and skim fluid products – at times very strong

• Fat value = 55% of blend price in 1960 but fell to 30.5%

• Skim value = 45% of blend price in 1960 but increased to 69.5%

• If the market is to send the proper economic signals to producers, a pricing change was needed

• Higher valuation of (derivative) skim products means that skim should be priced higher in relation to fat
## Manufactured Yield from 1% Increase in Protein Component

<table>
<thead>
<tr>
<th>Product</th>
<th>Added yield/cwt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheese</td>
<td>1.75#</td>
</tr>
<tr>
<td>Nonfat dry milk</td>
<td>1.0#</td>
</tr>
<tr>
<td>Ice cream</td>
<td>1.0#</td>
</tr>
<tr>
<td>Cottage cheese</td>
<td>6.0#</td>
</tr>
</tbody>
</table>
The Midwest MCP Plan Prior to Year 2000

- Five “Old” federal order markets (26.4% of total federal order pool)
  - Chicago regional order
  - Nebraska - Western Iowa order
  - Eastern South Dakota order
  - Iowa order
- Exemption for somatic cell count for milk in Class I uses
- Somatic cell adjustment made in other classes
  - Class II
  - Class III
  - Class IIIA or what is now IV
- Components included
  - Protein
  - Fat
  - Other solids
Tests Required for MCP

• # butterfat

• % protein

• % other solids not fat (no test is done)
_component Reporting_

- Average tests for components reported with BFP
  - Protein
  - Butterfat
  - Other solids

- BFP was a derived formula price (1995-99) Based on competitive M-W price
  - update previous month M-W base with product value
  - e.g., basic formula for June reflects May price + change in product prices from May-June since M-W was updated or “Tweaked” with these values
Component Reporting

- A single fat & protein component test for current month and BFP were used to compute other solids price - it was really an estimated value
- Using the BFP to calculate residual value made it an estimate for actual component values
  * some aspects were reflecting current market value at test for derivative products (i.e., butter and cheese)
  * BFP price for other solids was not
  * it was based on whatever it took to make the value of all components add up to the BFP
Calculation of Other Solids

$11.300  BFP for month “at test”

Less $2.6491  BFP fat test (e.g., 3.67%) 
\[ \times \text{butterfat price} \]

Less $5.1751  BFP protein test (e.g.
\[ \times \text{protein price} \]

= $3.4758  Residual value of other 
\text{solids}  
\[ \$11.3000 - \$7.8232 = 3.4758 \]

\[ \text{BFP} - \text{Fat} + \text{Prot} = \text{Other Solids} \]

Value which was DIVIDED BY:

\[ \div 5.4751  \]

Pounds of other solids per 
\text{cwt of milk}* 

= $.6348  Value of other solids per 
\text{pound} 

• pounds of \text{other solids} was calculated by subtracting percent protein solids (3.13) from total per cwt solids-not-fat (8.58%) which yields 5.4751# of other solids

• Basically \text{forces} protein and fat values into the BFP from the grade B survey and uses other solids to take up the slack
Component Reporting

- Because other solids value was computed as a residual, \textit{it could be negative} in some cases
  - Protein/fat demand heavy & BFP is low due to low demand in prior month
  - Unlikely to happen for sustained periods but has occurred in 1998
  - When it does, the protein price is reduced after the other solids has been driven down to a value = 0
  - Would not occur with “true” component pricing
  - Happened because started with a “tweaked” competitive pay price (BFP) and \textit{forced} the component values to fit that price
  - Under true component pricing, the components would each be valued based on product prices rather than forced to fit what the “tweaked M-W” or BFP says it \textit{should be}
Class I vs. Class II and Class III Economics

- Orders attempt to equalize raw product procurement cost across all handlers

- For Class II and Class III uses milk testing and pricing on solids is feasible and has been adopted
  - Higher product yields recover price premiums
  - Lower product yields from low component levels can be offset by price discounts
  - The equal raw product cost across handlers principle in market orders is maintained
Class I vs. Class II and Class III Economics

• For Class I uses equalization is difficult/ impossible
  – Handlers/processors could reduce solids to the minimum legal level and sell excess solids but would be more difficult and has not been widely adopted
  – Handlers/processors could charge consumers more for higher solids milk but many resist
  – Solids “value” in fluid products is more difficult to determine than the fat value
  – Consumers do not readily understand the issue - “milk is milk”
  – Some attempts to get regulations on higher solids milk have met political resistance
Milk Quality Economics

• Milk quality affects dairy product yield and quality
  – Somatic cell count varies inversely with protein level
  – High cell count results in increased rennet coagulation time
  – Slower curd firming in cheese making
  – Increased levels of cheese quality defects

• Under MCP could pay premium for higher protein that would actually reduce yield and quality of derivative products if quality is not considered

• Need to gear premiums to the actual value behind component
  – Orders were not supposed to impose quality standards at that time
  – But implementation of MCP was not be practical without it
  – Quality standards were being used anyway to make things work
A producer price differential was calculated using:

- Value of Protein
- Value of BF
- Value of Other Solids as a Residual
- Somatic Cell Adjustment
- Class II Differential x Order Class II Util. %
- Class I Differential x Order Class I Util. %
- Class IIIA Differential x Order Class IIIA Util. %
Determination of Producer Price Under FMMO with Multiple Component Pricing

POST Year 2000 Order Reform Uses Actual Component Pricing for All Components in the Milk (Incl. Other Solids)
MAJOR PRICE CALCULATIONS

The BFP and the class prices for all market orders (both those using MPC and those using Fat - Skim pricing) are based on component prices calculated from finished product prices.
MAJOR PRICE CALCULATIONS

- 4 week Class III price
- 4 week Class IV price
- Advanced 2 week Class II price
- Advanced 2 week Class I price
History of CLASS III PRICE

- 1960 – June 1995 Minnesota Wisconsin (M-W) cheese/butter survey
- After 1995 but prior to Dec 1999 M-W based but adjusted by relative quantities of cheese and butter
- After Dec 1999 new class III constructed price was implemented
  - Based on components important in cheese making
  - Price constructed for Class III cwt with standardized components
  - Value of components derived from product prices
  - Same components used to calculate farm pay price in federal orders
  - Butterfat, protein, other nonfat solids
CLASS III PRICE

- Class III price is announced early following month
- Announcement is made on the Friday on or before 5th of the month
- Based on prior months product and component values
PROCEDURES FOR CONSTRUCTING CLASS III PRICE

• Component values are based on actual product values in the market place
  – Butter
  – Cheese
  – Dried whey
• Formulas used to decompose the product values into prices for components
  – Butterfat
  – Protein
  – Other solids
• Formulas also incorporate:
  – Yield of product
  – Cost of manufacturing
DERIVATION OF CLASS III PRICE FROM PRODUCT PRICES

\[ \text{NASS 4-week Butter price} \times F(BF) \rightarrow \text{Butter fat price/lb} \times 3.5\# \rightarrow \text{Class III price/cwt.} \]

\[ \text{NASS-4 week Cheese Price} \times F(P, BF) \rightarrow \text{Protein price/lb} \times 3.1\# \rightarrow \text{Class III skim price/cwt.} \]

\[ \text{NASS 4-week Dry whey price} \times F(W) \rightarrow \text{Other solids price/lb} \times 5.9\# \rightarrow \text{Class III price/cwt.} \]
BUTTER FAT FORMULA

(1)  Butterfat price/lb = (NASS monthly price Grade AA – $0.114) ÷ 0.82*

Where:

$.114 = make allowance
0.82 = yield factor for butter*

Note:

* Yield factor = Lbs. of butterfat required to make a # of butter

+ U.S. butter is only 80% butterfat but manufacturing losses of .02% occur

+ Thus .02 is added to the yield factor
The value of butterfat to a plant making butter is the price of butter less the make allowances divided by the # of lbs. of butterfat needed to make a lb. of butter.
DERIVATION OF CLASS III PRICE FROM PRODUCT PRICES

\[ \text{NASS 4-week Butter price} \rightarrow F(BF) \rightarrow \text{Butter fat price/lb} \rightarrow X 3.5# \rightarrow \text{Class III price/cwt.} \]

\[ \text{NASS-4 week Cheese Price} \rightarrow F(P, BF) \rightarrow \text{Protein price/lb} \rightarrow X 3.1# \rightarrow \text{Class III skim price/cwt.} \]

\[ \text{NASS 4-week Dry whey price} \rightarrow F(W) \rightarrow \text{Other solids price/lb} \rightarrow X 5.9# \rightarrow \text{Class III price/cwt.} \]
CALCULATING OTHER SOLIDS VALUE

(6) Other solids value/lb =

(NASS monthly dry whey price - $0.137) ÷ 0.968

Where:

$0.137 = make allowance for whey

0.968 = yield factor for dry whey*

Note:

A lb. of other solids yields slightly more than one lb. of dry whey because dry whey contains slightly more than 3% moisture. Therefore yield factor of < 1 used.
The value of dry whey to a plant producing dry whey is the price of dry whey less the make allowance ÷ by the number of lbs of other solids needed to make a pound of dry whey.
DERIVATION OF CLASS III PRICE FROM PRODUCT PRICES

\[ F(BF) \times 3.5 \]
\[ F(P, BF) \times 3.1 \]
\[ F(W) \times 5.9 \]

NASS 4-week Butter price

NASS-4 week Cheese Price

NASS 4-week Dry whey price

Butter fat price/lb

Protein price/lb

Other solids price/lb

Class III skim price/cwt.

Class III price/cwt.
• The cheese price is calculated using the weighted average of two styles of cheddar
  - 40# blocks of cheddar
  - 500# barrels of cheddar

• The two types are weighted by sales

• The 500# barrel is the base and blocks are assumed to be worth 3¢/lb more (i.e., add manufacturers costs)

(Note: when we looked at cheese prices earlier this term the spread was wider than 3 cents)
PROTEIN TO CHEESE YIELD FACTOR

• Van Slyke cheese yield formula

• “TRUE” protein now used in calculation

• Prior to January 1, 2000, crude protein was used

• Crude protein based on nitrogen content

• True protein = crude protein – non-protein nitrogen found in the milk

• Cheese yield 1.405 # / # protein

• Make allowance is approx $1.70/cwt or about $.17/lb
PROTEIN FORMULA (VALUE)

(7) Protein Price Per lb. =

\[(\text{NASS monthly cheese price} - \$0.1702) \times 1.405 + \]
\[\{ [ (\text{NASS monthly cheese price} - \$0.1702) \times 1.582] - \]
\[\text{Butter fat price} \} \times 1.28\]

Where

- Line 1 is the net value of protein in cheese. The net value of protein is defined as the cheese price less the make allowance X the number of lbs. of cheese that can be made from a lb. of protein.
(7) Protein Price Per lb. =
(NASS monthly cheese price $-.1702) x 1.405 +
{[(NASS monthly cheese price $-.1702) x 1.582] – Butter fat price} x 1.28

Line 2 is designed to account for the cheese value of butterfat in excess of its value in butter.

- Protein (in particular casein) functions to retain butterfat in cheese
- Thus Line 2 recognizes that the value of protein exceeds the mere volume it contributes to the cheese
- The formula incorporates the value of butterfat in cheese less the value of butterfat in butter adjusted for the ratio of fat to protein
DERIVATION OF CLASS III PRICE FROM PRODUCT PRICES

\[ F(BF) \times 3.5\# \]

NASS 4-week Butter price → Butter fat price/lb → Class III price/cwt.

\[ F(P, BF) \rightarrow F(P, BF) \rightarrow F(P, BF) \]

NASS-4 week Cheese Price → Protein price/lb → Class III skim price/cwt.

\[ F(W) \times 5.9\# \]

NASS 4-week Dry whey price → Other solids price/lb → Class III price/cwt.
DERIVATION OF CLASS III PRICE FROM PRODUCT PRICES

NASS 4-week Butter price

\( F(BF) \) × 3.5#

Butter fat price/lb

NASS 4-week Cheese Price

\( F(P, BF) \) × 3.1#

Protein price/lb

NASS 4-week Dry whey price

\( F(W) \) × 5.9#

Other solids price/lb

\( X \) .965

Class III skim price/cwt.

\( \times 3.5\# \)

\( \times 3.1\# \)

\( \times .965 \)
CONSTRUCTING THE CLASS III PRICE

(9) Class III price @ test = 3.5 * butterfat price + 0.965 * Class III skim milk price

• The Class III price reflects a cwt of milk standardized at:
  - 3.5% butterfat
  - 3.1% protein
  - 5.9% other solids
  - 12.5% total solids

• Values for the standardized cwt of Class III milk are
  - the 3.5# fat valued at Class IV/III butterfat price
  - the 96.5# of skim milk valued at Class III skim price
  - the Class III skim milk price value is linked to protein and other solids price
CALCULATING CLASS IIISKIM MILK PRICE

(8) Class III skim milk price =

\[ 3.1 \times \text{protein price} + 5.9 \times \text{other solids price} \]

Assumptions for standard milk

- 3.1% true protein
- 5.9% nonfat/non-protein solids
The Class III component relationships may be expressed directly in terms of actual butter, cheese and dry whey prices.

\[(10) \text{ Class III price } = 10.26 \times \text{NASS cheese price} - 0.40 \times \text{NASS butter price} + 5.88 \times \text{NASS dry whey price} - 2.51\]

- These calculation factors are obtained by mathematically substituting the product price formulas for component values.

- This transformation permits Class III to be expressed directly in terms of butter, cheese and dry whey prices.
Effect of a 10¢ increase in cheese, dry whey or butter on class III price

• 10¢ increase in cheese price increases milk price $1.03/ cwt.

• 10¢ increase in dry whey price increases milk price $.59/cwt.

• 10¢ increase in butter price DECREASES class III milk price by 4.3¢ /cwt.