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What is the Difference Between the Costs of Reconstitution vs. Fresh Milk Processing?

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Preface

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Summary

The purpose of this study is to estimate the difference between the in-plant cost of producing partially reconstituted milk products versus the cost of producing fresh milk products. This cost difference, which is referred to as the comparative cost of reconstituting milk, is calculated under several assumptions about how milk is processed (the operating environment) and what prices are paid for inputs (milk, labor, etc.) and received for dairy outputs.

When it is assumed that current Federal Order provisions regarding reconstituted milk are suspended, the cost of producing blended milk products is less than the cost of fresh milk processing in Boston, Jacksonville, and New York, based on March 1981 prices. Results for Dallas and Knoxville are mixed; costs savings from reconstitution occur primarily when blended milk is standardized to a lower solids-not-fat content than currently exists in milk. There is no cost savings associated with reconstituted milk in Chicago. The greatest after-tax cost saving per gallon of blended milk is 4.9 cents and occurs in Boston.

Added processing and capital costs are an important but relatively minor component of the comparative cost of reconstituting milk. The factors which seem to have the biggest impact on the sign and magnitude of the comparative cost are the prices of nonfat dry milk, condensed skim milk, Class I milk, and blended milk products relative to fresh milk products. Class I prices are especially important insofar as existing price structures result in a high correlation between Class I prices and comparative costs, i.e., the cost advantage associated with reconstituted milk increases in markets with high Class I prices.

Preliminary results indicate that a drop in Class I prices ranging from $0.35 in Chicago to $1.37 in Boston would eliminate any potential savings from reconstitution, based on March 1981 prices. Similarly, if the wholesale price of blended milk products was less than the wholesale price of fresh milk products by as little as 2 cents per gallon in Chicago and as much as 11 cents per gallon in Boston, all potential savings from reconstitution would be eliminated, based on March 1981 prices.

Prices of dairy products from March 1981 are used to calculate the comparative cost of reconstituting milk. This time period was chosen because it was the most recent period for which prices were available at the time data were collected and it was felt that prices would be neither abnormally low nor high at this time. Given the seasonal pattern of Class I milk prices and nonfat dry milk (or condensed skim milk) prices, it was determined that the difference between Class I milk and nonfat dry milk prices is actually relatively high during the first several months of the year--such that March prices tend to favor reconstitution. Nonfat dry milk becomes relatively more expensive than Class I milk in October when new USDA purchase prices are announced under the price support program. The comparative cost of reconstituting milk was calculated based on October 1980 and annual average 1980 dairy prices. In both cases, reconstitution was significantly less desirable than when March prices were used.

What is the Difference Between the Costs of Reconstitution vs. Fresh Milk Processing?

Recent efforts by the Community Nutrition Institute and others to eliminate current Federal Milk Marketing Order pricing provisions relating to reconstituted milk have raised questions about the cost of reconstituting milk compared to the cost of producing fresh beverage milk products.[1] The purpose of this study is to measure the cost of using reconstituted milk to make Class I or beverage milk products given various assumptions about the processing or operating environment and economic conditions.

Ultimately, policy analysts will wish to compare the cost of reconstituting milk products with the cost of processing comparable fresh milk products. Hence, this study uses the approach of directly measuring the difference between the cost of producing fresh milk products and the cost of producing partially reconstituted milk products. This difference is denoted as the comparative cost of producing reconstituted milk, and it refers to the added or incremental cost that would be incurred by a fresh fluid milk bottler who replaced part of his output with blended or partially reconstituted milk products. If the cost of reconstituting beverage milk products exceeds the cost of processing fresh beverage milk products, the comparative cost of reconstituting milk, i.e., the difference between the two, is positive. If fresh milk costs more to process than reconstituted milk, then the comparative cost of reconstituted milk is negative.

Reconstituted or partially reconstituted milk products can be made in several ways and can refer to various and quite different products. In this study, the term reconstituted milk denotes fluid milk products that are made from condensed, dried, or other manufactured milk products and contain no fresh milk. For example, mixtures of water and nonfat dry milk or water and condensed skim milk are referred to as reconstituted skim milk. Using our terminology, milk products made by mixing reconstituted milk and fresh milk products are called blended milk products. For example, reconstituted skim milk can be mixed with fresh cream or fresh whole milk to produce blended whole milk or blended lowfat milk. This terminology, which is also described by Novakovic and Story (3), is not used universally. Others may use the terms reconstituted and blended milk interchangeably or they may have different definitions of one or the other. Throughout this report we will use the terms as they have been defined above, although the numbers we report as the comparative cost of reconstituting milk refer to the comparative cost of producing blended milk products (not just the reconstituted skim milk component of the blend).

This study attempts to measure the comparative cost of reconstituting milk under a variety of realistic assumptions about technical

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[1] For further details on reconstituted milk and the policy issues involved, see Novakovic and Story (3), Hammond et al. (1), or USDA (4).

factors and the operating and economic environment. An economic-engineering approach is used to estimate the comparative cost of reconstituting milk. Various plant conditions and processing environments are engineered to represent alternative, realistic operating conditions. Several assumptions are made about prices and other economic conditions which can also affect costs, in particular prices are collected for six cities--Boston, Chicago, Dallas, Jacksonville, Knoxville, and New York. This approach does not result in just one number representing the comparative cost of reconstituting milk; rather it allows one to measure the comparative cost of reconstituting milk under several sets of realistic assumptions about the operating and economic conditions which influence costs.

Assumptions and Model Design

Various technical data are collected and assumptions are made to help specify the model. The technical characteristics of the model include the following:

1. Bottling plants produce 80 percent beverage milk products and 20 percent byproducts. Plants have plant and equipment to reconstitute byproducts and sufficient excess capacity to reconstitute at least 10 percent but not as much as 50 percent of the beverage milk output.

2. The beverage milk product mix includes whole milk, lowfat milk, and skim milk. Based on 1979 data for Federal Milk Marketing Orders, it is assumed that the average fat content of beverage milk products is 2.605%.

3. Fresh milk products are standardized to 2.605% BF by combining fresh raw milk with an appropriate amount of fresh skim milk. Excess light cream is generated as a result.

4. Raw milk contains 3.67% butterfat (BF) and 8.62% solids-not-fat (SNF). One hundred pounds of raw milk can be separated into 18.35 pounds of light cream and 81.65 pounds of skim milk. Light cream is 20% BF and 7.2% SNF. Skim milk is 0% BF and 8.94% SNF.

5. Reconstituted skim milk is manufactured from water and nonfat dry milk or condensed skim milk. Nonfat dry milk is Grade A and of the low heat type and contains 97.5% SNF. Condensed skim milk is 32% SNF, which is considered to be the highest concentration of solids that can be shipped in fluid form without causing unloading problems. The typical plant has equipment for filtering and removing odors from water, if the normal water supply so requires.

6. Plants that reconstitute milk mix reconstituted skim milk with excess light cream (and raw milk, if needed) to produce partially reconstituted or blended milk products in sizes, containers, and product types comparable to the fresh product line. Blended milk

products average 2.605% BF. Butterfat is first obtained from surplus light cream. If more butterfat is needed than what is available from cream normally separated at the plant, the deficit is obtained by adding raw milk to the blend.

7. Reconstituted skim milk can be formulated to yield any level of SNF in a blended milk product. Two levels of SNF content are studied: 8.7% SNF which approximates the average SNF content of fresh milk products and 8.25% SNF which is the legal minimum SNF content for fluid milk products in most states.

8. State or Federal regulations proscribing the reconstitution of milk are ignored except that it is assumed that blended milk products must be packaged in appropriately labeled containers separate from fresh milk.

9. Raw milk is purchased at prevailing Federal Order minimum prices. Nonfat dry milk, condensed skim milk, and all other inputs are purchased at prevailing market prices.

10. Nonfat dry milk and condensed skim milk are purchased in truck-load quantities of 45,000 pounds and 5,292 gallons respectively. Given the state of current technology for bulk powder, it is assumed that nonfat dry milk is shipped in 50-pound bags.

11. Prices may vary regionally; therefore six plant sites and their associated prices are identified. The comparative cost of reconstituting milk is calculated for Boston, Massachusetts; Chicago, Illinois; Dallas, Texas; Jacksonville, Florida; Knoxville, Tennessee; and New York, New York.

Based on these data and assumptions, professional engineering consultants at JAI Engineers developed prototype designs for plants and calculated input requirements and product flows (see Appendix A).[2/]

In addition to these technical factors, there are four basic factors that describe the basic operating environment, these are:

1. plant size - Two sizes of plants are modeled. One, representing a moderate size plant, handles 30,000 gallons of beverage milk per day. The second produces 100,000 gallons of beverage milk per day and represents a large plant.

2. blended milk volume - 10 or 50 percent of all beverage milk produced (plant size) are blended milk products,

3. raw ingredients used to reconstitute - nonfat dry milk or condensed skim milk can be used to make reconstituted skim milk, and

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[2/] See Novakovic and Aplin (2) for further details.

4. solids-not-fat standard - blended milk can be formulated to contain 8.7 or 8.25 percent SNF.

Finally, several assumptions about the economic environment can be made. The first refers to Federal Order provisions regarding the pricing of reconstituted milk. In this study, it is assumed that current provisions prevail (the regulated situation) or reconstituted milk is exempt from Federal Order pricing (the unregulated situation). This assumption and all previous technical factors and assumptions about the operating environment of plants are not affected by plant location; plants anywhere in the U.S. could be large or small, use nonfat dry milk or condensed skim milk, be regulated or unregulated, etc. Prices of inputs and output are likely to vary by plant location. Table 1 shows the prices assumed for the six city locations that are studied.

Total comparative costs of reconstitution can be separated into four major components, as follows:

Processing Costs: processing costs are the costs incurred due to added labor, heat, and electricity needed in plants that reconstitute milk as compared to otherwise comparable plants that do not reconstitute milk.

Capital Costs: most plants that replace part of their fresh product output with blended milk require additional equipment and expanded plant space. The cost of new investments in plant and equipment is based on the purchase prices of new capital goods, salvage values at the end of the operating lives of the new capital goods, and appropriate interest rates to determine the annualized values of capital goods over their operating life.

Raw Ingredients and Milk Costs: raw ingredients are defined herein as raw milk, water, nonfat dry milk, and condensed skim milk. Changes in the cost of acquiring raw ingredients are due to changes in the amounts of raw ingredients required and/or the prices of raw ingredients. The comparative cost of raw ingredients will vary with Federal Order pricing policy. Under current rules, plants must pay the Class I differential on all reconstituted milk used in Class I, thus adding to raw ingredients costs. Under the proposals advanced by the Community Nutrition Institute and others, this added charge is eliminated.

Revenue Losses: totally fresh milk plants generate a surplus of light cream under the plant designs and assumptions of this study. Plants that blend milk products require some or all of the surplus cream as a high quality source of butterfat to blend with reconstituted skim milk. Consequently, revenues from the sale of excess cream drop. Another revenue loss that can be reflected in the comparative cost of reconstituting milk is the change in revenues that would result if the price of blended milk products was less than the price of fresh milk products, as some have suggested would happen. Although the

Table 1. Basic Price and Other Economic Assumptions for Plants in Six Cities.[a]

	Boston	Chicago	Dallas	Jacksonville	Knoxville	New York
Price of Labor ($/hour)[b]	10.45	12.52	8.59	7.02	9.71	16.50
Price of Heat ($/MBH)	1.86	1.86	1.86	1.86	1.86	1.86
Price of Electricity (¢/KWH)	7.0	3.32	3.81	8.03	4.73	9.0
Price of Water (¢/gallon)	0.4	0.4	0.4	0.4	0.4	0.4
Price of Nonfat Dry Milk (¢/lb.)	96.1	94.75	96.73	96.73	96.73	96.1
Price of 32% Condensed Skim Milk (¢/lb. of wet solids)	95.0	92.0	102.0	103.0	98.0	93.6
Price of Class I Milk ($/cwt.)	15.56	13.90	14.96	15.49	14.74	15.25
Price of Class II Milk ($/cwt.)	12.62	12.90	12.90	12.82	12.90	12.70
Price of Class III Milk ($/cwt.)	--	12.67	12.67	--	12.67	--
Difference Between Wholesale Prices of Fresh and Blended Beverage Milk ($/gallon)	0.0	0.0	0.0	0.0	0.0	0.0
Operating Life of New Physical Capital (years)	15	15	15	15	15	15
Discount Rate (nominal)	14%	14%	14%	14%	14%	14%
No. of Plant Operating Days per Year	312	312	312	312	312	312
Marginal Tax Rate	52.5%	52.5%	52.5%	52.5%	52.5%	52.5%

a Raw milk, nfdm and condense prices are for March 1981 and are from the Agricultural Marketing Service, USDA. Factor prices are from JAI Engineers.

b Wages plus fringe benefits.

model accommodates this possibility, this study assumes prices of comparable blended and fresh products are equal; since measurement of the possible impact of reconstitution on product prices or any other price was not among the primary objectives of this study.

The comparative cost of reconstituting milk is also calculated after adjustments for income taxes. Although most cost studies ignore taxes, income taxes are a necessary and relatively easily measured expense associated with any business operation. Hence, before- and after-tax costs are calculated. Income taxes tend to reduce added before-tax costs as taxable incomes decline or reduce added before-tax savings as taxable incomes increase.

The cost figure reported here refers only to in-plant costs; costs associated with assembly and distribution are not measured (receiving costs are determined from the point at which the product enters the plant and loading costs are measured up to the point that trucks leave the loading dock). We hypothesize that the fluid milk bottler who replaces part of his fresh milk output with blended milk products might achieve reduced per-unit assembly costs and increased per-unit distribution costs, but it is our judgment that the potential individual reduction in one and increase in the other are very small and the offsetting difference between the two would have a negligible impact if we included it in our cost calculations.

Results

The comparative cost of reconstituting milk can be calculated for as many as 192 possible combinations of the various plant and price data. Results for 112 of these combinations are reported in Table 2. Costs are reported after taxes; before-tax costs are given in Appendix B. Cases 1 through 16 are identical to cases 17 through 32 with the exception that reconstituted milk is assumed to be regulated in cases 1 to 16 and unregulated in cases 17 to 32. For the sake of brevity, results from cases 1 to 16 are shown only for New York. When reconstituted milk is priced according to the current Federal Order provisions, no combination of prices or operating assumptions were found which would result in a cost advantage for reconstitution, i.e., reconstituted milk was never cheaper than fresh milk; hence results for cases 1 to 16 using other city prices are probably only of academic interest anyway.[3/]

The results indicate that, other things being the same, the cost advantage to reconstituting milk per gallon of blended milk output is always <u>lower</u> for 1) the smaller plant (30,000 gallons of beverage milk

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[3/] The minimum after-tax cost disadvantage to reconstituted milk under current Federal Order price policy is 5.6 cents per gallon of blended milk (Case 15 in Boston).

Table 2. Total Comparative Costs of Reconstituting Milk, After Taxes, Based on Prices in Six Test Markets (cents per gallon of blended milk).

Case No. and Characteristics					Cost by Location[g]						
No.	Plant Size[a]	Blended Volume[b]	Raw Ingredient[c]	SNF Standard[d]	Boston[e]	Chicago[e]	Dallas[e]	Jacksonville[e]	Knoxville[e]	New York[e]	New York[f]
17	30,000	10%	nfdm	8.7%	-1.5	4.0	0.6	-1.3	1.5	0.1	9.2
18	30,000	50%	nfdm	8.7%	-1.5	2.2	0.0	-1.2	0.6	-0.6	5.5
19	100,000	10%	nfdm	8.7%	-1.9	3.6	0.2	-1.6	1.1	-0.5	8.6
20	100,000	50%	nfdm	8.7%	-1.6	2.1	-0.1	-1.3	0.5	-0.7	5.3
21	30,000	10%	condense	8.7%	-2.4	2.6	1.7	0.2	1.4	-1.2	7.9
22	30,000	50%	condense	8.7%	-2.3	1.0	0.6	-0.4	0.3	-1.7	4.3
23	100,000	10%	condense	8.7%	-3.1	1.8	1.1	-0.4	0.7	-2.2	6.9
24	100,000	50%	condense	8.7%	-2.4	0.9	0.5	-0.6	0.1	-1.9	4.1
25	30,000	10%	nfdm	8.25%	-3.3	2.2	-1.3	-3.1	-0.4	-1.7	7.4
26	30,000	50%	nfdm	8.25%	-3.3	0.4	-1.8	-3.0	-1.3	-2.4	3.6
27	100,000	10%	nfdm	8.25%	-3.8	1.8	-1.6	-3.5	-0.7	-2.3	6.8
28	100,000	50%	nfdm	8.25%	-3.4	0.3	-1.9	-3.1	-1.4	-2.6	3.5
29	30,000	10%	condense	8.25%	-4.1	0.9	-0.2	-1.7	-0.5	-2.9	6.1
30	30,000	50%	condense	8.25%	-4.0	-0.7	-1.3	-2.3	-1.5	-3.5	2.6
31	100,000	10%	condense	8.25%	-4.9	0.2	-0.8	-2.3	-1.1	-3.9	5.2
32	100,000	50%	condense	8.25%	-4.2	-0.8	-1.4	-2.5	-1.7	-3.6	2.4

a Plants process either 30,000 or 100,000 gallons of beverage milk output per day.

b The volume of blended beverage milk equals 10 or 50 percent of the total beverage milk output per day.

c Either nonfat dry milk (nfdm) or 32% condensed skim milk (condense) is used to make reconstituted skim milk.

d Solids-not-fat in blended beverage milk products are standardized to either 8.7 or 8.25 percent.

e Reconstituted milk is not priced under Federal Orders.

f These are Cases 1 through 16, which correspond to Cases 17 through 32 except they assume that reconstituted milk is priced in Class I according to current Federal Order pricing provisions.

g A negative comparative cost signifies a cost advantage to reconstituting; a positive comparative cost implies a cost disadvantage to reconstituting.

per day), 2) blended milk containing more solids-not-fat (8.7% SNF), or 3) current Federal Order pricing provisions. The per unit cost advantage of reconstituting tends to be lower when blended milk volume is higher (50 percent of plant size), but this is not always true. Given the prevailing relative prices, the cost advantage of reconstituting milk is lower when nonfat dry milk is used to make reconstituted skim milk in all cities except Dallas and Jacksonville.

Given prevailing market prices in the six cities, the comparative cost of reconstituting milk by city can be ranked from low to high as follows: 1) Boston, 2) Jacksonville, 3) New York, 4) Dallas, 5) Knoxville, and 6) Chicago. Prices in Boston, Jacksonville, and New York result in a cost savings that can be attributed to reconstituted milk. Chicago prices do not result in any cost savings from reconstituted milk. Results for Dallas and Knoxville are mixed, indicating cost savings primarily when blended milk is standardized to the lower SNF content. The comparative cost of reconstituting milk is quite sensitive to the time period from which prices data are chosen. The prices used here are for March 1981. As will be shown later, prices from other months can lead to different cost magnitudes, although the ranking of cities stays the same.

The highest after-tax cost <u>disadvantage</u> per gallon of blended milk output is 8.4 cents (before taxes it is 17.6 cents) and occurs in Chicago under the following operating assumptions (case 1):

1. plant size equals 30,000 gallons of beverage milk per day,
2. blended milk volume equals 10 percent of plant size,
3. nonfat dry milk is used to make reconstituted skim milk,
4. blended milk is standardized to 8.7 percent SNF, and
5. current Federal Order pricing provisions are in effect.

In this case (and all other cases which result in a positive comparative cost of reconstituting milk), it is more expensive to reconstitute and blend milk than to process fresh milk. Hence one would not expect reconstituted milk would be used under such circumstances and conditions.

The highest after-tax cost <u>advantage</u> per gallon of blended milk is 4.9 cents (10.3 cents before taxes) and occurs in Boston under the following assumptions (Case 31):

1. plant size equals 100,000 gallons of beverage milk per day,
2. blended milk volume equals 10 percent of plant size,
3. condensed skim milk is used to make reconstituted skim milk,
4. blended milk is standardized to 8.25 percent SNF, and
5. reconstituted milk is not priced under Federal Orders.

In this case (and all other cases in which the comparative cost of reconstituting milk is negative), it is cheaper to reconstitute and blend milk than to process fresh milk. Thus an economic incentive to replace fresh milk with blended milk exists under these circumstances and conditions.

The Impact of Assumptions About the Operating Environment

Based on New York prices, moving to the larger plant size enhances the cost advantage to reconstitution, after taxes, of 0.2 to 1.0 cents per gallon of blended milk. Expanding blended milk volume to 50 percent of plant size enhances the cost advantage to reconstitution, after taxes, by 2.8 to 3.8 cents per gallon of blended milk when current Federal Order provisions prevail and by -.03 to 0.7 cents when current pricing provisions are ignored. Reducing the solids-not-fat content of blended milk to 8.25% enhances the cost advantage to reconstitution by about 1.8 cents per gallon of blended milk. Eliminating the relevant Federal Order pricing provisions enhances the cost advantage to reconstitution, after taxes, by 9.1 cents per gallon of blended milk in plants that have a blended milk volume equal to 10 percent of plant size and by 6.1 cents per gallon in plants having a blended milk volume equal to 50 percent of plant size.

Processing and Capital Costs

Comparative processing costs, after taxes, are calculated to range from 0.1 to 1.9 cents per gallon of blended milk. Comparative capital costs, after taxes, range from 0.0 to 0.2 cents per gallon. It is difficult to compare these estimates with those from other studies; insofar as no equally comprehensive study of such costs are known. Hammond et al. assumed that reconstituted milk would require additional processing costs of five cents per cwt. of reconstituted milk and no additional capital costs (1, pp. 8-9). Direct comparison of these numbers should be made cautiously because of the conceptual difference between the two studies. Our costs are after-tax costs for blended milk products made from reconstituted skim milk, light cream, and (possibly) raw milk and composed of 2.605 percent butterfat and 8.7 or 8.25 percent solids-not-fat. The study by Hammond et al. refers to blended milk products made from reconstituted skim milk, butter, and fresh milk (1, p. 24). The product composition is not defined, but they probably assumed that the blend was formulated to approximate current averages of fresh milk, which we assumed to be 2.605 percent BF and 8.7 percent SNF.

Thus, if one wishes to compare our processing and capital costs with those of Hammond et al., our before-tax costs should be used, costs for blended milk of 8.25 percent SNF should be excluded, and costs should be adjusted to a hundredweight basis. Making these adjustments, our before-tax processing plus capital costs range from 3.5 to 52.2 cents per hundred pounds of blended milk. Even allowing for inflation, this would suggest that the estimate used by Hammond et al. is low.

The Sensitivity to Price Changes

The cost estimates reported herein are obviously sensitive to the prices and other economic assumptions that are used. Moreover, it is somewhat difficult to pinpoint the reason(s) why comparative costs are higher in one city or lower in another when all prices are different in different locations. Hence, it should be useful to explore the sensitivity of the estimates to changes in prices and other economic parameters.

Sensitivity analyses have been conducted on virtually all price and other economic variables (2). Within the range of prices reflected in the six city markets, it is possible to identify the variables that seem to play a greater role in influencing the level of comparative costs. In general, processing costs seem to be a relatively minor component of total comparative costs. Rather large changes in the prices of labor, heat and electricity barely affect the comparative cost of reconstituting milk. Likewise, water costs and changes in the price of water do not seem to have much impact on total comparative costs. Changes in the initial price of added plant and equipment, the operating life of capital, the discount rate, and the number of operating days, which directly affect capital costs, also appear to have a negligible impact on total comparative cost. Changes in the Class II price have no impact whatsoever on total comparative costs because any resulting change in raw ingredient cost is exactly offset by the change in revenue losses, under the assumptions of this study.

The factors that seem to influence the comparative cost of reconstituting milk most are the prices of nonfat dry milk, condensed skim milk, Class I milk, and blended milk products relative to fresh milk products. A five cent increase in the prices of nonfat dry milk and condensed skim milk will lower the after-tax cost advantage to reconstituting milk approximately one to two cents and three to five cents per gallon, respectively. For every five cents per gallon that the wholesale price of blended milk products is less than the price of fresh milk products the after-tax cost advantage to reconstitution decreases 2.4 cents per gallon of blended milk. A 50 cent increase in the Class I price results in a one to two cent increase in the after-tax cost advantage of reconstituting milk.

Although it would be difficult to rank the importance of these variables, it is clear that, within a realistic range of possible prices, the prices of nonfat dry milk, condensed skim milk, Class I milk, and blended and fresh milk products are far more important in determining the magnitude of the comparative cost of reconstitution than the prices of labor, water, and the other variables are.

Class I Prices

Given the way that prices are currently aligned geographically, it appears that the Class I price is the most dominating factor. There is a high correlation between Class I prices and comparative costs; cities having higher Class I prices have lower comparative costs of reconstituting milk. Higher Class I prices tend to increase the desirability of replacing fresh raw milk with reconstituted milk.

The dominating effect of the Class I price is primarily due to the relative difference between dairy prices across markets. The Class I price in Boston is $1.66 (12%) higher than the Chicago price, but the price of condensed skim milk in these cities differs by only 3 cents (3%). This is true because Class III prices or manufacturing milk prices are relatively uniform across the U.S., but Class I prices increase steadily with the distance of a market from the upper Midwest. Given this price structure, the level of Class I prices will probably be the singlemost important economic variable in determining the level of the comparative cost of reconstituting milk.

The thrust of the study by Hammond et al. (1) is to measure the impact of reductions in Class I prices that are hypothesized to result from the deregulation of reconstituted milk. The hypothesized reduction is assumed to equalize the costs of reconstitution and fresh milk processing. The purpose of this study is not to analyze the policy questions surrounding reconstituted milk nor is it to thoroughly examine the implications for Class I prices of deregulation; however some preliminary estimates of the potential impact on Class I prices can be discussed.

Reducing Class I prices will enhance the cost disadvantage to reconstituting milk. For each case which results in the greatest cost advantage in each city, a new Class I price that would equalize the cost of reconstituting milk and the cost of fresh milk processing (i.e., make the comparative cost of reconstituting milk equal zero) has been calculated and is reported in Table 3. (Prices are not calculated in fractions of cents so the price reported is the one which results in the positive cost closest to zero.) The maximum reduction in Class I prices required to eliminate any potential savings from reconstitution is: $1.37 in Boston, $0.35 in Chicago, $0.80 in Dallas, $0.98 in Jacksonville, $0.70 in Knoxville, and $1.11 in New York. Hammond et al. estimate a short-run reduction in Class I prices for 1976 of $1.08 in the Northeast, $0.14 in the Lake States, $0.83 in the South Central States, and $1.57 in the Southeast (1, p. 16).

The reader is urged to make comparisons cautiously and draw conclusions carefully. As will be shown later, the comparative cost of reconstituting milk is sensitive to the choice of price data; prices from a different month or year can significantly alter the magnitude of the comparative cost of reconstitution. We are not prepared to make a final or conclusive judgment on likely or potential impacts of reconstituted milk deregulation on Class I prices. Given this important caveat, it would appear that the estimates of Hammond et al. are somewhat high, allowing for inflation and the nature of our breakeven prices. In addition, by comparison to our numbers, the regional impacts estimated by Hammond et al. may be somewhat overstated in the Southeast and somewhat understated in the Northeast.

Wholesale Prices of Milk Products

In addition to Class I prices, the comparative cost of reconstituting milk can be significantly altered by differences between the wholesale prices of fresh and blended milk products. Although it has been assumed that there is no difference between these prices (see Table 1), the wholesale price of blended milk can be reduced to equalize

Table 3. Changes in Class I Prices Required to Eliminate All Possible Cost Savings Associated with Reconstituted Milk, Based on Comparative Costs, After Taxes, in Six Cities.

City/Case[a]	Results Based on March 1981 Prices: Cost Advantage to Reconstituted Milk	Results Based on March 1981 Prices: Class I Price	Breakeven Class I Price	Class I Price Reduction
	(¢/gal. blended milk)	($/cwt.)	($/cwt.)	($/cwt.)
Boston/31	4.9	15.56	14.19	1.37
Chicago/32	0.8	13.90	13.55	0.35
Dallas/28	1.9	14.96	14.16	0.80
Jacksonville/27	3.5	15.49	14.51	0.98
Knoxville/32	1.7	14.74	14.04	0.70
New York/31	3.9	15.25	14.14	1.11

[a] See Table 2 for the characteristics of these cases.

the costs of reconstituting milk and fresh milk processing. In order to eliminate any possible savings from reconstituting milk, the wholesale price of blended milk would have to be less than the wholesale price of fresh milk by 11 cents per gallon in Boston, 2 cents in Chicago, 4 cents in Dallas and Knoxville, 8 cents in Jacksonville, and 9 cents in New York.4/

Although a caveat about making direct comparisons is again in order, these figures can be examined in light of estimates reported by the USDA (4). The USDA study reports estimates of the difference between the retail prices for fresh milk and "blended reconstituted milk," with their blended milk being of the type described by Hammond et al. (4, p. 75968). They also calculate price differences for three different blends of reconstituted milk and fresh milk--50 percent reconstituted, 60 percent reconstituted, and 70 percent reconstituted. In our study, reconstituted skim milk is 87 percent of the volume of blended milk in all plants which blend 10 percent of their beverage milk output, and it is 58 percent of the volume of blended milk in plants which blend 50 percent of their beverage milk. The cases for Boston, Jacksonville, and New York that are associated with the breakeven wholesale price differences mentioned above (11, 8, and 9 cents/gallon, respectively) represent plants that have 58 percent reconstituted skim milk in their blend. The difference between retail prices for fresh milk and blended milk containing 60 percent reconstituted milk is calculated by the USDA to be 8 cents per gallon in the Northeast and 9.8 cents per gallon in the Southeast, based on 1978 data (4, p. 75968). The cases for Chicago, Dallas, and Knoxville that are associated with the breakeven wholesale price differences mentioned above (2, 4, and 4 cents per gallon, respectively) represent plants that have 87 percent reconstituted skim milk in their blend. The difference between retail prices for fresh milk and blended milk containing 70 percent reconstituted milk is calculated by the USDA to be 2.2 cents per gallon in the Lake States, 4.4 cents per gallon in the Corn Belt, and 7.0 cents per gallon in the South Central States, based on 1978 data (4, p. 75968).

Dairy Prices from Different Time Periods

Farm prices for raw milk, i.e., Class I, II, and III prices, have historically exhibited different seasonal patterns of increase than have wholesale prices of nonfat dry milk or condensed skim milk. In recent years, raw milk prices have tended to increase gradually through the year, whereas nonfat dry milk prices tended to hold fairly steady prior to adjustments in the CCC purchase price and then jump to the level of the CCC purchase price in April and October. Prices of condensed skim milk tend to follow the price of nonfat dry milk. Since raw milk is a

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4/The specific cases to which these figures apply are case 31 in Boston and New York, case 32 in Chicago and Knoxville, case 28 in Dallas, and case 27 in Jacksonville. These are the cases which result in the greatest cost advantage to reconstitution when the standard prices in the respective cities are used.

source of cost reduction and nonfat dry milk and condense are sources of cost additions, the relative difference between raw milk prices and nonfat dry milk or condense prices can affect the sign as well as the magnitude of the comparative cost of reconstitution. In other words, when raw milk and nonfat dry milk or condense prices are relatively far apart it can be cheaper to reconstitute milk, but when these prices are relatively close it can be cheaper to process fresh milk. Since relative price differences can vary seasonally, one should examine prices from several time periods.

The prices for Class I, II, and III milk, nonfat dry milk and condensed skim milk used for the various cities in the preceding analyses are the reported prices for March 1981. At the time data were being assembled, these were the most recent available prices. To get some measure of the sensitivity of the results to the choice of time period for which prices are collected, dairy price data for New York were also assembled for October 1980 and the average of all months in 1980. October represents a month in which nonfat dry milk and condensed skim milk prices would be expected to be relatively close to raw milk prices, whereas these prices would be relatively farther apart in March. At this time, a thorough analysis of prices in other months, years, or market areas has not been completed, but the preliminary results are given below.

The comparative cost of reconstituting milk is calculated for these alternative New York dairy prices for four cases reported in Table 4. Representing high and low cost cases, the cases shown should illustrate the general impact of choosing prices from different time periods.

As shown in Table 4, there are significant differences in the comparative costs of reconstitution based on dairy prices from these three time periods. Case 17 has the highest cost disadvantage, based on New York prices; with the original March 1981 prices, the comparative cost of reconstitution for case 17 was virtually zero. With October or annual average 1980 prices, there is no doubt that it is more expensive to reconstitute milk in New York under the conditions of case 17. At the other end of the spectrum, case 31, the case with the greatest cost advantage, results in a cost savings attributable to reconstitution under all three price sets. Case 23 results in the greatest cost advantage among all cases in which 1) reconstituted milk is unregulated and 2) the SNF standard is held at 8.7 percent. There is no cost savings for these types of cases when October or annual average 1980 prices are used (cases 17 and 23 represent the high and low costs among these types of cases). Moreover, not all of the cases in which the SNF standard is reduced to 8.25 percent result in a cost savings when the other dairy prices are used. Cases 25 and 31 represent the high and low cost cases when 1) reconstituted milk is unregulated and 2) the SNF standard is reduced to 8.25 percent. Both cases result in comparative cost savings when March prices are used, but the cost advantage of reconstituted milk is eliminated for case 25 (and presumably a few others) when October and annual average 1980 prices are used.

To summarize, the results with March 1981 prices for New York indicated that it was cheaper to reconstitute milk than to process fresh milk

Table 4. The Comparative Costs of Reconstituting Milk, After Taxes, Based on Dairy Prices for Three Time Periods.

	October 1980	Annual Average 1980	March 1981
Prices:			
Class I ($/cwt.)	14.47	14.28	15.25
Class II ($/cwt.)	12.56	11.96	12.70
Nonfat Dry Milk (¢/lb.)	96.63	91.46	96.1
Condensed Skim Milk (¢/lb. of wet solids)	93.64	89.86	93.6
Comparative Cost of Reconstitution, for Cases:[a]			
17	3.1	2.1	0.1
23	0.6	0.1	-2.2
25	1.2	0.3	-1.7
31	-1.1	-1.6	-3.8

[a] See Table 2 for a detailed description of the characteristics of these cases. A positive cost indicates a cost disadvantage to reconstituting. A negative cost signifies a cost advantage to reconstituting milk.

under virtually all of the test case configurations; however, when prices from other time periods are chosen, the cost advantage of reconstituted milk is eliminated for all cases in which SNF standards are maintained at 8.7 percent and even some of the cases in which the SNF standard is reduced to 8.25 percent.

If the prices of nonfat dry milk and condensed skim milk exhibit the same seasonal relationship to milk prices in the other cities as they do in New York, as one would expect, one would hypothesize that there would be no cost advantage to reconstitution in Dallas and Knoxville when October and annual average 1980 prices are used, and the cost advantage in Boston and Jacksonville is reduced and probably eliminated in many, if not most, cases.[5/]

[5/] The difference between comparative cost in New York and Boston, based on March prices is about one cent, but the difference between comparative costs in New York based on March 1981 and October 1980 prices is almost three cents.

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Appendix A

Technical Data

Appendix A

Technical Data

The following tables contain some of the technical data used for this study. Table A1 lists the capital items required under various operating assumptions and the purchase prices for additional plant and equipment. These data are used to calculate capital costs.

Table A2 itemizes the labor, heat, and electricity requirements under alternative assumptions about the operating environment.

Tables A3 and A4 illustrate the quantities of raw ingredients needed and milk products produced in plants of both sizes and under the various other operating assumptions.

Table A1. Purchase Prices and Salvage Values of Additional Plant and Equipment Under Alternative Operating Assumptions.

Assumptions/Plant and Equipment		Value ($)
I. Nonfat Dry Milk Used to Reconstitute		
A. 10% Blended Volume		
1. 30,000 gallon plant		0
2. 100,000 gallon plant		0
B. 50% Blended Volume		
1. 30,000 gallon plant		
a. blend vat	10,000	
b. blender and pipe	13,000	
c. refrigeration	18,000	
d. trash handling	14,000	
e. total		55,000
f. salvage value		5,500
2. 100,000 gallon plant		
a. blend vat	22,000	
b. blender and pipe	36,000	
c. refrigeration	60,000	
d. trash handling	36,000	
e. enlarge blend room	15,000	
f. total		169,000
g. salvage value		16,900
II. Condensed Skim Milk Used to Reconstitute		
A. 10% Blended Volume		
1. 30,000 gallon plant		
a. two used 3,000 gallon tanks	6,500	
b. installation	4,500	
c. pump and pipe	9,500	
d. total		20,500
e. salvage value		2,050
2. 100,000 gallon plant		
a. two used 6,000 gallon tanks	18,000	
b. installation	9,300	
c. pump and pipe	9,500	
d. total		36,800
e. salvage value		3,680

Table A1. (continued)

Assumptions/Plant and Equipment	Value ($)	
B. 50% Blended Volume		
1. 30,000 gallon plant		
a. two used 6,000 gallon tanks	18,000	
b. installation	9,300	
c. pump and pipe	9,500	
d. in-line blender	28,000	
e. refrigeration	11,000	
f. total		75,800
g. salvage value		7,580
2. 100,000 gallon plant		
a. two used 15,000 gallon tanks	45,000	
b. installation, pump and pipe	31,000	
c. in-line blender	32,500	
d. refrigeration	44,500	
e. enlarge blend room	15,000	
f. total		168,000
g. salvage value		16,800

Source: JAI Engineers.

Table A2. Additional Labor, Heat and Electricity Inputs Required at Plants Converting to Partially Reconstituted Products Under Various Operating Assumptions.

Input Requirements	10% Blended Milk Volume[a]				50% Blended Milk Volume[b]			
	30,000 gal. plant[c]		100,000 gal. plant[d]		30,000 gal. plant[c]		100,000 gal. plant[d]	
	Nfdm[e]	Condense[f]	Nfdm[e]	Condense[f]	Nfdm[e]	Condense[f]	Nfdm[e]	Condense[f]
Additional Labor (man hours/day)								
Receive tanker milk	- .4	- .4	-1.0	-1.0	-3.8	-3.8	-5.0	-5.0
Receive nfdm	.5	--	1.5	--	1.3	--	4.5	--
Receive condense	--	.6	--	.8	--	1.8	--	2.3
Blending nfdm	.7	--	2.0	--	2.0	--	2.9	--
Blending condense	--	.3	--	1.0	--	1.6	--	1.7
Trash handling	.7	0	2.0	0	2.0	--	2.9	--
Changeover on fillers	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Clean blend equipment	--	--	.3	--	.3	--	.3	--
Clean condense tanks	--	.6	--	.6	--	.6	--	.6
Material handling in cooler	.8	.8	1.7	1.7	.8	.8	1.7	1.7
Delivery and administration	1.0	1.0	2.5	2.5	1.0	1.0	2.5	2.5
TOTAL	4.8	4.4	10.5	7.1	5.1	3.5	11.3	5.3
Additional Heat (100,000 btu/hour)								
Pasteurizing	11.2	11.2	29.6	29.6	11.2	11.2	29.6	29.6
Cleaning tanks	--	3.8	--	5.4	2.7	2.7	2.7	5.4
TOTAL	11.2	15.0	29.6	35.0	13.9	13.9	32.3	35.0

Table A2. (continued)

Input Requirements	10% Blended Milk Volume[a]				50% Blended Milk Volume[b]			
	30,000 gal. plant[c]		100,000 gal. plant[d]		30,000 gal. plant[c]		100,000 gal. plant[d]	
	Nfdm[e]	Condense[f]	Nfdm[e]	Condense[f]	Nfdm[e]	Condense[f]	Nfdm[e]	Condense[f]
Additional Electricity (kilowatt hours)								
Raw milk pumping, receiving	-3.0	-3.0	-15.0	-15.0	-28.4	-28.4	-75.0	-75.0
Condense pumping, receiving	--	3.3	--	9.1	--	9.9	--	26.1
Nfdm blending	.4	--	.6	--	6.0	--	22.4	--
Condense blending	--	.5	--	4.0	--	6.4	--	12.9
Agitate raw milk	--	--	--	--	-54.0	-54.0	-90.0	-90.0
Agitate reconstituted skim	--	--	--	--	13.5	13.5	15.0	15.0
Agitate condense	--	36.0	--	54.0	--	54.0	--	90.0
Pasteurize and homogenize	7.6	7.6	16.6	16.6	7.6	7.6	16.6	16.6
Changeover on fillers	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
Plant lighting	.2	.2	.2	.2	.2	.2	.2	.2
Conveyor system	12.0	12.0	76.4	76.4	12.0	12.0	76.4	76.4
Refrigerate blend water	74.2	56.2	244.0	150.0	370.0	225.0	1200.0	901.0
CIP systems	--	15.0	--	15.0	--	15.0	--	15.0
TOTAL	201.4	237.8	432.8	420.3	436.9	371.2	1275.6	1098.2

Source: JAI Engineers.

[a]Blended milk equals 10 percent of total beverage milk volume.
[b]Blended milk equals 50 percent of total beverage milk volume.
[c]Beverage milk volume equals 30,000 gallons of beverage milk products per day.
[d]Beverage milk volume equals 100,000 gallons of beverage milk products per day.
[e]Nonfat dry milk is used for reconstitution.
[f]Condensed skim milk is used for reconstitution.

Table A3. Product Flows in Plants Producing 30,000 Gallons of Beverage Milk Per Day.[a]

Totally Fresh (Per Day)	Totally Fresh Milk Plant	Plant with 10% Blended Milk		Plant with 50% Blended Milk	
		8.7%[b]	8.25%[c]	8.7%[b]	8.25%[c]
Raw Ingredients:					
Raw Milk (cwt.)	2,755	2,479	2,479	1,836	1,836
Nonfat Dry Milk (lbs.)[d]	0	2,059	1,939	6,894	6,267
Water (gals.)[d]	0	2,450	2,464	8,175	8,247
Condensed Skim Milk (lbs.)[d]	0	6,273	5,909	20,912	19,094
Water (gals.)[d]	0	1,945	1,988	6,491	6,709
Intermediate Products:					
Skim Milk (cwt.)	750	675	675	375	375
Light Cream (cwt.)	169	152	152	84	84
Produced from:					
Raw Milk (cwt.)	919	827	827	460	460
Final Products:					
Fresh Milk (gals.)	30,000	27,000	27,000	15,000	15,000
Produced from:					
Raw Milk (gals.)	21,344	19,209	19,209	10,672	10,672
Skim Milk (gals.)	8,686	7,817	7,817	4,343	4,343
Excess Light Cream (cwt.)	169	118	118	0	0
Blended Milk (gals.)	0	3,000	3,000	15,000	15,000
Produced from:					
Raw Milk (gals.)	0	0	0	5,328	5,328
Light Cream (gals.)	0	397	397	994	994
Reconstituted Skim (gals.)	0	2,603	2,603	8,686	8,686

[a] Quantities are reported in pounds and gallons; sums may not add exactly due to rounding errors introduced when converting pounds to gallons.

[b] Solids-not-fat are standardized to 8.7 percent.

[c] Solids-not-fat are standardized to 8.25 percent.

[d] Plants use either nonfat dry milk and the corresponding water <u>or</u> condensed skim milk and the corresponding water, not both at once.

Table A4. Product Flows in Plants Producing 100,000 Gallons of Beverage Milk Per Day.[a]

Products (Per Day)	Totally Fresh Milk Plant	Plant with 10% Blended Milk 8.7%[b]	Plant with 10% Blended Milk 8.25%[c]	Plant with 50% Blended Milk 8.7%[b]	Plant with 50% Blended Milk 8.25%[c]
Raw Ingredients:					
Raw Milk (cwt.)	9,182	8,264	8,264	6,119	6,119
Nonfat Dry Milk (lbs.)[d]	0	6,863	6,465	22,878	20,889
Water (gals.)[d]	0	8,167	8,214	27,250	27,489
Condensed Skim Milk (lbs.)[d]	0	20,909	19,697	69,707	63,647
Water (gals.)[d]	0	6,482	6,628	21,635	22,362
Intermediate Products:					
Skim Milk (cwt.)	2,501	2,251	2,251	1,251	1,251
Light Cream (cwt.)	562	506	506	281	281
Produced from:					
Raw Milk (cwt.)	3,064	2,757	2,757	1,532	1,532
Final Products:					
Fresh Milk (gals.)	100,000	90,000	90,000	50,000	50,000
Produced from:					
Raw Milk (gals.)	71,146	64,031	64,031	35,573	35,573
Skim Milk (gals.)	28,952	26,057	26,057	14,476	14,476
Excess Light Cream (cwt.)	562	394	394	0	0
Blended Milk (gals.)	0	10,000	10,000	50,000	50,000
Produced from:					
Raw Milk (gals.)	0	0	0	17,761	17,761
Light Cream (gals.)	0	1,324	1,324	3,315	3,315
Reconstituted Skim (gals.)	0	8,677	8,677	28,952	28,952

a Quantities are reported in pounds and gallons; sums may not add exactly due to rounding errors introduced when converting pounds to gallons.

b Solids-not-fat are standardized to 8.7 percent.

c Solids-not-fat are standardized to 8.25 percent.

d Plants use either nonfat dry milk and the corresponding water <u>or</u> condensed skim milk and the corresponding water, not both at once.

Appendix B

Comparative Costs of Reconstituting Milk, Before Income Taxes

Table B1. Total Comparative Costs of Reconstituting Milk, Before Taxes, Based on Prices in Six Test Markets (cents per gallon of blended milk).

Case No. and Characteristics					Cost by Location						
No.	Plant Size[a]	Blended Volume[b]	Raw Ingredient[c]	SNF Standard[d]	Boston[e]	Chicago[e]	Dallas[e]	Jacksonville[e]	Knoxville[e]	New York[e]	New York[f]
17	30,000	10%	nfdm	8.7%	-3.2	8.4	1.2	-2.7	3.1	0.2	19.4
18	30,000	50%	nfdm	8.7%	-3.1	4.5	0.0	-2.6	1.2	-1.3	11.4
19	100,000	10%	nfdm	8.7%	-4.1	7.5	0.5	-3.4	2.3	-1.0	18.1
20	100,000	50%	nfdm	8.7%	-3.4	4.3	-0.2	-2.8	1.0	-1.6	11.1
21	30,000	10%	condense	8.7%	-5.1	5.3	3.5	0.3	2.8	-2.7	16.4
22	30,000	50%	condense	8.7%	-4.9	2.1	1.2	-1.0	0.5	-3.7	9.0
23	100,000	10%	condense	8.7%	-6.6	3.8	2.3	-0.9	1.4	-4.7	14.4
24	100,000	50%	condense	8.7%	-5.1	1.8	0.9	-1.2	0.3	-4.1	8.7
25	30,000	10%	nfdm	8.25%	-7.0	4.6	-2.6	-6.6	-0.7	-3.6	15.5
26	30,000	50%	nfdm	8.25%	-7.0	0.7	-3.9	-6.4	-2.7	-5.2	7.6
27	100,000	10%	nfdm	8.25%	-7.9	3.7	-3.3	-7.3	-1.5	-4.9	14.3
28	100,000	50%	nfdm	8.25%	-7.2	0.5	-4.0	-6.6	-2.9	-5.4	7.3
29	30,000	10%	condense	8.25%	-8.8	1.8	-0.4	-3.7	-1.1	-6.3	12.8
30	30,000	50%	condense	8.25%	-8.5	-1.5	-2.8	-5.0	-3.3	-7.4	5.4
31	100,000	10%	condense	8.25%	-10.3	0.3	-1.7	-4.9	-2.4	-8.3	10.8
32	100,000	50%	condense	8.25%	-8.8	-1.8	-3.1	-5.2	-3.5	-7.7	5.0

[a] Plants process either 30,000 or 100,000 gallons of beverage milk output per day.

[b] The volume of blended beverage milk equals 10 or 50 percent of the total beverage milk output per day.

[c] Either nonfat dry milk (nfdm) or 32% condensed skim milk (condense) is used to make reconstituted skim milk.

[d] Solids-not-fat in blended beverage milk products are standardized to either 8.7 or 8.25 percent.

[e] Reconstituted milk is not priced under Federal Orders (regulated).

[f] These are Cases 1 through 12, which are identical to Cases 17 through 28 except they assume that reconstituted milk is priced in Class I according to current Federal Order pricing provisions.