

CALCULATING MILK EQUIVALENTS: MILKFAT OR TOTAL SOLIDS BASIS

*Robert Jacobson**

Effective January 1, 1991, for the first time in the forty-two year history of the dairy price support program, dairy product surpluses are being measured on a basis different from the traditional milkfat equivalent basis. The new term is 'total solids basis'. The intent of the new measurement is to offer a more balanced definition of what constitutes dairy product surplus in relation to the composition of cow's milk, as compared to letting the milkfat in butter dictate the definition of surplus. The ideas in this new version of surplus get complicated enough for us to justify a few moments on the topic.

Basically, Congress instructed USDA to calculate the milk equivalent of the dairy products purchased under the price support program on the basis of fat content and nonfat solids content. Total solids milk equivalent is a weighted average of the two. In the dairy title of the 1990 farm bill, the legislative definition of 'milk equivalent, total milk solids basis' is set forth as follows: "... the weighted average of the milk equivalent (as computed on a milkfat basis and on a milk solids nonfat basis) of such products, with weighting factors equal to not more than 40 percent for the milk equivalent, milkfat basis, and not more than 70 percent for the milk equivalent, solids nonfat basis. The weighting factors shall total 100 percent"

So there we have it. Given that general definition, USDA had to come up with a specific procedure for dealing with the arithmetic of milk equivalents. They have done that and have distributed a 14-page statement detailing the procedure.¹ Over time, there will be modifications to this initial approach, but it is something that we need to be familiar with now.

Before we get into the nuts and bolts of total solids, recall that there are three key places in the 1990 farm bill where the total solids calculation means dollars and cents.

1. A supply-demand adjuster schedule is hooked to the support price for the 1991-1995 period. The measure of surplus used to move the supply-demand adjuster, i.e., to increase or decrease the support price, is total solids.
2. When surpluses are projected to exceed 7.0 billion pounds total solids in any calendar year through 1995, the "Secretary shall, if necessary" place an assessment on all milk marketed to "offset any cost to the CCC associated" with the purchase of that extra surplus. One estimate on such an assessment is that it would run about 7-8 cents per cwt. for each one billion pounds total solids beyond 7.0 billion pounds.
3. The amount of surplus projected on a total solids basis for any year is to be reduced by the amount that imports (total solids) in the most recent calendar year exceed the average annual quantity of imports in the 1986-1990 period. Annual imports on a total solids basis in the 1986-1990 base period averaged about 4.1 billion pounds, total solids. Therefore, as an example, imports of 5.0 billion pounds in a year would reduce the projected surplus for the next year by 0.9 billion pounds.

Major Components of Milk

Let us address some of the parameters relative to milk solids. In 1991, U.S. milk production was 148.5 billion pounds. The average annual test for different components of this milk was as follows:

*Robert E. Jacobson, Emeritus Professor, Department of Agricultural Economics and Rural Sociology, The Ohio State University.

¹"Methodology of Calculating the Milk Equivalent Total Solids Basis, of CCC Purchases of Surplus Dairy Products and of Imports of Dairy Products," Commodity Analysis, Division, ASCS-USDA, December 19, 1990.

Milkfat	3.67 Lbs
Protein	3.20
Lactose	4.75
Ash (minerals)	0.65
Water	<u>87.73</u>
TOTAL	100.00 Lbs of Milk

Note the following points:

1. The milkfat test has been virtually constant at close to the 3.67 percent level since 1968, even while average milk production per cow has increased from 9,135 pounds in 1968 to 14,867 pounds in 1991. Therefore, the average milk cow is producing an additional 211 pounds of milkfat in a lactation as compared to 1968.
2. Protein, lactose, and ash, otherwise called solids-not-fat (SNF), average about 8.60 pounds per cwt. of milk.
3. The milkfat plus the solids-not-fat total 12.27 pounds per 100 pounds of milk. This sum is the total solids. Note that the milkfat represents about 30 percent of the total solids. The 30 percent factor relates to the milkfat weighting factor specified by implication in the 1990 farm bill (30 percent to 40 percent). On average, about 2½ pounds of solids-not-fat are produced for each one pound of milkfat.
4. The annual milk supply consists of approximately 18 billion pounds of total solids and 130 billion pounds of water.

The Surplus Measurement Problem

The big question before us is how should we measure surplus milk, when in fact we are purchasing surplus dairy products in the price support program—butter, cheddar cheese, nonfat dry milk, occasionally evaporated milk -- that have vast differences in the amount of milk components in their makeup? The extremes can generally be noted in butter with 80 percent milkfat and virtually zero percent solids-not-fat versus nonfat dry milk with virtually zero percent milkfat and 97 percent solids-not-fat.

The momentum for re-defining surplus was generated in 1988, 1989, and 1990 when there were massive excesses of milkfat, even while shortages of solids-not-fat occurred in the marketplace. Was there a surplus, or was there a shortage? Our traditional definition of surplus on a milkfat equivalent basis indicated that there was a surplus.

The following table reflects the annual CCC purchases of dairy products during the 1988-1990 period and the milkfat equivalents of those purchases.

CCC Purchases of Dairy Products, 1988-1991

	Butter	American Cheese	Nonfat Dry Milk	Milkfat Equivalent
	-----mil. lbs.-----			
1988	313	214	267	8,578
1989	423	24	0	8,972
1990	387	22	128	8,209
1991	443	122	271	10,353

Source: Agricultural Stabilization and Conservation Service, USDA.

Under the "old" milkfat equivalent basis for measuring surplus, the factors used as milk equivalents were as follows:

<u>Product</u>	<u>Milkfat Equivalent</u>
Butter, lb.	20.65 lbs. milk
Cheese, lb.	9.88 lbs. milk
Nonfat dry milk, lb.	ZERO lbs. milk
Evaporated milk, lb.	2.15 lbs. milk

Therefore, in a year like 1988, when 267 million pounds of nonfat dry milk were purchased by CCC, that amount of powder did not reflect any surplus at all because there was no milkfat equivalent for nonfat dry milk; it does not take any milkfat to make nonfat dry milk. In the next year, 1989, there were no purchases of powder by CCC, indicating a market shortage of skim milk for nonfat dry milk production. Yet, 1989 was defined as a severe surplus year because the 423 million pounds of butter purchased by CCC, with a milkfat equivalent of 20.65 pounds of cows milk for each pound of butter, indicated a milk surplus of almost 9.0 billion pounds just on the basis of butter purchases.

Clearly there was a milkfat surplus and a skim milk shortage in 1989. How can those two matters be reconciled? It is generally acknowledged that milkfat surpluses, relative to solids-not-fat surpluses, will probably be the problem in the future. However, it is useful to note that in five of the thirteen years during the 1978 through 1990 period, solids-not-fat surpluses exceeded milkfat surpluses; and in four of the years, surpluses of milkfat and solids-not-fat were almost in balance. In fact, for the next five years, USDA projections of CCC purchases of dairy products indicate that it is anticipated that surpluses of milkfat and solids-not-fat will be in

reasonable balance. However, the continuing commotion about milkfat; the fact that the average milkfat test of class I products is 2.2 percent, meaning that 1½ pounds of milkfat must be removed from every 100 pounds of producer milk at a fluid processing plant; and the possibility that new standards of identity for fluid milk products could force more solids-not-fat into the class I market all suggest that milkfat will be the problem in the future as compared to solids-not-fat.

The Total Solids Milk Equivalent Approach

The milk equivalent total solids factors that have been adopted effective January 1, 1991 (a) reflect updated and slightly different milkfat equivalent factors as compared to the previous ones, and (b) reflect solids-not-fat equivalent factors for the first time. The factors are as follows:

Milk Equivalent Per Pound of Product, Total Solids		
	Milkfat (Lbs.)	SNF (Lbs.)
Butter	21.80	0.12
Nonfat dry milk	0.22	11.58
American cheese	9.23	9.90
Evaporated milk	2.15	2.09

An example of the way to interpret these factors, using butter as the product, is that (1) it takes the milkfat from 21.80 pounds of milk, and (2) the solids-not-fat from 0.12 pounds of milk to make one pound of butter.

Obviously, the constraints of 30 to 40 percent milkfat weight, and 60 to 70 percent solids-not-fat weight, with a weighting factor total equal to 100 percent, become important considerations in measuring 'milk equivalent total solids'. Take the case of cheese for example. The milk equivalents for cheese are 9.23 pounds on a milkfat basis and 9.90 pounds on a solids-not-fat basis. Therefore the two boundaries on how much milk is represented in one pound of cheese are computed as follows:

<u>40% milkfat & 60% SNF</u>		<u>30% milkfat & 70% SNF</u>	
9.23 pounds x .40 = 3.692		9.23 pounds x .30 = 2.769	
plus		plus	
9.90 pounds x .60 = 5.940		9.90 pounds x .70 = 6.930	
M.E.T.S. = 9.632 lbs.		M.E.T.S. = 9.699 lbs.	

The difference between 9.632 pounds and 9.699 pounds of milk may not appear very significant, but across several hundreds of millions of pounds of product, and especially in periods when either disproportionate amounts of butter or powder are being pur-

chased, the outcome can be substantially different. It is useful to look at CCC purchase data for 1989 or 1990, because in those two years especially, the disproportionate amounts of butter purchases relative to powder purchases, in conjunction with the 'old' milkfat equivalent basis for measuring surplus, provide a stark comparison.

The year 1989, when no nonfat dry milk was purchased, provides the more direct contrast. As was noted previously, the surplus in 1989 on the old milkfat equivalent basis was 8.972 billion pounds. Let us recompute that surplus using the new total solids approach and a 40/60 weighting of milkfat/solids-not-fat.

The milkfat and SNF equivalents for each product are as follows:

	Milkfat Equivalent	SNF Equivalent (mil. lbs.)
Butter: 423 Mil. Lbs. x 21.8 =	9,221	
423 Mil. Lbs. x 0.12 =		51
Cheese: 24 Mil. Lbs. x 9.23 =	222	
24 Mil. Lbs. x 9.90 =		238
NDM: no purchase =	0	
TOTAL	9,443	289

As the above calculations indicate, it required 9.4 billion pounds of cow's milk in 1989 to produce the milkfat that ended up in surplus dairy product; but it required less than a half billion pounds of cow's milk to produce the solids-not-fat that ended up in surplus dairy product.

The 40/60 weighting factors on total solids take us the next step.

9,443 Mil. Lbs. x 0.4 =	3,777 mil. lbs.
289 Mil. Lbs. x 0.6 =	<u>173 mil. lbs.</u>
TOTAL	3,950 mil. lbs.

The total solids approach indicates that the 1989 surplus was four billion pounds of milk, not the nine billion pounds reported on the milkfat equivalent procedure used at that time. Because four billion pounds is under the five billion pound trigger mechanisms in the price support schedule, one can readily see the potentially huge economic implications of the total solids approach.

One other dimension of this approach is the flexibility that the USDA has in weighting the milkfat in the 30/40 range and the SNF in the 60/70) range. If we look at the 1989 example again, and weight the milk equivalents 30/70 rather than 40/60, the surplus on a milk equivalent total solids basis would have been 3.0 billion

pounds rather than 4.0 billion pounds. The dairy title of the 1990 Farm Bill does not direct the USDA regarding the weighting factors to be used in any year. The USDA will likely compute the surplus using the range of weighting factors and make a judgement based on the impact of costs to the price support program and whether one weighting would call for a price support adjustment as compared to a different weighting.

Consolidating Equivalent Factors

The new approach to measuring milk equivalent incorporates the additional SNF factors that complicate any quick estimate of how much surplus milk is represented by CCC purchases. However, once we know the weighting factors it is possible to use a single total solids equivalent factor for each milk product.

Given a 40/60 weighting scheme, the single total solids equivalent factors that are currently in effect are as follows:

Butter-one pound: 8.792 pounds of milk
 Cheese-one pound: 9.632 pounds of milk
 Nonfat dry milk-one pound: 7.036 pounds of milk
 Evaporated milk-one pound: 2.114 pounds of milk

The derivation of these factors, using butter as an example, is as follows:

21.8 pounds milkfat equivalent x 40%
 + 0.12 pounds SNF equivalent x 60%
 = 8.792 pounds of milk

The calculation basically states that it requires the milkfat from 21.8 pounds of milk and the SNF from 0.12 pound of milk to make one pound of butter. However, when you arbitrarily limit the weighting of the milkfat in that computation to 40 percent, and when you force the weighting of the SNF to 60 percent of the total, the METS (milk equivalent total solids) factor computes out at 8.792 pounds.

The METS for the other products are computed similarly.

Cheese: $9.23 (0.4) + 9.90 (0.6) = 9.632$ pounds of milk
 Nonfat dry milk: $0.22 (0.4) + 11.58 (0.6) = 7.036$ pounds of milk
 Evaporated milk: $2.15 (0.4) + 2.09 (0.6) = 2.114$ pounds of milk

The single milk equivalent factor makes it much easier to estimate what amount of surplus milk is associated with a given quantity of CCC purchases. For example, 100 million pounds of nonfat dry milk purchases reflect almost 704 million pounds of milk.

Summary

At this juncture, most of what can be said about the total solids approach to measuring surplus has been said. Four points might be noted in conclusion.

First, the total solids approach reflects a positive change in the definition of surplus. The milkfat equivalent basis is too limiting.

Second, the new approach will be subject to fine-tuning for a while, and we will likely see some modifications in equivalence factors.

Third, it may make more sense in the long run to measure surplus on a cost or dollars basis (how much does price support cost?) and get away from these milk equivalent types of approaches.

Finally, the U.S. Department of Agriculture continues to report most dairy products on a milkfat equivalent basis, using the new milkfat equivalent factors. In fact, some series, like commercial disappearance, have been revised going back to earlier years as well. **It is only for measuring surplus in relation to price support activity that the USDA is using the milk equivalent total solids basis as the procedure for defining how much milk is required to make one pound of product.**