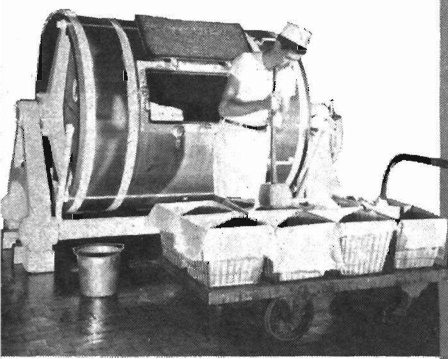
Deciding---

Whether to Manufacture



Butter and Powder

. . . or Cheese

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Deciding - - -

Whether to Manufacture Butter and Powder . . . or Cheese

A report to aid management in making economic decisions . . . .

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DURING the past 10 to 20 years, many specialized dairy plants have added facilities to manufacture additional dairy products. These facilities make it possible to divert milk to different products within the plant. This flexibility gives management the opportunity to manufacture the product or products that will give the greatest net returns.

Low cost combinations of labor, buildings, equipment, and supplies under a given set of conditions have been emphasized in research studies of specialized plants. In general, a plant equipped to produce only cheddar cheese can operate at lower costs per 100 pounds of milk received than can a cheese plant with standby equipment and additional building space to manufacture other dairy products. This same specialized plant, however, may be at a disadvantage because it cannot shift its operation from manufacturing one product to another as product prices change. In other words, a plant with facilities to divert milk to several different products may be able to increase gross returns more than it increases costs by maintaining the necessary flexibility to take advantage of changing product price relationships. The purpose of the study herein reported is to give management information that can be used as a guide in evaluating the advantages and disadvantages of plant flexibility.[1]

Procedure and Sources of Data

This analysis is based on data obtained from 28 dairy plants in Oregon, Idaho, and Washington.[2] These plants manufacture one or more of the following products: butter, nonfat dry milk, whole milk powder, and cheddar cheese.

The first part of this study shows costs of standby equipment, necessary additional building space, and larger supply inventories to make different volumes of milk into cheddar cheese in butter-powder plants[3] or into butter and powder in cheese plants. Capital requirements to divert milk to different products are referred to as costs of flexibility.[4] These requirements

[1] This study was made with funds provided under the Research and Marketing Act of 1946.

[2] Some of the basic data were used in other studies. Walker, S. A., Preston, H. J., and Nelson, G. T., "An Economic Analysis of Butter-Nonfat Dry Milk Plants," University of Idaho Research Bulletin No. 20, 1953; and Nelson, G. T., "Input-Output Relationships in Specialized Butter-Powder and Cheese Plants," Oregon State College Technical Bulletin 32, 1954.

[3] These are butter-spray process nonfat dry milk plants and will be referred to as butter-powder plants throughout this report.

[4] Flexibility in this study refers to diversions of milk within the plant and not between plants.

represent excess capacity to the plant and are compared with the increase in prices of butter, powder, and cheese needed to cover the added cost of flexibility. This information can be used as a guide by dairy organizations that are planning to build a new plant or are considering additions to an existing specialized plant to manufacture several dairy products.

Capital costs are important in deciding whether to maintain a flexible operation. Once the flexible plant is built, however, labor and supply costs are of greatest importance in determining which product or products to manufacture.[5] The second section shows the relative prices of butter, powder, and cheese at which it would be equally profitable for a flexible plant to manufacture either cheese or butter and powder. The relative prices are based on the value per 100 pounds of milk as determined by multiplying product yields times the prices of finished product and subtracting labor and supply costs.

The last part shows the relation of finished product prices and total manufacturing costs from 1947 to 1953 in specialized butter-powder, specialized cheese, and plants with facilities to manufacture all milk received into either cheese or butter and powder (flexible plants). The resulting figures show whether the average net returns per 100 pounds of milk at the plant for the period 1947 to 1953 are greater for specialized butter-powder, specialized cheese, or flexible plants.[6]

Costs of Flexibility

Costs of additional manufacturing facilities needed to make cheddar cheese in butter-powder plants or butter and powder in cheese plants are shown for different volumes. Volumes of milk diverted to butter and powder range from 60,900 to 324,800 pounds per day compared with a variation of 10,000 to 312,000 pounds of milk diverted into cheese. Differences in volume are due to combinations of labor and capital. Full utilization of labor and machinery cannot be obtained with volumes smaller than 60,000 pounds of milk per day in manufacturing butter and spray process powder.

Manufacturing cheese in butter-powder plants

To make cheese in a butter-powder plant requires additional equipment, more building space, and larger supply inventories. Charges for these capital requirements include insurance, interest, taxes, repairs, and depreciation. For this analysis, interest and insurance are based on a percentage of the total purchase cost of buildings, equipment, and supply inventories. Taxes are computed as a percentage of buildings and equipment costs. The rates used are 3.27 per cent of total purchase cost for interest, 0.94 of a per cent for insurance, and 2.2 per cent for taxes.[7] Repairs include labor, parts purchased, and depreciation on shop equipment. Depreciation is based on expected life of buildings and each item of equipment.

[5] In a flexible plant, it is necessary to have some workers who are both buttermakers and cheesemakers. This may result in an additional cost for labor, but for purposes of this study management, office personnel, and plant employees are assumed to be sufficiently flexible to adjust to the change of manufacturing either cheese or butter and powder.

[6] Differences in selling costs for specialized and flexible plants were not considered. It is also possible that flexible plants would receive lower prices for a given product since they may not be a reliable source of supply.

[7] These are equivalent to rates of 4.5 per cent for interest, 1.293 per cent for insurance, and 3.027 per cent for taxes, and are based on average investment level in observed plants.

Table 1. COSTS OF MAINTAINING STANDBY EQUIPMENT, BUILDING SPACE, AND SUPPLY INVENTORIES TO MANUFACTURE DIFFERENT VOLUMES OF MILK INTO CHEDDAR CHEESE IN BUTTER-POWDER PLANTS, 1952

Milk manufactured into cheese daily	Annual capital expenses*	Costs of flexibility per 100 pounds of milk	Increase in price of cheese to cover costs of flexibility†
10,000 pounds	$ 6,067	16.6¢	1.44¢
20,000 pounds	8,039	11.0	0.96
40,000 pounds	11,763	08.1	0.70
60,000 pounds	15,606	07.1	0.62
72,000 pounds	17,170	06.5	0.57
96,000 pounds	22,077	06.3	0.55
120,000 pounds	26,150	06.0	0.52
144,000 pounds	30,756	05.9	0.51
192,000 pounds	38,953	05.6	0.49
240,000 pounds	46,831	05.3	0.46
312,000 pounds	59,508	05.2	0.45

* Charges for interest, insurance, taxes, repairs, and depreciation.
† A change in price of 1 cent per pound of cheese is equal to 11.5 cents per 100 pounds of milk, with a yield of 10.5 pounds for cheese and an allowance in value for whey and whey fat recovered.

Annual expenses for making different volumes of milk into cheese range from $6,067 to $59,508 and represent costs of maintaining a flexible operation (Table 1). Unit costs of flexibility decrease as volume increases. These costs range from 5.2 cents to 16.6 cents per 100 pounds of milk. To the plant manager, costs of flexibility are fixed and represent excess capacity for his plant. In planning to build a flexible plant or in adding facilities to an existing butter-powder plant, costs of flexibility can be compared with increases in finished product prices needed to cover these costs. For example, if a dairy organization decides to add facilities to their butter-powder plant to manufacture 20,000 pounds of milk per day into cheese, flexibility costs are 11 cents per 100 pounds of milk. To cover these added costs, the price of cheese would have to increase approximately 1 cent per pound, assuming no change in butter and powder prices.[8] Increases in the price of cheese to cover flexibility costs for other volumes range from about a half cent to 1.44 cents. Changes in butter and powder prices are shown in Table 2.

Manufacturing butter and powder in cheese plants

Capital requirements for making butter and powder are computed on the same basis as for manufacturing cheese. Expenses for interest, insurance, taxes, repairs, and depreciation range from $35,113 to $96,187 when facilities are maintained to manufacture from 60,900 to 324,800 pounds of milk per day into butter and powder (Table 2). Costs of flexibility range from 8.1 cents per 100 pounds of milk when the largest volume is diverted, to 15.8 cents when the smallest volume is made into butter and powder.

Increases in the price of butter needed to cover flexibility costs range from 1.67 to 3.26 cents, assuming no change in the powder price. To cover

[8] Finished product values less manufacturing costs in butter-powder and cheese plants are equal with cheese priced at 38 cents per pound, butter at 65 cents, and powder at 16 cents.

Table 2. COSTS OF MAINTAINING STANDBY EQUIPMENT, BUILDING SPACE, AND SUPPLY INVENTORIES TO MANUFACTURE DIFFERENT VOLUMES OF MILK INTO BUTTER AND POWDER IN CHEESE PLANTS, 1952

Milk manufactured into butter and powder daily	Annual capital expenses*	Costs of flexibility per 100 pounds of milk	Increase in prices to cover costs of flexibility†	
			Butter	Powder
60,900 pounds	$35,113	15.8¢	3.26¢	1.79¢
73,200 pounds	35,647	13.3	2.75	1.51
91,300 pounds	37,488	11.3	2.33	1.28
121,800 pounds	47,709	10.7	2.21	1.21
152,000 pounds	56,714	10.2	2.11	1.16
203,000 pounds	72,299	09.8	2.02	1.11
324,800 pounds	96,187	08.1	1.67	0.92

* Charges for interest, insurance, taxes, repairs, and depreciation.
† A change in price of 1 cent for butter is equal to 4.84 cents per 100 pounds of milk. A change of 1 cent for powder is equal to 8.82 cents per 100 pounds of milk.

the same costs, the price of powder would have to be increased approximately a cent when the largest volume is diverted, to 1.79 cents when the smallest volume is manufactured into butter and powder.

Costs of flexibility are higher for a butter-powder operation than for a cheese operation of comparable raw milk volume. For example, at a volume of approximately 60,000 pounds of milk per day, flexibility costs for making butter and powder are 15.8 cents per 100 pounds of milk compared to 7.1 cents for a cheese operation (Tables 1 and 2). In plants with facilities to manufacture about 300,000 pounds of milk per day, flexibility costs per 100 pounds of milk are 8.1 cents for butter and powder and 5.2 cents for cheese. As the size of plant increases, the difference between butter-powder and cheese operations decreases. This is a result of greater economies of scale in making butter and powder.

Labor and Supply Costs-Product Value Relationships in Flexible Plants

Capital costs are important in deciding whether to maintain a flexible operation, but once the plant is built, labor and supply costs must be considered. In plants that have facilities to manufacture all milk into either cheddar cheese or butter and spray process powder, management is interested in knowing which product to produce. This can be determined by comparing labor and supply costs with finished product values.

A plant with facilities to manufacture an average daily volume of 56,000 pounds of milk into cheese or butter and powder is used to show the relative prices (Table 3). At these series of prices, finished product values less labor and supply costs are approximately equal whether the milk is made into cheese or butter and powder. Therefore, variations from the price combinations shown in Table 3 would give a net returns advantage to manufacture one of the products or product combinations. For example, with cheese priced above 38 cents per pound and butter at 65 cents and powder at

16 cents, it would be profitable for a flexible plant to make cheese.[9] At a price below 38 cents per pound for cheese, the advantage would be for making butter and powder. Likewise, with cheese priced above 30 cents per pound and with butter at 55 cents and powder at 11 cents, the advantage to the flexible plant would be to make cheese.

Product price combinations other than those listed in Table 3 can be used to show prices at which a flexible plant would obtain equal net returns for milk made into either cheese or butter and powder. For the plant with an average daily volume of 56,000 pounds of milk, a change of a cent in the price of butter and a half cent in the price of spray process powder is equal to 0.8 of a cent change in the price of cheese. As size of plant increases, labor and supply costs per 100 pounds of milk made into butter and powder decrease more rapidly than costs for making cheese.[10] For example, costs of converting 56,000 pounds of milk into butter and powder are 18 cents higher per 100 pounds of milk received than for making a comparable volume into cheese. At an average daily volume of 150,000, the difference is 12 cents per 100 pounds of milk. From a cost point of view, as the size of plant increases there is a slightly greater advantage in manufacturing butter and powder. The difference in costs, however, does not appreciably change the price combinations listed in Table 3.

Table 3. FINISHED PRODUCT PRICES AND VALUES PER 100 POUNDS OF MILK.*

Cheese		Butter and powder		
Price per pound	Value per 100 pounds milk†	Price per pound: Butter	Price per pound: Powder	Value per 100 pounds milk†
30¢	$3.00	55¢	11.0¢	$3.00
34	3.46	60	13.5	3.46
38	3.92	65	16.0	3.93
42	4.38	70	18.5	4.39
46	4.84	75	21.0	4.85

* Plants with facilities to manufacture an average daily volume of 56,000 pounds of milk into either cheese or butter and powder.

† Yields times prices of finished products minus labor and supply costs. Yields per 100 pounds of 4 per cent milk in observed plants were butter 4.84 pounds, nonfat dry milk and buttermilk powder 8.82 pounds, cheese 10.5 pounds, skimmed whey 88 pounds, and 40 per cent whey cream .46 of a pound. Values for buttermilk powder, whey, and whey fat were varied in proportion to prices of butter, powder, and cheese. Values of these products per 100 pounds of milk in the observed plants were 9 cents for buttermilk powder and 38 cents for whey and whey cream with butter at 65 cents, powder at 16 cents, and cheese at 38 cents per pound.

Product Prices and Net Revenue in Specialized and Flexible Plants

Historically, wholesale prices of butter and cheese have followed the same general price pattern (Figure 1). From 1910 to 1953, wholesale butter prices in Chicago averaged 20.8 cents higher than cheddar cheese prices on the Wisconsin Cheese Exchange. The largest variation was in 1947 when the butter price was 34.6 cents above the cheese price. In 1932 the difference in prices averaged only 10.1 cents per pound.

The consistency with which butter and cheese prices change does not show whether returns are greater when milk is made into cheese or butter and powder. Nor does it measure the net returns advantage of specialized cheese, specialized butter-powder, or flexible plants.

Returns to different types of plants are compared for the period 1947 to

[9] In practice, a plant manager would also have to consider differences in selling costs.

[10] Nelson, G. T. "Input-Output Relationships in Specialized Butter-Powder and Cheese Plants," Oregon State College Technical Bulletin 32, 1954.

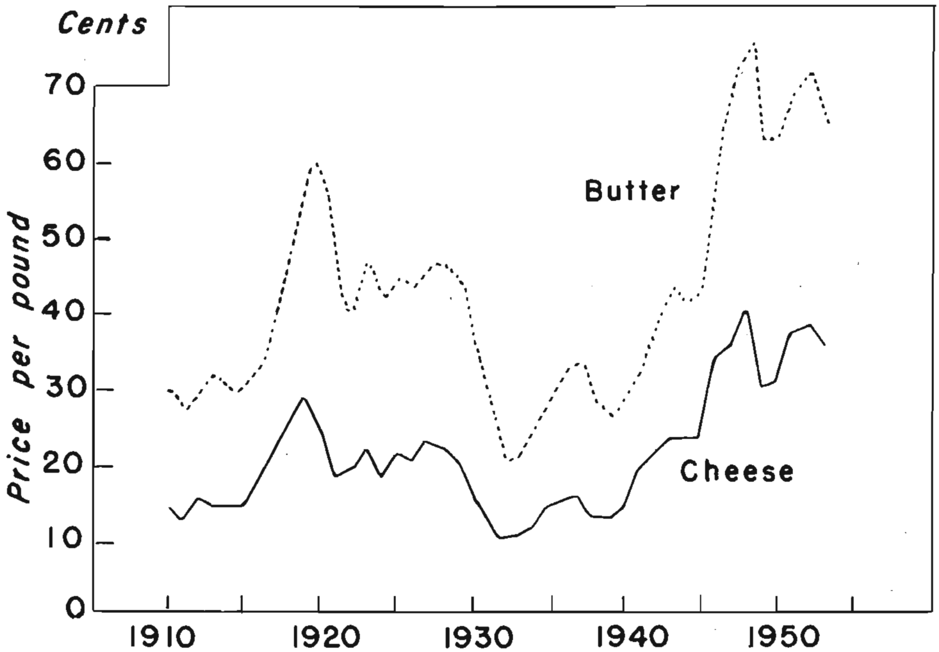

Figure 1. Average wholesale prices of 92 score butter in Chicago, and cheddar cheese on the Wisconsin Cheese Exchange, 1910-1953.

1953.[11] Finished product prices were multiplied by product yields to get total returns per 100 pounds of 4 per cent milk. Manufacturing costs[12] were then deducted from total returns to determine net returns or the paying ability of different types of plants.

Net returns in butter-powder plants were higher than in cheese plants for 71 of the 84 months during the period 1947 to 1953. Returns for the 7-year period averaged $3.76 per 100 pounds of milk manufactured into butter and powder compared to $3.58 for milk made into cheese, or a difference of 18 cents per 100 pounds of milk in favor of the butter and powder (Table 4).

For comparisons of specialized and flexible plants, it was assumed that the flexible plant manufactured all of its milk into either cheese or butter and powder each month that prices were favorable for a certain product or products. In other words, for 71 of the 84 months the flexible plant manufactured butter and powder, and for only 13 months it made cheese. Net returns per 100 pounds of milk in flexible plants for the 7-year period averaged 2 cents less than in specialized butter-powder plants, but 16 cents higher than in specialized cheese plants (Table 4). Returns were higher, however, in flexible plants than in butter-powder plants for the years 1947, 1948, and 1951.

[11] During much of this period cheese, butter, and powder were supported by the Government purchases and storages. Prices were fixed during World War II and were not available for powder prior to the war period.

[12] Since depreciation and repairs depend on use made of equipment, charges for these expenses were adjusted for flexible plants.

Table 4. NET RETURNS PER 100 POUNDS OF 4 PER CENT MILK IN SPECIALIZED CHEESE, SPECIALIZED BUTTER-POWDER, AND FLEXIBLE PLANTS, 1947-1953*

Year	Net returns per 100 pounds of milk			Amount net returns in flexible plants were above or below revenue in—	
	Cheese plants	Butter-powder plants	Flexible plants	Cheese plants	Butter-powder plants
1947	$3.71	$3.78	$3.81	$ .10	$ .03
1948	4.20	4.29	4.30	.10	.01
1949	3.02	3.35	3.30	.28	–.05
1950	3.06	3.37	3.32	.26	–.05
1951	3.77	3.83	3.85	.08	.02
1952	3.84	4.04	4.00	.16	–.04
1953	3.49	3.67	3.61	.12	–.06
Average (7-year period)	3.58	3.76	3.74	.16	–.02

* Net returns are based on monthly finished product prices minus manufacturing costs.

Summary

Costs of standby equipment, necessary additional building space, and larger supply inventories to manufacture butter and spray process powder in cheese plants are higher than when cheese is made in butter-powder plants. These costs of flexibility represent excess capacity and fixed costs to the plant. On the basis of 100 pounds of milk, costs decrease as the volume of milk diverted increases. Increases in prices needed to cover costs of flexibility in different types of plants range from 0.5 to 1.4 cents for cheese, 1.7 to 3.3 cents for butter, and nearly 1.0 to 1.8 cents for powder. This information can be used as a guide by management in deciding whether to maintain a flexible operation.

Once a flexible plant is built, labor and supply costs are of greatest importance in determining which product or products to manufacture. These costs, deducted from finished product values, give net returns and corresponding price combinations at which it is equally profitable for a flexible plant to manufacture either cheese or butter and powder. Milk made into cheese priced at 30 cents a pound gives the same net returns as milk manufactured into butter and powder when butter is 55 cents and powder is 11 cents per pound. Other product price combinations show that a change of 4 cents in the price of cheese is equal to a change of 5 cents in butter and 2.5 cents in spray process powder.[13] For example, the net return for 100 pounds of milk is the same when made into cheese priced at 34 cents per pound, or butter at 60 cents and powder at 13.5 cents a pound.

Total manufacturing costs, deducted from finished product values at the plant, show net returns for the period 1947 to 1953 were higher in specialized butter-powder than specialized cheese or flexible plants. Returns per 100 pounds of milk averaged 2 cents more in butter-powder plants than flexible plants and 18 cents more than cheese plants. Returns were higher for milk made into butter and powder than into cheese for 71 of the 84 months during the period 1947 to 1953.

[13] A value is added for whey, whey fat recovered, and buttermilk.

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