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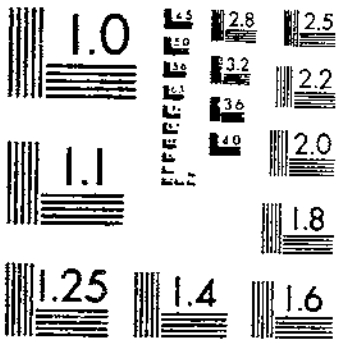

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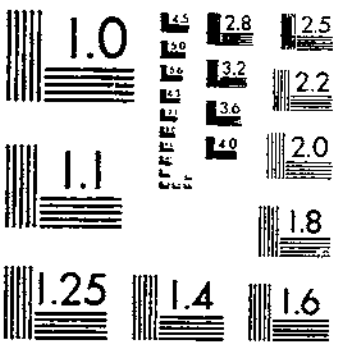

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The Demand and Price Structure for DAIRY PRODUCTS

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CONTENTS

The Demand and Price Structure for DAIRY PRODUCTS[1]

By Anthony S. Rojko, *Agricultural Economic Statistician, Agricultural Marketing Service*

HIGHLIGHTS

The major contribution of this bulletin is the formulation and statistical fitting of relations that describe the economic influences which affect prices and consumption of milk and dairy products. Because of the significant changes that have occurred in the consumption of milk fat and solids-not-fat since the late 1930's, separate economic relations were formulated for the period between World Wars I and II and the period following World War II. Likewise, because of the increasing importance of margarine and "filled" milk products, the postwar relations were formulated to take into account relationships between the dairy and the fats and oils economies. In addition to their use for analysis of price and consumption movements and assistance in gaging future trends, results of these analyses can be used to indicate probable effects of certain Government programs.

The bulletin also brings together a mass of information relating to other economic influences and institutions that affect prices and consumption of dairy products. Inclusion of these subjects is to aid in the interpretation and use of the formal results obtained from statistical analyses. These subjects include (1) methods of pricing fluid and manufacturing milk; (2) Government participation with respect to fluid milk; (3) Government price support programs; (4) price relationships among different marketing levels; (5) seasonal variation in prices; and (6) price differentials by regions and markets.

The quantity of milk produced within a year or less is affected only slightly by current prices received by farmers, because many decisions regarding production adjustments are made more than a year in advance of the production period. When production is altered by changing the rate of feeding per cow, the time needed for adjustment is short compared to that needed to increase the milking herd. Major changes in total production of milk usually result from changing the number of cows milked or, in a longer-run situation, by

[1] Submitted for publication, May 2, 1957.

increasing production per cow by improved breeding, feeding, and other basic practices. However, the quantity of milk produced in any given year does substantially affect the price received by farmers. Based on results from statistical analyses, and assuming no change in demand for dairy products, it is estimated that for each 10 percent increase in the production of milk, prices received by farmers for milk tended to decrease slightly over 20 percent during the period between World Wars I and II, and slightly over 30 percent in the period following World War II. A larger decrease in price resulted in the postwar period because fluid milk increased its share of the total demand. Greater reductions in prices are needed to sell an equivalent quantity of product for fluid milk than for manufactured dairy products.

Milk production is utilized for many outlets, each having its own characteristic demand. Domestic human consumption depends on such factors as retail prices of milk and dairy products and consumer income. The amount fed to livestock depends on prices at the farm for milk, purchased feed, and animals fed. The quantity exported depends on world business conditions, foreign milk production, and delivered prices of United States dairy products in world markets. The demands for milk in these outlets are interrelated. For example, price is a factor in each outlet. Although the prices are not identical, they are related. If the farm price of milk goes up, so do domestic retail prices and delivered prices in foreign markets. The central theme of this report is that we cannot fully explain the demand for milk by separate studies of the demands for milk in each segment of the market; rather, we should study all segments simultaneously.

For the period between World Wars I and II, yearly changes in the quantity fed to animals, net change in dairy products in storage, and net foreign trade were small in relation to total production of milk; no attempt was made to develop statistical analyses for these outlets. During this period, changes in the supply of milk available for consumption were highly associated with changes in production. However, this was not true during years of large wartime demand for export and for the years after World War II, in which substantial quantities of dairy products were bought by the Government for price support; for these years certain modifications in the analyses were required.

The consumption of any single dairy product depends not only on the demand for that product but also on the consumption of the several other dairy products, because for any short period of time the combined consumption of all dairy products must come from the same fixed supply of milk. Prices must be at a level such that the quantities of milk demanded in all outlets equal the total supply of milk. Thus, statistical procedures used for measuring the effect of various factors on prices and consumption were those which took into account the simultaneous interaction of the total supply of milk and economic factors that affect each dairy product. This bulletin discusses the conditions under which such complex systems of equations are needed. It concludes that simpler analyses can be used for minor dairy products but that, in most instances, data are lacking to carry out such analyses.

Because of the simultaneous determination of the consumption of individual dairy products, and because each processed dairy product

differs in physical characteristics, a uniform method of aggregating dairy products had to be used. For the demand analyses in thi bulletin the individual products were combined on a milk equivalent (fat solids) basis.

A few of the conclusions that can be drawn concerning consumers' response to prices and income from results obtained from the several statistical analyses are as follows:

During the period between World Wars I and II, consumption of fluid milk and cream tended to increase between 3 and 5 percent for each 10 percent decrease in retail price, assuming no change in consumer incomes. With no change in prices, an increase in consumer incomes of 10 percent on the average would have increased consumption by between 2 and 3 percent. During the same period, consumption of butter tended to increase on the average between 4 and 6 percent when retail prices of butter decreased 10 percent, and to increase between 2 and 4 percent when incomes increased 10 percent, in each instance after allowing for the effects of other economic factors.

Although the analyses for the period following World War II are based on a relatively short period of time, the estimates of the demand coefficients appear plausible when considered in connection with the results obtained for the prewar period and the trends in consumption of milk fat and margarine during recent years. Consumers' response to prices and income for fluid milk and cream remained essentially the same as in the prewar period. Consumers' response to changes in the price of butter increased substantially, reflecting the growing importance of a competing product, margarine. However, changes in prices and consumption since 1953 indicate that the price response for butter may have shifted back to the prewar level. This suggests that people who now use butter as a spread for bread may react in about the same way to changes in prices of butter as did most people in the prewar period. The postwar analysis also confirms earlier studies which concluded that consumption of margarine is influenced more by the price of butter than by that of margarine.

The analyses suggest that cheese is considered more as a substitute for meats, poultry, or fish in planning a meal now than in former years. Prices of meat, poultry, and fish apparently influenced consumption of American cheese only slightly during the prewar period. In recent years, a 10 percent increase in consumption of cheese might be expected with a 10 percent increase in the price of substitutes, after allowing for the effect of other factors.

Beginning in the early 1930's, the Government from time to time purchased manufactured dairy products for price support. In most years before World War II, Government purchases were relatively small; when they were at a peak, in 1938, it is estimated that prices for the year as a whole probably were raised by not more than about 6 percent, although in a single month prices may have been raised more. On the other hand, during the period following World War II, it is estimated that prices received by farmers for butterfat and manufacturing milk probably would have been reduced by about 30 percent in the marketing year beginning April 1, 1953, if the Government had not purchased for price support the equivalent of 11 billion pounds of milk in the form of dairy products or taken other action. And, in the absence of Government purchases or equivalent action,

it is estimated that prices received by farmers for all milk at wholesale would have been reduced by about 25 percent in the same period.

INTRODUCTION

The major objective of this bulletin is to identify and to measure the primary economic influences which affect prices and consumption of milk (at the farm), fluid milk, and manufactured dairy products. Analyses designed to estimate numerical coefficients for the following economic relations are included: (1) Price and income elasticities for milk at the farm or local market level; (2) price and income elasticities for total milk and selected dairy products at retail; and (3) price relations for and between prices of milk and individual dairy products at and between the three different levels of marketing—retail, wholesale, and farm. Because of significant changes in the consumption of milk fat and solids-not-fat since the late 1930's, separate relations are developed for the interwar (mostly 1924–41) and postwar (1946–53 or 1946–54) periods.

Incidental to the general objectives, but important to the interpretation of results obtained from the analyses, this bulletin includes (1) background information on basic changes and trends in prices, supply, and consumption of milk and milk products; (2) a discussion of the nature of pricing and pricing arrangements in the fluid and manufacturing segments of the dairy industry; (3) geographic relationships among prices of individual dairy products; (4) Government participation in pricing milk produced mainly for fluid uses; and (5) effect on prices of Government purchase and support programs.

Researchers in the past have exhibited considerable interest in the analysis of pricing arrangements, prices, and consumption of milk and milk products. This interest stemmed in part from (1) the need of minimum sanitation requirements and their possible effect on pricing of fluid milk, (2) the role of Government in pricing fluid milk and in supporting prices of manufactured dairy products, and (3) the relative importance of milk and dairy products in the family budget, including its importance as a supplier of the many needed nutrients in our diet. Some of these studies provide an excellent background to a better understanding of the findings in the current study. Following is a brief resume of some of the more important contributions grouped into two broad categories: (1) Analyses of pricing methods and price structure, and (2) analyses of consumption and demand.

In the 1930's Black (*7*) [2], Cassels (*24*) and Gaumnitz and Reed (*57*) greatly advanced the field of price analysis of the dairy industry. These comprehensive studies were concerned primarily with the problems involved in pricing fluid milk and the nature of the price structure in milk markets, including classified pricing and other pricing arrangements. Of interest was their application of location theory to explain geographic and interproduct differences in prices. Price analysis in this context for fluid milk markets was continued

[2] Italic numbers in parentheses refer to Literature Cited, p. 224.

by Bressler, Hammerberg, and Parker in a series of Connecticut studies (*60*) and by Bredo and Rojko (*18*) in a regional study. Hassler (*62*) extended the same type of analysis to manufactured dairy products for the United States as a whole. One of the major objectives of these studies was to test the pricing efficiency of the marketing system. This was usually accomplished by developing a set of hypothetical prices consistent with marketing costs and competitive theory and the comparison of these with prevailing prices to locate inefficiencies in pricing.

Many studies also have dealt with specific pricing problems and factors that affect prices in a particular segment of the dairy marketing system. For the fluid sector, these include recent studies on the pricing of Class I and surplus milk initiated by the Milk Market Administrators (*14, 16, 91* and *92*), pricing of milk in the New York market by Luke (*80*) and pricing of surplus milk in the Chicago market by March (*82*). For the manufacturing milk sector, they include studies by Cook et al (*31*), Mathis and Hirsch (*84*), and Swantz (*132*), which dealt with payments for manufacturing milk and processed products at the plant level, and the study by March and Herrmann (*83*) on the pricing of butter in central markets.

The impact of institutions on pricing of milk is well known. Important studies in this area are those by the Federal Trade Commission (*171, 172, 173, 174, 175, 176*), Taylor et al (*133*), the National Grange (*135*), Hillman et al (*67*), Spencer and Christensen (*125, 126*) and the United States Agricultural Marketing Service (*145*). The study by the Agricultural Marketing Service of the impact of sanitary requirements, Federal orders, State milk control laws, and truck laws on price, supply and consumption (*145*) gives both a comprehensive summary of research work done in this area and a penetrating analysis of factors involved.

Studies of consumption have received high priority in the dairy field. Results of consumer surveys have been helpful in understanding factors that affect consumption, particularly those which usually cannot be measured from time series data. Most of these studies present estimates of consumption by categories of food, and in some instances, demand coefficients such as those relating consumption to income. This was done, for example, in the recent study by Clark et al (*29*) on food consumption of urban families in the United States. Froker, Macleod, and Spencer (*56*) give a summary of consumption studies completed through the mid-1940's and also of studies pertaining to demand analysis, including the early studies of Ross (*113, 114*) for the Chicago and New York markets. The establishment of consumer panels in recent years has permitted a more detailed analysis of budget-type data, particularly its behavior over time and the measurement of consumer response to price as well as to income, as demonstrated by recent studies made at Michigan State University (*105, 106, 118*). The present study is concerned with the estimation of coefficients of demand for individual products which are internally consistent with the corresponding coefficients for total milk.

Possibilities and limits of economic research on dairy products are affected to some extent by the nature of the dairy industry and the kind of institutional factors in which it operates.

Milk is produced in nearly every county of the United States on a year-round basis under varying degrees of specialization and different conditions of production. Because of its perishability, the frequency of its marketing, and its widely dispersed sources of supply in relation to outlets, raw milk does not lend itself to dealing on an "offer and acceptance" basis but must be sold by some prearranged pricing procedure. The pricing mechanism for milk that is produced primarily for fluid use differs from that for milk which is produced solely for manufacturing outlets.

Price-making bodies or procedures which govern the pricing and marketing of fluid milk include (1) simple negotiations between dealers and farmers or between dealers and representatives of farmers; (2) State milk control agencies, which may set prices at various stages of distribution from farmers to consumers; and (3) Federal milk marketing orders, which establish only minimum prices that shall be paid to producers.

Firms making processed dairy products base their purchase prices for milk or butterfat largely on the prices of finished products that are sold nationally. For example, the price of milk at certain creameries might be the wholesale price of butter at Chicago minus some predetermined differential for manufacturing and transportation costs. Except as they are influenced by Government price support operations, market prices of manufactured dairy products are established by the direct operation of market supply and demand influences. Butter and Cheddar cheese are traded on several mercantile exchanges. Although trading in wholesale markets is light in relation to total supply, wholesale prices of manufactured products tend to reflect the national supply and demand situation. This results because shipments between markets can be made at any time as transportation costs are low, compared to value of product, and manufactured products are relatively nonperishable.

Significant changes have occurred in the production of milk and the consumption of dairy products in the last two decades. Production of milk kept pace with population growth until the early 1940's. It remained relatively stable for the decade ending 1952, but since late 1952, has surged upward. The leveling off in production of milk in the 1940's was associated with two opposing trends in consumption of dairy products begun in the late 1930's: (1) An uptrend in the consumption of solids-not-fat, and (2) a downturn in the consumption of milk fat per person. Factors affecting these trends are discussed in detail in this bulletin.

Dairy products are significant items in the family food budget as well as important suppliers of nutrients in our national diet. During 1953–55 nonfarm consumers spent close to a fifth of every food dollar for dairy products. In the same period dairy farmers averaged $4.2 billion annually from sales of milk and butterfat—14 percent of the cash receipts from all farm products. For the United States as a whole, if sales of animals from milking herds are included, cash receipts from the enterprise represent nearly 20 percent of total cash receipts.

RELATIONS BETWEEN THE DAIRY INDUSTRY AND OTHER PARTS OF THE NATIONAL ECONOMY

This bulletin analyses the internal economic structure of the dairy industry and the relation of its different parts, as well as the whole, to the economy at large. The discussion in this section assumes that economic activity can be visualized as a continuing flow of services in one direction and a flow in reverse direction of money in payment for these services. In the case of dairy products, the production of milk, including the supplying of marketing services, can be considered as a flow of services, with money outlay of consumers considered as a counter flow in payment for these services. This outlay by consumers constitutes income to producers of milk and to those who furnish the marketing services.

The meaning of this concept and the factors that relate to it can be brought out by the following series of questions that apply directly to the dairy industry:

What are the factors that affect the rate at which resources flow into the production of milk?

In what sectors of the economy do these resources originate?

On the consumption side, how is consumer income apportioned among savings, on the one hand, and expenditures for different products and services on the other?

What are the factors that govern the flow of consumer expenditures for dairy products?

The discussion which follows is designed to provide answers to these and related questions.

TYPES OF ECONOMIC RELATIONS

The dairy industry is linked with the rest of the economy in several ways. Figure 1 illustrates the major economic relations. The dairy industry itself is grouped into three major sectors covering activities at the consumer, marketing, and farm levels. Relationships among these levels are discussed later, but the division is pointed out here to focus attention on the relation of each sector to the total economy.

At the farm level, the dairy industry is a part of the total feed-livestock sector of agriculture. The industry is directly associated with this sector in two major ways. One link of this association is formed by the competition of the dairy farmer with producers of other livestock and livestock products in the use of feeds. The price of feed and the quantity available to the dairy farmer depends not only on the demand for feed in dairying but also on the total supply of feed and the demand for feed for other livestock enterprises. The other important economic link is the price, supply, and demand for meat animals. The number of cows kept for milk is affected by this relationship, and the supply of meat animals for slaughter is affected to some extent by the decisions of dairy farmers. These two relationships are discussed in detail beginning on p. 37.

In figure 1, influences which are essentially physical in nature, such as production of milk, are represented by squares, whereas influences

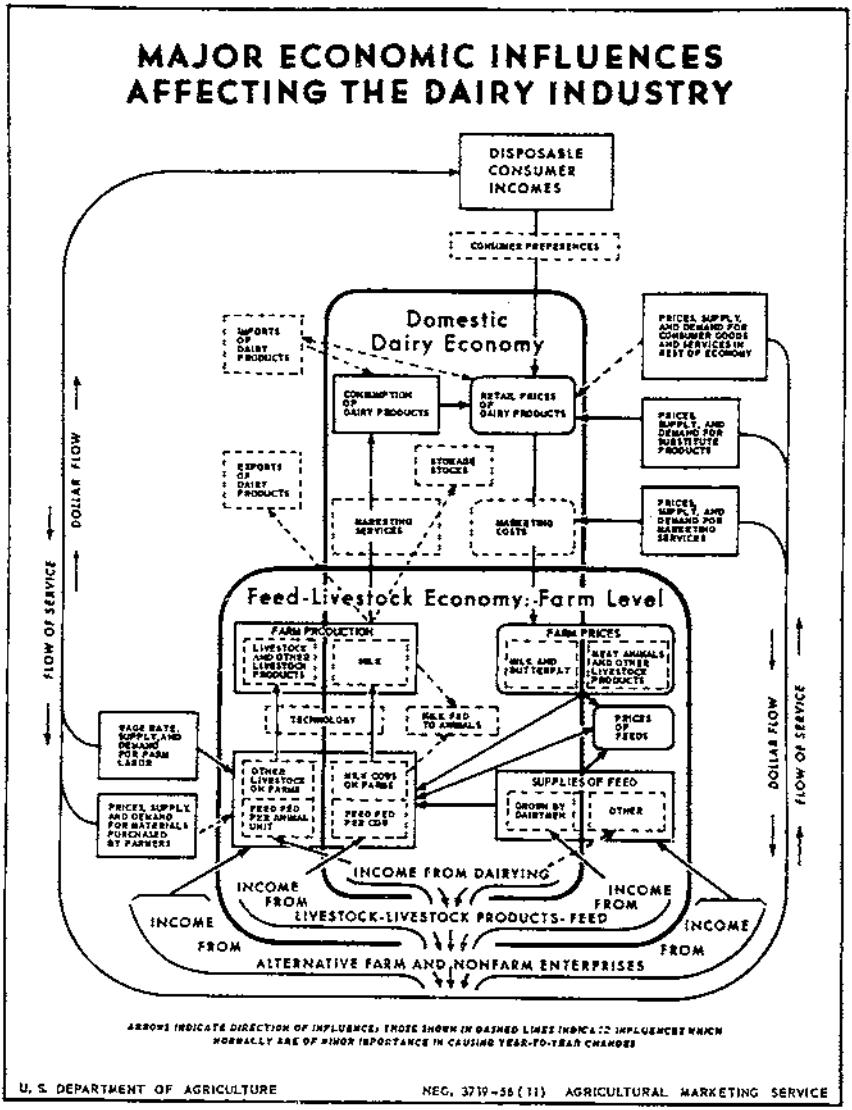

FIGURE 1. This diagram shows the major economic influences that affect the dairy industry. Consumer incomes, prices of substitute commodities, and production of milk are the main determinants of retail prices and consumption of dairy products. At the farm level, the dairy industry is part of the feed-livestock economy.

which are primarily economic in nature are shown as circles. Arrows are used to indicate the direction of these influences. Figure 1 suggests that the economic relationships which link the different sectors of the dairy industry with the rest of the economy can be grouped in several general ways, each of which is discussed in this section.

Product and Raw Material Prices

This section discusses those economic relationships in which prices play an active role in determining alternative economic choices made by firms and households. Influences that affect these choices, shown in figure 1, include prices of (1) dairy and competing products available to consumers and (2) goods and services purchased by firms in dairying, including those within the marketing sector. Prices link firms in the dairy industry with firms and households in the rest of the economy by indicating the supply of and demand for (1) competing goods sold and (2) resources used in dairying.

In the consumer sector, the decision as to whether households with given incomes, tastes, and preferences, spend their incomes on dairy or other products, or save, depends in part on the level of dairy-product prices in relation to prices of competing goods and to prices in general. If some products are close substitutes, a change in the supply or demand situation for either the dairy product or its substitute will be reflected in changes in prices or consumption of each. With the exception of margarine as a substitute for butter, vegetable fat for milk fat in beverages and frozen desserts, and possibly meats for cheese, no close substitutes for dairy products can be directly identified.

In contrast to the consumer sector, the price linkage in the marketing sector is through prices of the resources, including labor, used in performing the marketing services. Dairy marketing firms compete with firms in other sectors of the economy for the use of labor and certain other resources that are used to process and handle dairy products. The importance of these demands by dairy marketing firms in relation to other firms may be illustrated approximately in the following way:

For the period 1947–49, total charges for processing and marketing dairy products averaged about $3.2 billion annually as compared to about $19.4 billion for all farm foods. The total for dairy products equaled 16 percent of that for all foods. For the same period, wholesale and retail trade contributed annually around 19 percent to national income, while the contribution for transportation equaled 6 percent. Although these figures are not strictly comparable, it seems reasonable to assume that wage rates and prices of other resources used to provide marketing services are not materially affected by the demand for them in the dairy sector but rather by their supply and demand from the whole economy. If the costs of marketing services are primarily determined by influences external to the dairy industry, certain aspects of the analysis of factors that affect the demand for dairy products can be simplified. This point is discussed in more detail later.

In an economic sense, the dairy farmer is affected by decisions made by other farmers, by firms in other sectors of the economy, and by consumers, because their decisions affect the economic influences which guide him in his decisions. Whether he chooses to invest his resources, including labor, in milk production or some other agricultural or nonagricultural pursuit depends in part on the net returns resulting from alternative courses of action. Current wage rates, prices of feed, and prices of other supplies affect his day-to-day de-

cisions on production plan and farm operation. The shift toward a more commercialized type of dairy farm—with higher investment per cow and relatively greater cash expenditures—has tended to make the dairy farmer more sensitive to changes in the total economy. Some of this dependence stems from the nature of the milk product itself. For example, milk for fluid use is produced nearer to urban centers than are most other major agricultural products. Farm wage rates on dairy farms in southern New England are more sensitive to factory wages in that area than are wages on farms more distant from large urban manufacturing centers. As noted previously, dairying also is sensitive to other farm enterprises, particularly the feed-livestock segment via prices of feed and meat animals.

The importance of developments in the rest of the economy to dairying is evidenced by the nature of formula pricing in some regulated milk markets. A number of these formulas establish prices, at least in part, on current levels of economic influences outside of the dairy industry.

Income Flows and Flows of Service

An effective way of identifying the relations between the dairy industry and the rest of the economy is to trace out the path of income or money flow between this and other sectors. Purchases or sales of goods and services can be visualized as flows consisting exclusively of services, and incomes and money outlays, as counter flows. The flow concept suggests a continuous revolving process in the economy, with services and incomes flowing in opposite directions. As discussed earlier, figure 1 shows product and factor prices as economic influences that motivate these flows.

From an accounting standpoint, income earned by one sector for performing a service is income given up as expenditures by another sector to acquire the service. The principle is essentially the same as that involved in the exchange of services between individuals, firms, or households, but in this case the exchanges are aggregated over large sectors of the economy. The exchange may be recorded by a system similar to double entry bookkeeping which shows for each sector of the economy purchases from and sales to each of the other sectors during a stated period of time. The concept is similar in idea to the income and product accounts published by the United States Department of Commerce. This type of data is basic in developing input-output coefficients in interindustry studies. Fox and Norcross (*51*) present such data and discuss the problems involved in developing them for nine commodity groups in agriculture. They also discuss how such data can be used to advantage in economic analyses without a formal input-output study and still be consistent conceptually with the input-output idea. Data that pertain to the dairy industry, adapted to a considerable degree from tables 1 to 5 in their article, are given in table 1.

These data reveal several advantages that accrue from use of accounting technique to analyze flows of receipts and expenditures. The accounting method requires that all flows be accounted for within the scope of the analytical detail desired. For example, in column 1 of table 1 an attempt is made to account for the total outlay on dairy

TABLE 1.—*Dairy products: Marketing charges, farm income, and farm production expenditures, by selected items, 1947*

Item	Value			
	Total	As a percentage of the value of—		
		Dairy products		All agricultural products
		Between categories	Within categories	
	Billion dollars	*Percent*	*Percent*	*Percent*
Retail value	6.30	100	----	18
Marketing charges:				
Trade	1.73	----	67	20
Transportation, inter-city	.10	----	4	5
Processing	.76	----	29	14
Total	2.59	41	100	16
Equivalent farm value	3.70	59	----	20
Cash receipts from farm marketings:				
Sales for use by—				
Domestic civilians	3.80	----	93.8	20.8
Armed Forces	.06	----	1.5	12.0
Nonfood products and byproducts for domestic use	.01	----	.3	.2
Exports and shipments	.18	----	4.4	6.3
Total	4.05	----	100.0	13.6
Gross farm income:				
Cash receipts from farm marketings	4.05	----	79.7	13.6
Farm home consumption	.79	----	15.6	25.5
Rental value of farm dwellings	.24	----	4.7	20.3
Total	5.08	100	100.0	14.9
Production expenditures:				
Purchased feed	1.00	----	32.8	27.1
Hired labor	.49	----	16.1	17.2
Operation of motor vehicles	.24	----	7.9	15.3
Miscellaneous goods and services	.35	----	11.4	8.9
Taxes, interest, and net rent	.40	----	13.1	15.5
Depreciation	.57	----	18.7	21.8
Total	3.05	60	100.0	17.7
Realized net income of farm operator	2.03	40	----	12.1

Adapted from Fox and Norcross (*51*, tables 1—5).

products by (1) the source of these outlays and (2) their distribution as marketing charges in the marketing sector and as production expenditures in the farm sector of the dairy industry. These breakdowns help to identify all the sectors which affect or are affected by the dairy industry. It would be desirable if some of these breakdowns, especially for the marketing sector, could be in more detail; unfortunately, data are not available.

Income flow in some instances can be used to determine the importance of each sector and particularly the relative contribution of each to the total economy. Table 1 was designed to show how important each sector associated with dairying is to the economic structure of (1) the dairy industry and (2) the total agricultural sector of the economy. These two aspects are discussed interchangeably.

In 1947, the money outlay on dairy products was approximately 18 percent of the outlay on all domestically-produced foods. About two-fifths of this ended up as payment for marketing services and the rest was passed on as cash receipts to milk producers. A more detailed distribution of income payments in the marketing sector is available for 1939. Of the total income flow in that year into the dairy marketing sector, 51 percent went to retailing, 9 percent to wholesaling, 26 percent to processing, 12 percent to assembly, and 2 percent to transportation.[3] The low figure for transportation reflects the fact that fluid milk tends to be produced near large urban centers, and costs of transportation for manufactured products from the more distant midwestern areas are low in relation to value because of the high density of the products.

In tracing the income stream to the farm sector, we find that the contribution of dairying to agriculture becomes relatively more important when consumption of farm-produced food is included in the income from dairying. This suggests that dairying results in more products that become part of the home diet than do other farm enterprises taken as a group.

In 1947, about three-fifths of income to dairying became a cash outlay as production expenses. Production expenditures in dairying represented about 18 percent of the total in agriculture as compared to 15 percent of the total gross income in agriculture going to dairy farmers. This comparison suggests that dairy farmers incur more cash costs relative to gross income than other farmers, taken as a group. To this extent, their income is more sensitive to changes in relative costs and prices. This would be true to a greater degree for highly commercialized dairy farms in some areas than for those that grow their own feed. For dairy farms taken as a group, purchased feed is the major cost item, representing about a third of total expenditures. Hired labor and depreciation also are significant cost items. The relative importance of the various factors, as indicated by the income accounting approach, can be used to trace out the incidence of a change in any one of them on the dairy sector. For example, the impact of a rise in fuel costs on incomes of dairy farmers would be considerably less than a similar rise in feed costs.

Another way in which the data in table 1 may be used is to indicate the extent to which decisions made within the dairy sector may affect

[3] Adapted from data in Been (5, p. 17).

prices or availability of resources originating in other sectors. In using table 1 in this way, however, allowance must be made for the extent to which agriculture as a whole contributes to total expenditures of a given item in the total economy. For example, the amount spent by the dairy industry for operation of motor vehicles would have no significant effect on prices of gasoline and motor oil even though it represents 15 percent of the total for agriculture.

Consumer Income as a Major Economic Influence

A readily available series for use in explaining major changes in commodity flow over time is disposable income of consumers. Income flow affects every sector of the economy and it can be looked upon as a manifestation of the level of economic activity in the whole economy. Changes in real income [4] reflect changes in productivity or the state of economic progress in the entire economy; changes in money income per person reflect not only changes in productivity but also changes in the value of money arising from inflationary or deflationary trends. In advancing economies, productivity per man has risen on the average by about 2 percent per year. Under such circumstances, real income tends to increase steadily. Changes in real income affect the spending pattern of consumers. For dairy products, as for most commodities, an increase in real income means that more dairy products will be consumed with any given level of prices. In technical terms, it means a shift of the demand curve to the right. But it does not follow that people will increase their purchases of all commodities proportionately. Normally, changes in income cause changes in the spending pattern. These changing patterns, in turn, affect the relative flow of commodities, and, thereby, the relative contribution of each sector of the economy to national income. This affects the demand for resources by each sector in relation to the demands by other sectors.

Budget studies indicate that families with large incomes tend to spend proportionately less on dairy products, as for most foods, than do families with smaller incomes. This suggests that as real income increases over time the quantity of dairy products consumed probably does not increase proportionately. Figure 2 relates disposable income in 1935–39 dollars to domestic consumption of all dairy products, including and excluding the milk equivalent of butter. These data show a definite relationship between major changes in income and the quantity flow of dairy products if butter is excluded. This does not mean that consumption of butter is unaffected by changes in income. The lack of an observed relationship stems from the substitution effect of margarine. Figure 2 tends to overstate the income effect during the World War II period because it does not take into account wartime restriction and the lack of availability of other consumer goods. During a period of relative income stability or one including a period of low income, the substitution effects arising

[4] "Real income" is a term used by economists to represent income for some fixed level of prices. It is computed by dividing money income by an index of all prices. The consumer price index of the United States Bureau of Labor Statistics is frequently used for this purpose.

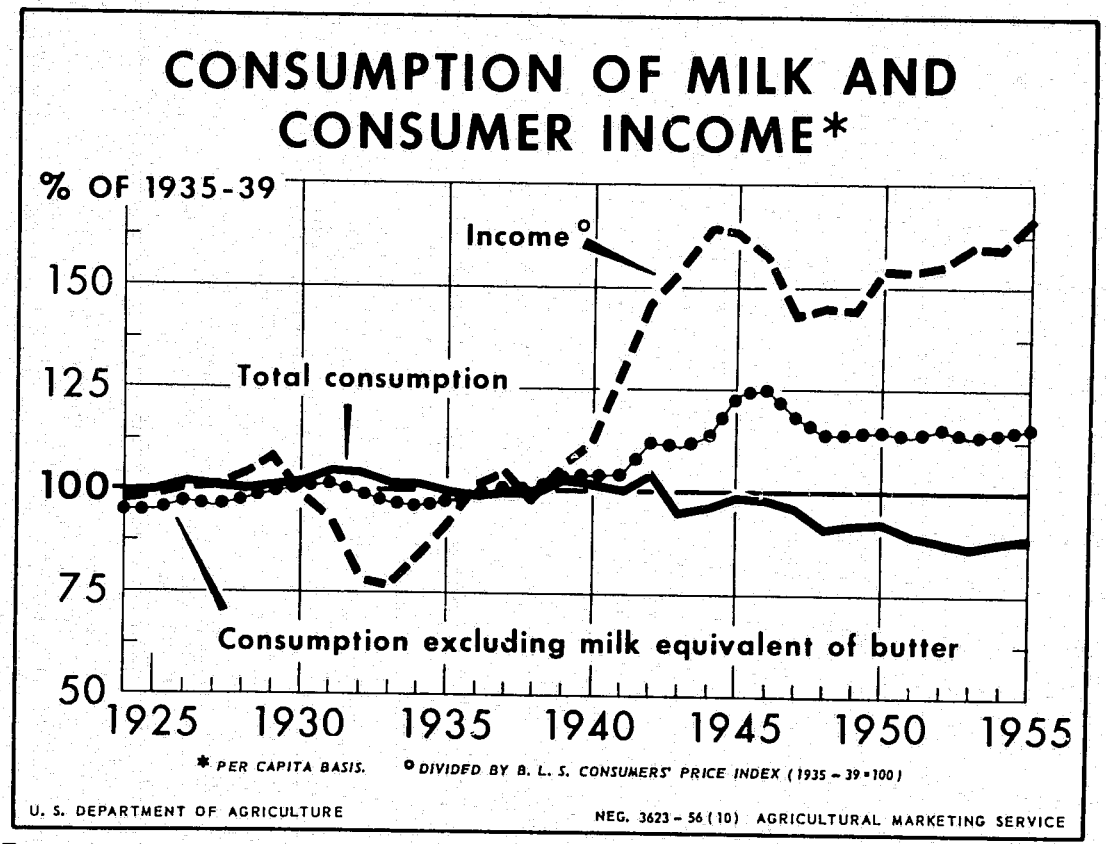

FIGURE 2.—Consumption of dairy products (milk equivalent), excluding the milk equivalent of butter, tends to increase as real income increases, but the proportionate increase in consumption is considerably less than that for income. The substitution effect of margarine on the consumption of butter obscures the income effect in a simple, time-series quantity-income relationship of this sort.

from price changes would perhaps tend to obscure the simple quantity-income relationship.

Figure 2 suggests that there may be a lag in the adjustment of quantity to changes in income. It is reasonable to expect that consumption may not only be affected by year-to-year changes in income but also by the level of past income. Consumption habits attained under a previous level of income probably tend to be continued at least for a time.

Results from certain statistical analyses designed to quantify the income-quantity relationships suggested by figure 2 are given in table 2. Two periods were used: 1924–41 and 1934–52. The period between World Wars I and II has been used by many analysts as the most recent one which was sufficiently long and yet fairly free of external disturbances. Changes in income during 1934–52 were substantially greater than during 1924–41. The 1934–52 period, furthermore, was a period of generally increasing or relatively high real incomes. Thus it is particularly useful for testing hypotheses regarding relationships between consumption and increases in income. The milk equivalent of butter was excluded from the total for these analyses because the consumption of butter has been affected materially by the substitution effect of margarine. An additional aspect of these analyses that should be mentioned is that the supply of milk available in one outlet is affected by the quantity of milk used in other outlets. Analyses of this type do not take into account this interdependence. Equations which allow for this interdependence are presented later.

One striking observation gained from the results given in table 2 is that the analyses for the period 1934–52 show a greater degree of association than the analyses for 1924–41, especially for the simple relationships. The simple income-quantity relationships for 1924–41 are not statistically significant. They do not become significant until the effect of price and time is eliminated. On the other hand, the degree of association between consumption and income was high even in the simple relationships for the period 1934–52. Apparently, when the changes in level of real income are substantial, as they were in the period 1934–52, income effects tend to overshadow the effects of price. On the other hand, the coincidence of high incomes, lack of durable goods, and availability of milk products other than butter during some of the period, combined with the correlated upward trends for income, population, and consumption during these years, may tend to result in spuriously close income-quantity relationships. The importance of these trend factors is shown by the much lower coefficients of determination obtained for 1934–52 when the analyses are based on first differences. Similar differences are not evident for the analyses based on data for 1924–41.

The income coefficients become statistically significant if price is added to the 1924–41 analyses. On the other hand, price appears to have no significant effect on the 1934–52 analyses. This tends to substantiate that income was the dominant force during this period. The inclusion of time in the 1924–41 analyses markedly improves the relationship but reduces the effect of year-to-year changes in income to a statistically nonsignificant level. It also significantly reduces the price effect. When time was included in the 1934–52 analyses, the

TABLE 2.—*Dairy products excluding butter: Selected relationships between disposable income, in constant dollars, and consumption*

Analysis	Coefficient of determination	Standard error of estimate	Constant term	Effect on consumption of 1-percent change in—							
				Income [1]		Income in preceding year [1]		Price [1]		Time	
				Net effect [2]	Standard error	Net effect [2]	Standard error	Net effect [2]	Standard error	Net effect [2]	Standard error
				Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Based on 1924–41:											
Using actual data:											
1st analysis [3]	0.08	0.016	2.43	0.08	0.07						
Do	.09	.015	2.38			0.10	0.08				
Do	.57	.011	3.23	.40	.09			−0.82	0.20		
Do	.26	.015	2.75			.21	.10	−.33	.18		
2d analysis [3]	.10	.016	2.37	[4].04	.12	.11	.09				
Do	.57	.012	3.21	[4].38	.12	.40	.10	−.82	.21		
Do	.94	.004	2.60	[4].07	.06	.21	.04	−.28	.10	0.04	0.00
Using first differences [5]	.09	.006	.00	.05	.04						
Do	.42	.005	.00	.20	.06			−.33	.12		
Based on 1934–52:											
Using actual data:											
1st analysis [3]	.84	.011	1.85	.30	.03						
Do	.90	.010	1.91			.28	.02				
Do	.86	.003	1.56	.26	.05			.21	.17		
Do	.90	.013	1.85			.27	.04	.05	.15		
2d analysis [3]	.90	.011	1.92	[4]−.01	.10	.28	.03				
Do	.90	.011	1.85	[4]−.01	.11	.27	.04	.05	.16		
Do	.92	.010	1.57	[4].02	.10	.36	.08	.07	.15	−.03	.02
Using first differences [5]	.19	.013	.00	.22	.11						
Do	.19	.013	.00	.22	.12			.00	.17		

[1] Income and price divided by Bureau of Labor Statistics index of consumer prices.
[2] Regression coefficients can be used as percentages without significant bias.
[3] Coefficients are based on relations in logarithms.
[4] Net effect of change in income from preceding year.
[5] Coefficients are based on relations that involve first differences of logarithms.

income coefficient relating to the effect of level of income on consumption was improved, but not by a statistically significant amount.

Some analyses were run to measure separately the effect on consumption, C_t, in period t of the level of past income, Y_{t-1}, and of the change in income from the previous level, $Y_t - Y_{t-1}$. This relationship can be expressed as

$$C_t = a + b(Y_t - Y_{t-1}) + BY_{t-1}$$

Results of these analyses suggest differences for the two periods. Apparently, the effects of year-to-year changes in income on consumption were greater in the period 1924–41 than the effects of changes in the level of income for the previous year. But when both year-to-year changes and previous income are included in the 1934–52 analysis, only the effects of changes in level of previous income appear significant.

When the analyses are run in logarithms, all of the regression coefficients between consumption and income are less than unity, and most of them are positive. This confirms the hypothesis advanced earlier that consumption of dairy products tends to increase as real income increases, but that the proportionate increase in consumption is considerably less than that for income. The coefficients on the average suggest that consumption increases by about a third as much as does real income.

TRENDS IN ECONOMIC FLOWS AND PRICES OF DAIRY PRODUCTS

Basic Factors That Affect Long-time Trends

Trends in production, consumption, and prices of dairy products reflect changes in the economic structure of the dairy industry and the total economy. These changes in the long run result from changes in technology, either in the production of dairy products or in the production of other goods and services, or both, and from changes in tastes and preferences of consumers who purchase dairy products and other goods and services.

Changes in tastes and preferences, and in technology, need not be related but probably frequently are. An example is the increased consumption of cheese during the last two decades. After remaining relatively stable at 4.5 pounds per capita from the early 1920's to the early 1930's, consumption of cheese increased to 6.8 pounds in 1947 and to 8.0 pounds in 1956. During the years when consumption was increasing rapidly, revolutionary changes were taking place in methods of processing and marketing cheese. Some have suggested that this increase is associated with the rising importance of processed cheese, cheese spreads, and cheese foods. Nicholls (*94*, p. 139) states that the first important patent on processed cheese was granted to J. L. Kraft on June 6, 1916. Based on data from Census of Manufactures (*156*), production of processed cheese, cheese foods, and cheese spreads comprised about one-half of the total production of cheese in 1954 compared with one-half in 1947, one-third in 1931 and 1935, and only one-tenth as late as 1929. It is of interest to note that Hobson and Schaar (*69*, p. 21, table XI), in a consumer preference study in six

cities in 1932, found that 66 percent of the people preferred processed American cheese to natural mild American cheese. It appears that most of the increase in the consumption of cheese has been of the processed types. It has also been suggested that the increase in consumption of cheese resulted in part from better merchandising and packaging of processed cheese, especially that of offering a wider selection of cheeses to the consumer and a more standardized product. There is some evidence that the trade now is using similar merchandising practices for natural cheese. Based on available consumer panel data,[5] household purchases of natural cheese as a percentage of total cheese increased about 5 percentage points from 1954 to 1955.

Another illustration of sharp changes in consumer preferences over time is the acceptance of margarine as a substitute for butter by a large number of consumers in the last decade. Because of supply shortages, civilian consumption of butter was held down during 1943–46 by a rationing program. Supplies of vegetable oils permitted people to substitute margarine and other spreads for butter. This substitution occurred while the relationship between prices of margarine and butter remained essentially the same as in pre-World War II period. Fox (*50*, p. 76) suggests that "Under point rationing, consumption of butter by middle-and-high-income groups was probably reduced more than consumption by lower income groups. Consequently, persons who had been little influenced by relative prices of butter and margarine were driven by point values and the physical shortage of butter to try margarine."

However, consumers did not shift back to the higher-priced fat as butter became more available in the postwar period. This indicates a change in the tastes and preferences of some former butter consumers. According to Fox (*50*, p. 77), "Major elements involved were: (1) A preferred commodity whose supply was forcibly curtailed; (2) a substitute previously regarded as inferior which could move into the vacuum and which many consumers accepted as an adequate replacement; and (3) a basic price advantage in favor of the substitute product, which in the aggregate offset any tendency of consumers to return to the preferred commodity. The relation between butter and margarine in the last two respects was almost unique among food products. The difference in taste was not as much as between, say, competing meats, fruits or vegetables, and the retail price of butter averaged 2.2 times that of margarine." The net result was a reduction in consumption of butter from 16.1 pounds per person annually in 1940–42 to 10.5 pounds annually in 1947–49. A further shift in the demand for butter occurred when the price of margarine became more favorable to consumers in relation to the price of butter. In 1935–49 the butter-margarine price ratio was 2.2 as compared to 2.8 for 1952–53. In only 1935, 1941, and 1946 during the 1935–49 period did prices deviate by more than 10 percent from the 2.2 average ratio.

Following World War II, a shift in the supply curve for margarine occurred. This resulted mainly from the shift on the part of this country from a net import basis for edible fats and oils, other than

[5] For the period April 1954 through March 1956 the Agricultural Marketing Service obtained data on household purchases of cheese monthly based on a consumer panel of the Market Research Corporation of America.

butter, to a net export basis, chiefly reflecting a sharp expansion in production, particularly for soybeans. A further factor that encouraged increased consumption of margarine was the elimination of restrictions on its sale in many States and the dropping of the Federal tax of 10 cents per pound on colored margarine effective July 1950. Consumption of margarine increased from an annual rate of 5.5 pounds per person in 1947–49 to 7.8 pounds for 1952–53. In 1940–42 the annual rate averaged 2.6 pounds per person. In the meantime, consumption of butter dropped from an annual rate of 10.5 pounds per person in 1947–49 to 8.4 pounds for 1952–53.

When rationing and price controls were eliminated in 1946, per capita consumption of butter increased only slightly. The combined consumption of butter and margarine in the post-World War II period continued below the prewar consumption level. Fox (*50*, p. 76) suggests that the down trend in their combined consumption was associated with the down trend in the consumption of bread and other complementary foods. He states, "Per capita consumption of butter plus margarine during 1947–50 was about 16 percent lower than in 1935–39. Consumption of wheat flour per capita was down almost 15 percent, and consumption of potatoes, sweetpotatoes, and cornmeal was down by even larger percentages. Hence the ratio of consumption of butter plus margarine to that of the principal complementary foods was nearly the same in both periods."

Turning to the supply side, table 3 shows some of the physical factors that affect production of milk. The behavior of the two physical components of milk production—number of cows and milk production per cow—are of interest.

Adverse economic conditions in the 1930's depressed milk production per cow below the level that it would have been under normal conditions. Because of unfavorable milk-feed price relationships, farmers apparently restricted rate of concentrate feeding. In addition, with the relatively low carcass value and with milk providing a source of cash, the culling rate was low and many of the poorer producers were kept in herds. The drought in 1934 and 1936 also affected milk production per cow. Except for this period, the rate of production per cow has increased steadily and at a faster rate than the flow of total milk. The high rate of production per cow has been made possible through improved feeding and breeding. Since the 1930's, quantities of grain and concentrates fed per cow have increased considerably (table 3). The feeding of concentrates currently is close to 70 percent above that in the 1935–39 period. Likewise, better management practices in the handling of roughages and improvements in the quality of roughage have tended to improve milk production per cow. These practices include production of improved roughages for off-pasture use and better and longer pasture seasons through different varieties of plants and the applications of more fertilizer. In addition, improved breeding and culling, and the increased use of artificial insemination have resulted in higher producing cows. The number of cows enrolled in artificial breeding programs increased from zero prior to 1939 to about 25 percent of the total milk cows in 1955. This upward trend will most probably continue. Higher culling rates also tend to minimize the number of low producers in the milking herd.

TABLE 3.—*Milk production per cow, milk cows on farms, and related factors, 1920–57*

Year	Index numbers (1935–39=100)		Per 100 cows			Cows bred under artificial breeding program [3]	Condition of dairy pastures [4]	Grain and concentrates fed per milk cow per day [5]
	Production of milk per cow	Milk cows 2 years old and over [1]	Heifers kept for milk cows [1]		Cows and heifers eliminated during year [2]			
			Under 1 year	1–2 years old				
Averages:			*Number*	*Number*	*Number*	*Thousands*		*Pounds*
1920–24	----------	87	19.8	19.1	18.1	----------	83.3	----------
1925–29	101	90	20.3	18.8	18.4	----------	79.7	----------
1930–34	98	100	21.7	20.4	17.9	----------	65.0	[6] 3.99
1935–39 [7]	100	100	22.0	19.7	20.5	[8] 5	73.4	4.03
1940	105	100	23.9	22.2	20.1	34	77.2	4.59
1941	108	102	24.6	22.3	18.9	71	76.8	4.92
1942	108	105	25.2	22.4	19.2	113	87.8	5.18
1943	104	109	25.9	22.4	20.3	183	81.4	5.50
1944	104	111	26.0	22.9	22.7	218	78.0	5.51
1945	109	111	24.4	22.7	27.2	361	87.3	5.82
1946	111	106	23.6	21.7	24.3	579	81.0	5.67
1947	114	103	24.4	21.4	26.1	1,184	82.9	5.71
1948	115	98	24.4	22.5	25.6	1,714	79.7	5.72
1949	120	95	25.5	22.3	22.4	2,091	80.6	6.21
1950	121	95	26.0	22.6	23.8	2,620	82.9	6.17
1951	121	94	26.9	23.3	25.5	3,510	85.9	6.18
1952	122	92	28.1	24.7	22.6	4,295	79.7	6.26
1953	126	94	27.5	25.0	23.6	4,845	75.4	6.42
1954	128	96	26.7	24.6	26.4	5,155	75.0	6.38

1955	132	94	26.1	24.7	25.7	5,414	76.5	6.49
1956	[9] 136	93	26.0	23.6	24.4	5,763	75.1	6.77
1957 [9]		92	26.2	23.4				

[1] Milk cattle on farms, January 1.

[2] Cows and heifers 1 year old and over at beginning of year less cows 2 years old and over at end of year. Includes mainly animals culled out, death losses, and farm slaughter.

[3] Prior to 1947, data represent cows enrolled on January 1. Beginning 1949, includes small numbers bred in Alaska, Hawaii, and Puerto Rico.

[4] Weighted average for season. 1924–55, April 1 through October 1; prior to 1924, May 1 through October 1.

[5] Based on periodic replies from a total of about 6,000 dairy reporters to the question, "How many pounds of grain (including mill feeds and concentrates) were fed yesterday to all milk cows on your farm?" The series is based on quarterly reports (February 1, May 1, August 1, and November 1) from all States, with intervening months interpolated using monthly reports from about a dozen States where dairying is relatively important.

[6] Average for 1931–34.

[7] Averages of actual data for 1935–39 are: Production of milk per cow 4,403 pounds; milk cows 2 years old and over, 24,999 thousand; heifers kept for milk cows under 1 year old, 5,495 thousand and 1–2 years old, 4,919 thousand; cows and heifers eliminated during year, 5,148 thousand.

[8] Year 1939 only.

[9] Preliminary.

The trend in the number of cows kept for milk increased until the mid–1940's. A peak was reported on January 1, 1945. The number then declined until about 1949 and remained about stable during 1949–52, though still declining somewhat. Major factors contributing to this downturn were (1) high labor costs (table 10) because of relatively favorable employment opportunities to farm workers in nonfarm businesses, and because dairy farming is a heavy user of labor, and (2) relatively high cash receipts from less confining alternative farm enterprises such as the beef cattle enterprise. Alternative farming opportunities, notably beef cattle, became less favorable compared with dairying after mid-1952, which stimulated an increase in milk cow numbers. Subsequently, however, with less favorable price relationships and other developments, milk cow numbers as late as 1956 did not differ greatly from the 1949–52 level.

In addition to the usual price relationships discussed above, the number of cows also has been influenced to an increasing extent in recent years by technological changes in dairy farming. Technological changes are influencing cow numbers in both directions. On the one hand, they are tending to increase the number by enabling individual farmers to keep more cows; in fact, to take advantage of the technological gains, a larger herd must be kept in most cases. On the other hand, adoption of new methods usually entails substantial capital investments, causing some dairymen to discontinue dairying rather than to embark on a capital expansion program. This exodus is encouraged by favorable off-farm opportunities in some areas. Based on data from the Agricultural Census (*157*), the number of farms with milk cows declined 20 percent from April 1950 to November 1954. In the same period, the decline in milk cows, reflecting price relationships as well, was only 5 percent.

The decrease in number of milk cows has occurred at the same time that production per cow has been increasing. Since 1952, the rate of increase in output per cow has been enough to raise total production of milk to new record high levels.

Trends in Income Flows

Time series data of money flows provide useful insights into changing relationships between the dairy industry and the rest of the economy. Such changing relationships may provide insights into changes taking place in the economic structure of the dairy industry itself—insights that would not be as readily observed from changes in quantity flows or price data, the two components of income flow.

The major income flows that affect the dairy industry are (1) expenditures on dairy products at the retail level, (2) marketing charges by dairy processing and marketing firms, (3) cash receipts or gross income received by dairy farmers, and (4) cash expenses or money outlays by farmers for labor and other items used in the production of milk. The behavior of these major flows over time in relation to total flows in agriculture are shown in tables 4 and 5. These data are not strictly comparable in an accounting sense but, when studied in relation to other flows which are comparable in their own area, they give a reasonable picture of changes that are occurring.

The data in table 4 show that the relative contribution of dairying to total values for all farm foods—both at the retail and the farm

TABLE 4.—*Dairy and meat products and all farm foods: Relations between farm value, marketing charges, and retail costs, 1915–56*

Year	Value as a percentage of that for all farm foods						Farm value as a percentage of retail costs		
	Farm value		Marketing charges		Retail expenditures				
	Dairy products	Meat products	Dairy products	Meat products	Dairy products	Meat products	Dairy products	Meat products	All farm foods
Averages:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
1915–19	17	34	13	20	15	27	55	62	49
1920–24	22	29	14	25	18	27	52	45	41
1925–29	23	31	16	23	19	26	53	49	42
1930–34	26	28	16	24	20	26	47	38	35
1935–39	25	32	17	23	20	27	50	47	40
1940–44	23	33	18	18	20	25	52	62	47
1945	21	29	18	14	20	20	54	74	52
1946	22	33	18	15	20	24	56	71	51
1947	20	40	16	20	18	30	56	67	51
1948	21	40	17	20	19	30	55	66	49
1949	20	39	16	20	18	28	51	62	45
1950	20	42	16	19	18	30	51	64	46
1951	20	40	16	19	18	29	52	65	47
1952	21	38	16	20	18	28	52	62	45
1953	21	38	16	20	18	28	49	59	43
1954	20	39	17	20	18	28	46	58	41
1955	21	33	17	20	19	25	46	54	41
1956 [1]	22	32	17	19	19	24	46	52	40

[1] Preliminary.

Based on data from Been (*5*) and Marketing and Transportation Situation (*155*).

level—gradually increased until the early 1940's, if some of the years in the early 1930's are excluded. The peak at the retail level occurred in 1940. Although the trend at the farm level rose on the average until the early 1940's, the peak occurred in 1932. Since the early 1940's, the relative contribution of dairying has tended to decline; the greatest percentage decrease occurred at the farm level. The drop at both farm and retail levels resulted from the decline in the consumption of butter.

The larger drop at the farm level resulted from an increased proportion of income flow into marketing. The relative percentage for dairy marketing services in the early 1950's remained essentially at the prewar (1935–39) level. But dairy marketing costs increased relative to marketing costs of other farm foods, while total volume of dairy products handled declined (table 6). The increase in marketing costs reflects, at least in part, the increased importance of fluid milk, for which marketing charges are relatively large. It also reflects the decreased importance of butter, for which marketing charges are relatively small.

The relative contribution of dairying to agriculture when measured by the relation of cash receipts from the sale of dairy products to total cash receipts from farm marketings tended to increase from 1910 to about 1932, but it has declined since 1932 (table 5). The pattern of gross income from dairying in relation to total gross income from farming followed a similar course, except that the percentages were slightly greater than those for cash receipts, as the dairy enterprise produces slightly more food for home use on the average than do other farm enterprises.

Data shown in table 5 for dairy products do not include marketings of meat animals from milking herds; therefore, the percentages tend to underestimate the true relative position of dairying. For the years 1947, 1949, and 1951–53, cash receipts from the slaughter or sale of animals for slaughter from milking herds averaged $1.7 billion. This equaled about 30 percent of the cash receipts from the sale of dairy products. In reports of the Agricultural Marketing Service, these figures appear as income from the sale of meat animals. Time series data for determining the total income from dairying, including receipts from sale of meat animals, are not available. However, an inspection of the culling rate and the carcass value of milk cows gives an indication of the probable effect that this additional income had on the relative position of dairying in relation to total agriculture (tables 3 and 10). For example, a low culling rate in 1932, accompanied by a low carcass value in relation to a high culling rate and high carcass value in 1951, suggests that the relative income flow was overestimated in 1932, and underestimated in 1951. In the early 1930's only about 16 cows and heifers were eliminated per hundred cows as compared to a range of 22–27 for the period 1945–52. The relatively low carcass value in the 1930's in relation to the price of milk made it profitable to hold cows longer and to keep poorer producers. With a very high carcass value in relation to the price of milk in some of the postwar years, farmers were encouraged to cull heavily, since the sale of milk cows for beef gave a substantial addition to income. The relatively low carcass value since 1952 probably has tended to discourage culling.

TABLE 5.—*Dairy products, meat animals, and all livestock and livestock products: Relations between cash and gross income, 1910–56* [1]

Year	Dairy products		Income as a percentage of that from total farm marketings						Net income from agriculture as a percentage of total national income [3]
			Cash receipts			Gross income			
	Cash receipts	Gross income	Dairy products	Meat animals [2]	Livestock and livestock products	Dairy products	Meat animals [2]	Livestock and livestock products	
	Million dollars	*Million dollars*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Averages:									
1910–14	628	960	11	28	50	13	27	52	15
1915–19	1,050	1,524	10	29	48	12	28	51	17
1920–24	1,346	1,830	14	24	48	16	23	50	11
1925–29	1,672	2,171	15	26	53	17	25	55	10
1930–34	1,204	1,556	19	25	55	20	23	56	8
1935–39	1,409	1,787	17	27	55	18	25	56	10
1940–44	2,290	2,755	15	28	55	16	27	56	9
1945	3,021	3,575	13	26	54	14	26	54	10
1946	3,709	4,393	15	28	54	16	27	55	11
1947	4,013	4,738	13	31	55	15	31	56	11
1948	4,389	5,155	14	31	56	16	30	57	11
1949	3,748	4,370	13	30	55	14	29	56	8
1950	3,719	4,312	13	32	56	14	32	57	8
1951	4,250	4,969	13	34	59	14	33	60	8
1952	4,567	5,274	14	31	56	15	30	56	7
1953	4,366	4,966	14	28	55	15	28	55	6
1954	4,114	4,632	14	30	54	15	29	55	6
1955	4,212	4,716	14	28	54	15	27	54	5
1956 [4]	4,469	4,966	15	27	53	15			

[1] Includes Government payments for total cash receipts, 1933–55; dairy products, 1943–46; and meat animals, 1945–46.

[2] Includes cattle and calves, hogs, sheep and lambs.

[3] The series on national income is the sum of the Agricultural Marketing Service estimates of agricultural and nonagricultural income, which was constructed to meet legislative specifications for measuring income parity for agriculture. These series differ conceptually in several respects from those published by the United States Department of Commerce.

[4] Preliminary.

Trends in Production and Consumption

In 1931–33, price and production of milk in relation to that for other agricultural products were high. If these years are excluded, income from dairying in relation to total income from agriculture increased steadily to a peak of 19 percent in 1940 and then began a gradual decline. The decline can be associated to a large extent with the drop in the quantity of milk going into the manufacture of butter. Excluding the quantity of milk used in butter, production and utilization of milk have kept pace with the volume of total agricultural production (table 6). The simple coefficient of correlation between the 2 series for the period 1932–52, excluding the war years 1945 and 1946, was 0.99. In terms of relative changes, the statistical relationship suggests that a 1-percent change in dairy production, excluding butter, has been associated with a 1-percent change in volume of production of all agricultural products.[6] In this period, from the low in the mid-1930's to recent years, average retail prices of dairy products, whether butter is included or excluded, increased less than prices of all foods, but more than prices of all goods and services bought by consumers. It can be inferred that if cash receipts were available for that portion of milk used in all products except butter, the gradual upward trend in relative receipts would have continued into the 1940's.

The decline in the consumption of butter has been part of revolutionary changes in the dairy industry. Since the late 1930's, two opposing trends have developed: (1) An uptrend in the consumption of solids-not-fat, and (2) a downturn in the consumption of milk fat per person (table 6). The decline in the use of milk fat has resulted from (1) a reduction in fat content of some dairy products and (2) a replacement of milk fat by vegetable fat in other products. Evidences of the former are the lower fat content of current sales of fluid milk, sales of some low-fat ice cream, increased sales of processed and cottage cheese, and smaller sales of fluid cream, particularly whipping cream. Evidences of the latter include (1) the drop in the use of milk fat in butter, which resulted in part from the general reduction in consumption of fat-type table spreads, and in part from the substitution for butter of margarine and other lower-priced spreads, and (2) the replacement of milk fat by vegetable fats in products that are referred to technically as "filled dairy products" but sell at retail under brand names in a form that permits them to compete directly with the dairy product they resemble, such as ice cream or evaporated milk. The net result is that the consumption per capita of milk fat in 1954–56 averaged 27 pounds compared to 30 pounds or more for every year prior to 1948.

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[6] The statistical relationship is:

$$X_1 = -2.27 + 1.03X_2$$

where:

X_1 = Milk production on farms less milk fed to calves and used in making butter (index numbers, 1935–39 = 100).

X_2 = Total volume of agricultural production (index numbers, 1935–39 = 100).

TABLE 6.—*Milk production and consumption: Fat solids and solids-not-fat and related factors, 1925–56*

Year	Production				Whole milk delivered by farmers as a percentage of total delivered to plants and dealers [3]	Percentage of total output utilized for human use		Civilian disappearance of milk solids [1]		
	All agricultural products [1] [2]	Milk								
		Whole milk equivalent excluding— [1]		Total milk solids		Fat solids	Solids-not-fat	Total	Solids-not-fat	Total less butter
		Fed to calves	Fed to calves and use in butter							
				Million pounds	*Percent*	*Percent*	*Percent*			
Averages:										
1925–29	100	93	89	12, 737	47	97	51	90	88	88
1930–34	98	99	96	13, 603	49	97	51	96	93	94
1935–39 [4]	100	100	100	13, 718	56	97	54	100	100	100
1940	110	105	108	14, 462	59	97	55	105	106	106
1941	112	111	116	15, 188	61	97	56	106	107	108
1942	123	114	126	15, 618	66	97	61	111	114	115
1943	129	112	126	15, 378	67	97	63	106	116	115
1944	136	111	133	15, 332	71	97	67	107	116	116
1945	136	114	141	15, 653	74	97	69	113	124	125
1946	133	112	145	15, 400	77	97	71	123	136	137
1947	137	111	139	15, 321	77	97	70	122	133	134
1948	133	107	136	14, 748	78	97	71	118	131	131
1949	141	110	136	15, 161	79	97	72	121	133	133
1950	136	111	137	15, 203	79	97	72	124	137	136
1951	138	108	140	14, 895	80	97	72	123	138	137
1952	142	108	142	14, 848	82	97	75	126	144	141
1953	148	114	144	15, 514	84	97	76	126	144	141
1954	148	115	147	15, 731	85	97	73	130	150	146
1955	153	116	151	15, 837	86	97	79	134	155	151
1956 [5]	158	119	155	16, 137	87	97	80	137	158	154

[1] Index numbers, 1935–39=100.

[2] For sale and home consumption.

[3] Total includes total milk and cream marketings less milk and cream retailed by farmers.

[4] Averages of actual data for 1935–39 are: Milk production on farms excluding fed to calves, 103,130 million pounds; milk production on farms excluding fed to calves and use in butter, 59,106 million pounds; total milk solids, 9,262 million pounds; and total milk solids less butter, 7,473 million pounds.

[5] Preliminary.

On the other hand, consumption of milk solids-not-fat has been increasing steadily over the past 3 decades and is now about 49 pounds per person as compared to about 37 pounds in the 1920's. Even with this increase, the Nation is now using only about 80 percent of the total milk solids-not-fat produced for human food, but this is much higher than the 50 percent used 3 decades ago. The increase in consumption of milk solids-not-fat has come about by (1) the relatively greater use of dairy products containing both solids-not-fat and the fat portion of milk, and (2) the introduction of new or increased uses for nonfat products both for manufacturing and for household cooking (tables 7 and 8). For example, per capita disappearance of cheese in 1954–56 averaged 40 percent above the 1935–39 level, for fluid milk 16 percent. Also, consumers have only in recent years been able to buy nonfat milk powder in consumer packages.

These upward trends in the consumption of milk solids-not-fat have partially offset the decline in dairy income resulting from the decline in the consumption of milk fat. The offset has come about in two ways: (1) More of the milk has been diverted into higher priced outlets, and (2) farmers have shifted from selling farm-separated cream to selling whole milk. This shift occurred as a result, on the one hand, of increased total demand for solids-not-fat (from commercial and Government sources) and, on the other, of the ready willingness of farmers to sell whole milk (and thereby avoid separating on farms) as soon as a market for skim milk became available in their neighborhood. The volume of whole milk sold by farmers increased each year from 1932 to 1955, except for slight declines in 1948 and 1951 that resulted from substantial drops in total milk production. In the early 1930's, only about half of the milk equivalent delivered to plants and dealers was in the form of whole milk, but this increased to about six-sevenths in the mid-1950's (table 6).[7] This shift has meant greater cash incomes to dairy farmers, because (1) an increasing proportion of the nonfat portion of the milk was sold for cash and (2) in most localities, whole milk commands a higher price than does an equivalent quantity of farm-separated cream.

Total milk flow has been relatively stable, particularly in the decade ending 1952. For the period 1941–52, the maximum variation in total milk production in any given year from the mean value of this period was slightly above 3 percent. The average change from the mean value for the same period, disregarding direction of change, was 1.2 percent. The average year-to-year change for 1924–55 was 1.9 percent. For the 31 years, only in 7 did the year-to-year percentage change exceed 3 percent and only twice did it exceed 4 percent. A record year-to-year change of 5.2 percent occurred in 1941, compared with a near record of 4.8 percent in 1953.

Trends in Prices

Income flow into the dairy industry is affected by changes in prices as well as by changes in the volume of dairy products sold. Trends in retail prices of dairy products, in relation to those of competing products, and to prices in general, can be observed from data in table 9.

[7] A discussion of the factors that helped to bring about this change during World War II is given in Foote (*45*).

TABLE 7.—*Civilian consumption of dairy products per person, milk equivalent, 1924–56*

Year	Fluid milk [1]	Fluid cream [1]	Butter	All cheese	Evaporated and condensed milk	Ice cream	Total milk [2]
Averages:	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
1925–29	270	68	358	46	26	24	798
1935–39	264	66	337	55	36	25	791
1924	269	67	356	46	25	21	785
1925	270	67	360	47	25	23	790
1926	270	68	365	46	25	23	807
1927	269	67	365	45	25	24	801
1928	270	67	350	44	26	24	793
1929	272	68	349	47	30	27	800
1930	270	67	349	47	29	24	808
1931	268	67	364	45	29	21	826
1932	271	68	367	44	30	16	820
1933	270	67	361	45	30	15	803
1934	258	64	368	49	32	18	803
1935	261	65	348	52	34	20	790
1936	264	66	333	54	34	24	782
1937	265	66	331	55	36	26	787
1938	263	66	329	58	37	26	785
1939	266	66	344	58	37	27	813
1940	265	66	336	59	41	28	807
1941	267	67	317	58	40	34	791
1942	290	64	313	63	40	39	821
1943	315	56	235	48	40	31	740
1944	328	53	236	48	34	33	753
1945	335	64	216	65	39	37	777
1946	323	66	207	66	40	57	775
1947	306	63	221	68	44	51	758
1948	295	60	197	68	43	45	714
1949	296	56	207	72	42	45	724
1950	293	56	212	75	43	44	731
1951	299	53	189	71	39	44	705
1952	303	49	168	75	38	47	691
1953	300	47	166	73	37	48	682
1954	301	47	174	77	36	47	691
1955	305	47	177	77	34	48	698
1956 [3]	308	47	171	79	33	49	699

[1] Cream estimated at 20 percent of total "fluid milk and cream" consumption prior to 1942; beginning 1942, the proportion has been varied largely on the basis of information obtained for markets having Federal milk marketing orders.

[2] Includes dry whole milk, malted milk, dry ice cream mix, cottage cheese, other minor products, and an adjustment allowance.

[3] Preliminary.

Retail prices for all foods experienced greater swings in prices from the low point of economic activity in the mid-1930's to the current period of relatively high economic activity than did retail prices for all commodities. Agricultural prices usually lead nonagricultural prices in periods of rapid expansion or contraction in economic activity; it is more difficult to adjust agricultural than industrial production to changing economic conditions. The behavior of dairy prices is not

TABLE 8.—*Dairy products: Per capita consumption, 1909–56* [1]

Year	Fluid milk and cream [2]		Condensed whole milk		Evaporated whole milk	Butter	Cheese [4]		Cottage cheese [5]	Skim milk consumed	Cultured buttermilk [6]	Skim milk in chocolate drinks
	Fresh whole milk	Cream [3]	Sweetened	Unsweetened			American	Other				
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
1909	274	11.0	2.3	1.7	1.4	17.5	2.4	1.4	0.6	23.2	1.3	--------
1910	252	10.1	2.4	1.9	1.5	18.1	2.7	1.5	.6	22.9	1.3	--------
1911	241	9.6	2.4	2.2	1.7	18.4	2.5	1.4	.6	22.5	1.3	--------
1912	284	11.4	2.5	2.5	1.9	16.3	2.4	1.4	.7	22.3	1.3	--------
1913	274	10.9	2.6	2.9	2.4	16.2	2.6	1.6	.7	21.9	1.3	--------
1914	257	10.3	2.6	3.3	2.9	16.7	2.6	1.5	.7	21.6	1.3	--------
1915	254	10.2	3.2	2.9	3.3	17.0	2.5	1.6	.7	21.3	1.3	--------
1916	252	10.1	3.5	2.4	3.5	17.1	2.4	1.4	.7	21.1	1.3	--------
1917	262	10.5	3.7	1.8	3.8	15.5	2.4	1.3	.6	20.8	1.3	--------
1918	289	11.6	4.0	1.4	4.7	13.9	2.8	1.1	.6	20.4	1.4	--------
1919	268	10.7	2.7	.7	6.3	15.0	2.8	1.4	.6	19.8	1.4	--------
1920	278	11.1	.7	.7	7.1	14.6	2.8	1.2	.6	20.0	1.4	--------
1921	277	11.1	1.4	.7	7.7	16.0	2.8	1.3	.4	19.7	1.4	0.7
1922	274	10.9	1.9	.6	8.2	16.9	2.8	1.4	.5	19.5	1.4	.7
1923	262	10.5	1.7	.8	8.8	17.6	3.0	1.4	.6	18.9	1.8	.7
1924	269	10.8	1.5	.7	9.4	17.6	3.2	1.3	.8	18.4	1.8	.7
1925	270	10.8	1.5	1.0	9.0	17.8	3.3	1.3	.9	18.2	1.8	.7
1926	270	10.8	1.5	.7	9.5	18.1	3.2	1.4	1.0	17.9	2.2	.7
1927	269	10.8	1.3	.9	9.3	18.0	3.1	1.4	1.0	17.4	2.2	1.1
1928	270	10.8	1.2	.7	10.1	17.3	2.9	1.5	1.2	17.2	2.2	1.1
1929	272	10.9	1.2	1.2	11.0	17.3	3.2	1.4	1.2	17.1	2.6	1.1
1930	270	10.8	1.3	1.0	11.1	17.3	3.1	1.5	1.2	16.9	2.6	1.1
1931	268	10.7	1.0	.9	11.4	18.0	3.1	1.4	1.2	16.9	3.0	1.5
1932	271	10.8	.8	.8	12.2	18.2	3.0	1.4	1.2	17.1	2.9	1.8
1933	270	10.8	.7	.7	12.2	17.9	3.1	1.4	1.2	17.5	2.9	2.2
1934	258	10.3	.7	.7	13.3	18.3	3.4	1.4	1.2	17.4	2.9	2.6
1935	261	10.4	.7	.8	14.5	17.3	3.7	1.5	1.3	17.2	2.9	2.9

1936	264	10.6	.7	1.0	13.9	16.6	3.8	1.6	1.4	16.9	3.3	3.0
1937	265	10.6	.7	1.0	14.8	16.5	3.9	1.6	1.5	16.6	3.4	3.4
1938	263	10.5	.6	1.0	15.4	16.4	4.2	1.6	1.6	16.3	3.8	3.8
1939	266	10.6	.7	.8	16.1	17.2	4.2	1.6	1.8	16.1	3.8	3.8
1940	265	10.6	.8	1.0	17.3	16.7	4.3	1.6	1.9	15.9	4.2	3.8
1941	267	10.7	.8	.9	16.6	15.8	4.3	1.5	2.0	15.8	4.6	4.2
1942	290	10.2	1.0	.9	16.3	15.7	4.7	1.6	2.1	15.4	5.1	4.7
1943	315	11.1	.9	.8	16.9	11.7	3.0	1.9	2.2	14.6	5.9	5.0
1944	328	10.7	1.0	.9	13.6	11.8	3.0	1.8	2.3	14.1	6.5	5.6
1945	335	10.2	.9	1.0	16.1	10.8	4.7	1.9	2.9	13.9	7.0	6.1
1946	323	10.6	.8	.7	16.8	10.4	4.4	2.2	2.9	13.5	6.5	5.7
1947	306	10.0	.9	1.2	17.9	11.1	5.1	1.7	2.6	13.4	7.2	6.4
1948	295	9.7	.3	1.4	18.1	9.9	5.1	1.7	2.9	12.7	7.3	6.5
1949	296	9.0	.5	1.4	17.6	10.4	5.3	1.9	3.1	12.4	7.4	6.6
1950	293	8.9	.6	1.3	17.9	10.6	5.4	2.2	3.5	11.9	8.3	7.4
1951	299	8.4	.5	1.5	16.0	9.4	5.0	2.1	3.8	11.2	8.5	7.6
1952	303	7.9	.5	1.4	15.5	8.5	5.3	2.2	4.0	11.4	8.5	7.6
1953	300	7.5	.5	1.4	15.2	8.4	5.0	2.3	4.2	11.5	8.5	7.7
1954	301	7.5	.4	1.5	14.6	8.8	5.4	2.4	4.3	11.5	8.6	7.8
1955	305	7.5	.4	1.6	14.0	8.9	5.3	2.5	4.4	11.6	8.6	7.9
1956 [7]	308	7.5	.4	1.5	13.5	8.6	5.5	2.5	4.5	11.6	8.6	8.0

See footnotes at end of table.

427497—57——3

TABLE 8.—*Dairy products: Per capita consumption, 1909–56*[1]—Continued

Year	Natural buttermilk	Dry whole milk	Nonfat dry milk solids	Dry whey	Evaporated and condensed skim milk[8]	Malted milk	Dry buttermilk	Frozen desserts				
								Ice cream		Sherbet	Other frozen dairy products[10]	Ice milk
								Net milk used[9]	Product weight			
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
1909	64. 3	(11)			0. 6			3. 7	1. 5			
1910	63. 3	(11)			. 7			4. 6	1. 9			
1911	62. 5	(11)			. 8			5. 4	2. 3			
1912	61. 8	(11)			. 8			6. 3	2. 6			
1913	60. 9	(11)			. 9			7. 0	3. 0			
1914	59. 9	(11)			1. 0			8. 0	3. 4			
1915	58. 7	(11)			1. 2			9. 1	3. 8			
1916	58. 2	(11)			1. 3			10. 2	4. 3			
1917	57. 3	(11)			1. 5			11. 4	4. 8			
1918	55. 5	(11)			1. 8			14. 9	6. 3			
1919	54. 1	0. 1			2. 0			15. 9	6. 8			
1920	54. 6	. 1	0. 2		1. 5			17. 5	7. 5			
1921	53. 8	(11)	. 2		1. 3			17. 7	7. 5			
1922	53. 2	(11)	. 2		1. 4	0. 1		19. 0	8. 0			
1923	51. 6	. 1	. 4		1. 8	. 1		21. 0	8. 9			
1924	50. 3	. 1	. 4		1. 8	. 1		20. 6	8. 7			
1925	49. 6	. 1	. 4		1. 9	. 1		23. 2	9. 6			
1926	48. 1	. 1	. 5		2. 4	. 2		22. 7	9. 4			
1927	46. 8	. 1	. 7		2. 4	. 2		23. 9	9. 8			
1928	46. 3	. 1	. 8		2. 7	. 2		24. 1	9. 8			
1929	46. 0	. 1	1. 1		3. 0	. 2		26. 7	10. 6			
1930	45. 5	. 1	1. 3		2. 6	. 2		24. 4	9. 6			
1931	44. 8	. 1	1. 4		2. 4	. 1		21. 3	8. 5			
1932	45. 3	. 1	1. 4		2. 2	. 1		15. 7	6. 2	0. 1		

1933	46.4	.1	1.4	--------	2.0	.1	--------	14.9	6.0	.1	--------	--------
1934	46.0	.1	1.5	--------	2.2	.1	--------	17.5	7.0	.2	--------	--------
1935	45.6	.1	1.6	--------	2.4	.1	--------	19.9	8.0	.2	--------	--------
1936	44.7	.1	1.7	--------	2.8	.1	--------	23.5	9.4	.3	--------	--------
1937	44.0	.1	1.9	0.1	3.0	.1	-------	26.4	10.5	.3	--------	--------
1938	42.6	.1	2.1	.1	3.1	.1	--------	25.7	10.2	.3	--------	--------
1939	42.0	.1	2.1	.1	2.9	.1	0.1	27.3	10.8	.7	--------	--------
1940	40.5	.1	2.2	.1	3.2	.1	.1	28.5	11.2	.4	0.1	0.4
1941	40.4	.2	2.4	.1	3.9	.1	.2	33.9	13.4	.4	.2	.4
1942	39.2	.2	2.5	.1	4.3	.2	.2	38.9	15.6	.4	.2	.5
1943	36.0	.4	2.1	.1	5.1	.4	.2	30.6	12.9	2.4	.2	.3
1944	34.6	.3	1.5	.2	5.9	.3	.2	33.0	14.1	2.5	.2	.3
1945	34.2	.4	1.9	.2	7.6	.3	.2	37.0	15.5	3.2	.3	.4
1946	33.4	.5	3.2	.2	9.6	.3	.1	57.1	22.8	.6	.2	.5
1947	33.1	.4	2.9	.2	6.9	.2	.2	51.4	19.8	.5	.2	.5
1948	31.2	.3	3.3	.1	5.3	.1	.2	45.0	18.2	.5	.2	.7
1949	30.5	.2	3.2	.2	5.4	.1	.2	44.8	17.4	.6	.3	1.2
1950	28.7	.3	3.6	.2	5.0	.2	.2	44.4	17.0	.7	.3	1.5
1951	27.1	.3	4.2	.1	4.8	.2	.1	44.1	17.1	.9	.3	1.9
1952	27.2	.5	4.6	.2	4.6	.2	.2	46.7	17.6	1.1	[12].3	2.2
1953	27.1	.3	4.1	.2	4.7	.2	.2	47.6	17.7	1.3	[12].3	2.6
1954	27.0	.2	5.1	.2	4.8	.2	.2	46.6	17.2	1.4	[12].2	3.1
1955	26.8	.2	5.5	.2	4.6	.2	.2	48.0	17.7	1.5	[12].1	3.4
1956 [7]	26.7	.3	5.0	.2	4.5	.2	.2	49.0	18.1	1.6	[12].1	3.7

[1] Civilian consumption only, 1941 to date.

[2] Cream estimated as 20 percent of total "fluid milk and cream" consumption, 1909–41. Beginning with 1942, the proportion has been varied largely on the basis of information obtained for markets having Federal milk marketing orders.

[3] On basis of 25 percent fat content 1909–42 and 1945 to date, 20 percent in 1943 and 1944.

[4] Whole and part whole milk cheese (excluding cottage, pot, and bakers').

[5] Includes minor quantities of other skim milk cheese.

[6] Produced from skim milk.

[7] Preliminary.

[8] Includes evaporated and condensed buttermilk.

[9] Amount of milk (equivalent) used in making ice cream and miscellaneous frozen products, excluding approximate quantities supplied in the form of butter and condensed whole milk.

[10] Prior to 1949, reported as "frozen custards and frosted or frozen malted milk."

[11] Less than 0.05 pound.

[12] Does not include the following quantities of mellorine, in pounds: 1952, 0.3; 1953, 0.7; 1954, 0.9; 1955 and 1956, 1.0.

TABLE 9.—*Dairy and selected competing products: Index numbers [1935–39=100] of retail prices, 1913–56* [1]

Year	Dairy products		Milk, fresh, delivered	Butter	Cheese [3]	Evaporated milk	Margarine [4]	Meats, poultry, and fish	All foods [5]	Consumer price index
	All	Excluding butter [2]								
Averages:										
1913–14	86	81	73	101	81	----	----	69	81	71
1915–19	115	107	96	136	116	----	----	95	115	95
1920–24	133	126	118	151	132	158	174	108	133	127
1925–29	130	121	115	151	140	138	156	119	133	124
1930–34	96	98	97	92	101	102	95	89	99	103
1935–39	100	100	100	100	100	100	100	100	100	100
1940	101	102	103	99	98	98	92	96	97	100
1941	112	112	111	113	114	110	100	108	106	105
1942	125	123	122	130	132	125	130	126	124	117
1943	135	131	127	144	142	140	133	134	138	124
1944	134	132	127	136	144	139	133	130	136	126
1945	134	132	127	138	143	140	133	131	139	129
1946	165	153	145	195	193	161	156	161	160	140
1947	186	172	161	221	226	183	224	217	194	160
1948	205	192	179	238	252	207	227	246	210	172
1949	187	182	172	199	231	184	169	233	202	170
1950	185	182	168	200	229	178	166	244	204	172
1951	206	203	188	225	261	202	186	272	227	186
1952	215	211	197	235	268	209	158	270	232	190
1953	211	210	196	218	267	205	159	255	228	191
1954	204	205	193	200	255	195	160	251	227	192
1955	204	205	194	196	255	192	155	236	224	192
1956	209	211	202	200	256	198	156	226	226	194

[1] Data from or based on data from Bureau of Labor Statistics. For years since 1952, index numbers of prices converted from 1947–49 base to 1935–39 base using factors reported by Bureau of Labor Statistics (*160*, p. 36). For the period 1923–34, index numbers of prices for individual products were converted from 1923–25 base to 1935–39 base on the basis of the relationship between the index 1923–25=100, and the unpublished index 1935–39=100, during 1935–36. Index numbers of prices for individual products prior to 1923 were computed on the basis of the relationship between prices and the computed index, 1935–39=100, during 1923.

[2] Computed from index of prices for all dairy products, column 1, and index of prices for butter, column 4.

[3] Beginning July 1949, price quoted for processed rather than for natural cheese.

[4] Before August 1950, uncolored margarine based on 56 cities. Colored margarine August–December 1950, based on 37 cities; January–December 1951, 38 cities; and beginning 1952, 47 cities.

[5] Beginning 1950, revised series; includes some new items and adjusted weights.

unlike that of prices of all foods, except that, in recent years, the increase in dairy prices has been less than that in prices of all foods.

When dairy prices are compared with prices of substitute foods, it is found that the price of margarine in recent years relative to the 1935–39 average has been substantially lower than the price of butter. Because butter and margarine are substitutes, the relatively lower prices for margarine have exerted pressure toward weakening of prices of all dairy products (see pp. 67,197). On the other hand, prices of meat, poultry and fish, each to some degree a substitute for cheese, have risen about the same as the price of cheese since the pre-World War II period.

The relationship between the price of a particular dairy product and the index of retail prices for all dairy products can be summarized in the following way: The index of retail prices for all dairy products reflects the total supply-demand picture for dairy products, while prices of specified products reflect the supply-demand picture for that product. However, under equilibrium conditions, all individual dairy products must be equivalently priced. Differences, if any, reflect differences in cost and amount of marketing services performed, differences in product densities (since pricing is usually related to product weight rather than milk equivalent of the product), and differences in the quality of milk used. Trends in prices of the individual dairy products to the extent that they differ from the average for all items, reflect these differences.

A later section presents a detailed discussion of the relationships among retail prices. However, it should be noted that the price of butter dropped substantially more in the early 1930's than prices of cheese or fluid milk, reflecting greater fluctuations in the price of butter relative to changing economic conditions. The price of fluid milk increased substantially less in the early post-World War II period than prices of either butter or cheese relative to the 1935–39 average. This reflects the fact that the gross marketing margin accounts for a greater share of retail prices for fluid milk than for butter and cheese and that, as usual, the marketing margin increased relatively less than did the cost of raw milk. Expanded sales of bottled milk through stores, as opposed to home delivery, and introduction of some economies, such as every-other-day delivery to homes, have helped to limit the increase in cost of marketing fluid milk.

Longer-run comparisons show that during 1951–55 prices of fluid milk averaged 165 percent above prices in the 1913–14 period, prices of butter averaged 112 percent higher, and cheese averaged 222 percent above. These differences reflect a reduction in the marketing margin of butter in relation to fluid milk and cheese. This, in part, resulted from increased marketing services for milk and cheese in relation to those offered prior to World War I. It should be noted that longer-run price comparisons for cheese are difficult, in part, because sales of process cheese dominate the market in recent years while natural cheeses were sold in the earlier years (see p. 17). In July 1949 the Bureau of Labor Statistics began reporting prices for American process cheese as compared to prices for No. 1 milk Cheddar cheese prior to this date. Thus the 222 percentage figure probably overstates the increase in prices. Longer-run price comparisons also reveal that the marketing margin for evaporated milk has been reduced

TABLE 10.—*Prices paid and received by farmers: Selected series relating to the dairy industry, 1910–56* [1]

Year	Prices paid				Prices received						
	Grain mixture fed to milk cows producing—		Wage rates [2]	All commodities, interest, taxes, and wages	Milk			Butterfat in cream	Estimated carcass value of milk cows [3]	Livestock and livestock products	All farm products
	Wholesale milk	Cream sold as butterfat			Sold at wholesale	Used for city distribution	Delivered to condenseries				
Averages:											
1910–14	99	100	82	80	88	-------	-------	90	83	86	93
1915–19	144	156	122	118	133	-------	-------	134	134	135	153
1920–24	144	135	149	134	137	-------	154	147	84	120	140
1925–29	133	127	152	129	137	-------	147	153	118	131	138
1930–34	87	81	100	100	89	-------	84	83	62	78	82
1935–39	100	100	100	100	100	100	100	100	100	100	100
1940	95	92	107	99	101	101	99	97	106	94	93
1941	105	100	125	106	122	109	130	119	133	119	116
1942	130	128	163	122	143	126	150	138	169	147	149
1943	158	161	217	137	173	142	188	173	190	171	180
1944	181	184	263	146	178	145	191	175	166	169	184
1945	177	178	297	152	177	145	189	175	192	182	193
1946	209	213	320	166	222	174	242	223	209	209	221
1947	245	259	346	192	237	196	249	249	261	248	258
1948	260	272	365	208	271	217	281	277	372	272	268
1949	206	205	355	201	219	199	202	214	332	234	234
1950	209	214	351	205	216	191	206	215	398	241	241
1951	237	249	388	226	254	215	254	247	509	290	282
1952	254	259	416	230	269	226	269	260	407	264	269
1953	232	237	424	223	240	213	224	231	253	234	241
1954	223	228	421	225	221	202	202	204	225	220	233
1955	209	212	426	225	222	204	204	198	238	203	219
1956 [4]	203	205	443	229	231	209	210	203	-------	198	219

[1] Index numbers, 1935–39=100. Averages of actual data for 1935–39: Prices paid for grain mixture fed to milk cows producing wholesale milk, $1.51 per 100 pounds, and to those producing cream sold as butterfat, $1.30 per 100 pounds; prices received for milk sold at wholesale, $1.80 per 100 pounds, used for city distribution, $2.19 per 100 pounds, and delivered to condenseries, $1.39 per 100 pounds; prices received for butterfat in cream, 28.76 cents per pound; and estimated carcass value, $39.29 per cow.

[2] Simple average of quarterly indexes, seasonally adjusted.

[3] Computed by using average price of canner and cutter slaughter cows at Chicago times live weight of total cattle slaughtered.

[4] Preliminary.

substantially over time. Variations in marketing margins are discussed in detail in a later section.

The economic theory required to reconcile the fact that retail prices of individual dairy products reflect the supply-demand situation for each, yet all products must be equivalently priced, is given in a later section.

Comparisons also can be made of trends in prices received by farmers from sale of farm products and prices paid by farmers for labor and resources used in farming (table 10). Prices received by farmers for manufacturing milk (at condenseries) and butterfat appear to move in the same way as other prices received by farmers except that they have increased less in recent years. On the other hand, the farm price for milk used primarily for city distribution tends to be more stable in periods of rapid economic expansion or contraction than other farm prices. A sudden decline in consumer income, as from 1929 to 1932 or 1937 to 1938, widens the gap between prices of fluid and manufacturing milk. Prices of fluid milk show the "stickiness" generally associated with administered prices (public or private); prices of manufacturing milk and butterfat change readily in response to changes in demand conditions except when supported by Government action as was done frequently from 1949 to date. The price received by farmers from sale of cull cows for slaughter varies chiefly with changes in supply and demand for meats.

On the cost side, wage rates paid by farmers increased substantially above the 1935–39 average relative to other farm costs. Because of the importance of labor in the dairy enterprise, the relatively high labor costs in the post-World War II period tended to hold down production of milk. However, since 1952 other offsetting factors and developments occurred, resulting in increased production of milk to new record levels. (See pp. 19 to 22.) Dairy production costs relative to other farm costs also have increased in the early postwar period because the cost of feed, an important input in dairying, is more closely related to prices received by farmers than to prices paid. In the early postwar period, prices received have increased above the 1935–39 average relative to prices paid by farmers, but in more recent years they have been relatively lower.

DAIRYING AS A PART OF THE FEED-LIVESTOCK INDUSTRY

The feed-livestock industry is an important segment of the total agricultural sector of the economy. One of the marks of an advancing economy is that the livestock enterprise becomes relatively more important. With increases in real income, people tend to consume more meat, poultry, and dairy products and less of certain other items such as cereal products. In the last four decades, cash receipts from livestock and livestock products increased from 50 percent of the total from all agricultural commodities to about 55 percent in recent years (table 5). The dairy industry is an important segment of the livestock industry. In 1951–55, annual cash receipts from the sale of dairy products averaged $4.3 billion compared to $9.5 billion from the sale of meat animals, the other major component of the livestock sector. As a percentage of the total receipts from the sale of livestock

and livestock products, cash receipts from dairy products were 25 percent and those from meat animals, 54 percent.

The dairy industry is related to the entire livestock sector in two major ways. The first results from the competition of dairy farmers with producers of livestock and other livestock products for the use of feed. The price of feed and the quantity available to the dairy farmer depends on the total supply and demand for feed, including the effect of loan programs. The number of livestock fed on farms during the year depends primarily upon the supplies of feed on hand and the relation between feed and livestock prices. But the number of cows kept for milk depends not only on the price of milk in relation to feed prices but also on the price of milk in relation to prices of meat animals. The latter directly affects the culling rate among dairy herds. Therefore, the price, supply, and demand for meat animals can be considered as the second main economic link. Production of milk also is affected by income from dairying in relation to income from other livestock enterprises, and, to a lesser extent, by income from other agricultural and nonagricultural enterprises. These relations are depicted graphically in figure 1, page 8.

In the discussion that follows, only aspects that directly affect the dairy industry are considered. For more complete discussions of the economic relationships in the feed-livestock industry, the reader is referred to Breimyer (*19*), Lorie (*78*), Foote, Klein, and Clough (*47*), and Hildreth and Jarrett (*66*). The first two discuss economic relationships in the feed-livestock sector, with special emphasis on the factors that affect consumption of feed and production of livestock. The study by Foote, Klein, and Clough places emphasis on the factors that affect prices of feed. The study by Hildreth and Jarrett attempts to integrate both aspects through the use of a system of simultaneous equations.

Price, Supply, and Demand for Feed

The supply of feed fed to dairy cows comes from a variety of sources. Table 11 shows the different sources, each expressed as a percentage of the total feed fed to dairy cattle. Hay and pasture make up roughly two-thirds of the total. Concentrates in recent years have accounted for about a fourth, and silage about a tenth. Table 12 shows the different sources of feed consumed by dairy cattle. The quantity of feed consumed from each source is expressed as a percentage of the total quantity of feed available from that source. In other words, table 12 shows how significant are the demands for feed by dairy cattle upon a particular source in relation to the demands by other sectors. For example, close to a third of all feed available, including pasture, is consumed by dairy cows. Milk cows consume about two-fifths of the roughage and commercial by-product feeds produced and one-fifth of the feed concentrates.

As noted earlier, the supply of feed on hand and the relation between feed and livestock prices are important determinants of the number of livestock fed during the year. The quantity of feed produced in any year depends primarily on the number of acres planted and the yield per acre. Since year-to-year variations in acres planted tend to be small, year-to-year changes in the supplies of feed mostly result from

TABLE 11.—*Dairy cattle: Percentage of feed derived from specified sources, selected averages, 1909–46* [1]

Source	1909–11	1912–16	1917–21	1922–26	1927–31	1932–36	1937–41	1942–46
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Corn	10.7	7.8	9.5	5.4	5.7	5.5	6.5	8.1
Other grain	5.9	6.6	6.8	6.5	7.0	6.2	7.5	7.7
Commercial byproduct feeds	7.3	7.4	8.4	8.5	7.8	7.5	7.6	8.4
Oilseeds and skim milk	3.6	3.4	3.1	3.0	3.1	3.3	2.8	2.0
Hay	20.7	22.1	21.8	22.3	25.0	24.9	24.8	26.5
Silage and stover	3.6	3.4	3.1	10.1	10.7	12.0	11.6	9.9
Pasture	48.2	49.3	47.3	44.2	40.7	40.6	39.2	37.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Compiled from Jennings (*71*, table 7, p. 24). Data relate to years beginning October. This series not available after 1946.

TABLE 12.—*Dairy cattle: Percentage of specified feeds consumed, selected averages, 1909–46* [1]

Feeds	1909–11	1912–16	1917–21	1922–26	1927–31	1932–36	1937–41	1942–46
Grains:								
Corn:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Excluding corn in silage [2]				5. 4	6. 6	7. 3	9. 1	10. 4
Including corn in silage	7. 9	6. 3	7. 9	10. 0	11. 6	13. 7	14. 9	15. 1
Oats	18. 7	19. 0	18. 9	19. 0	21. 3	28. 4	30. 3	30. 7
All grain including corn in silage	10. 1	9. 3	10. 5	12. 4	14. 1	16. 0	17. 9	17. 2
Commercial byproduct feeds	38. 1	37. 0	44. 5	45. 3	46. 3	43. 1	41. 6	41. 1
All concentrates [3]	12. 9	13. 2	14. 0	15. 9	17. 6	19. 5	21. 0	20. 3
Roughage:								
Hay		33. 4	35. 5	39. 7	46. 2	49. 5	50. 5	53. 2
Pasture		27. 0	26. 9	30. 4	32. 8	34. 0	34. 3	34. 3
All roughage [4]	28. 9	28. 9	29. 3	35. 1	39. 2	41. 3	41. 6	42. 1
All feed, including pasture [5]	22. 3	22. 3	23. 0	25. 9	29. 0	31. 3	32. 0	31. 3

[1] Compiled from Jennings (*71*, tables 3–6, pp. 20–22). Data relate to years beginning October unless otherwise noted. This series not available after 1946.

[2] Silage not reported before 1919.

[3] Includes grains, byproduct feeds, oil seeds, and skim milk, including grain in corn silage.

[4] Hay, corn, silage, sorghum silage, corn stover, sorghum forage, pasture and grazing. Silage not included for 1909–21.

[5] Data relate to calendar year.

changes in yield per acre. These variations are primarily the result of nonprice factors such as weather. Foote, Klein, and Clough (47, p. 23) conclude that " . . . under short-term considerations, and to a considerable extent in the long run, supply (of feed) can be treated essentially as a factor which affects the other items in the feed-livestock economy, but which is unaffected by them." Relative stability in consumption is maintained by a considerable variation of stocks from year-to-year and, to a lesser extent, by variation in net foreign trade. However, in the long run, the level of demand for livestock products, and thereby the price of feed, affects the level of supplies of feed.

In any given year, excluding years when prices are effectively supported by a Government loan program, feed prices are determined chiefly by feed supplies, the number of animal units fed, and prices for livestock and livestock products. The price of feed tends to seek a level such that, with given levels of income and demand for livestock and livestock products, feed consumption nearly equals feed production, after appropriate allowance for loan programs.

In any given year, prices of meat animals and livestock products are determined mainly by the production of meat and other livestock products and consumer income.

There is considerable variation among dairy farmers and producers of livestock and other livestock products, in the nature and extent of competition for feed or resources used in the production of feed. Resources, including land and labor, used in the production of feed also can be used in the production of food and fibers. The extent to which these resources are shifted from the production of hay, pasture, grain, and other feeds to the production of foods and fibers depends on physical as well as economic conditions. On the physical side, the nature of the soil, type of topography, climatic conditions, and location of land in relation to markets all are important. For example, the only economically-feasible farm use for some land in northern Vermont may be in the production of hay and pasture for feeding dairy cows. On the other hand, land near commercial centers may be used for the production of cash truck crops as well as for dairying. Likewise, the nature of the soil and topography in the Midwest may result in a greater number of alternatives than for land in northern New England. The farming alternatives in these parts of New England are usually poultry or dairying and sometimes only a little more or a little less of each; the alternatives in the generalized farming areas of the Midwest on farms other than specialized dairy farms result from the combination of several enterprises into one farm operation. In these areas, shifts among enterprises can be made readily.

For example, farmers in the Corn Belt frequently must choose what proportion of the resources on the farm should go into the production of pasture, hays, corn, and other grains. The nature of the decision will be closely related to the type of livestock program in effect on the farm. Likewise, within the livestock operation, choices as to the type of livestock to be fed on the farm must be made. These choices, in turn, are conditioned by the feed program in effect. Once the feed is produced, economic choices must be made regarding its disposition. Decisions as to whether feed is fed to milk cows, beef cattle, hogs, other livestock on farms, or sold for processing or to other livestock producers are all interrelated. For example, on a corn-hog-dairy

farm which in a particular year has a fixed supply of feed, the hog enterprise may be enlarged by diverting more feed to it, but this will mean less feed for the dairy enterprise and thereby a likely reduction in the output of milk. The most important factors that affect such decisions are the relative prices of livestock and livestock products in relation to estimated costs of production.

Likewise, because the total supply of feed is essentially fixed in any year, the quantity of feed used by any sector of the livestock economy becomes established only after equilibrium has been reached in the feed-livestock industry as a whole. At equilibrium, the individual demands for feed by each species of livestock plus the demand for seed, industrial or food use, export, and storage must equal the total supply of feed. The same analogies apply to individual feeds. For these reasons, the quantity of feed fed to dairy cows in any year depends not only on the demand for feed by the dairy sector but also on the demand by other sectors. In addition, because of the different degrees of substitutability between the different feeds, the supply and demand situation for each feed taken separately affects the quantity and type of feed fed to dairy cows.

Another aspect of the feed-livestock industry that concerns the dairy industry results from its being more profitable for farmers in some areas to sell their feed rather than feed it, while it is more profitable for farmers in other areas to purchase rather than grow their own feed. Thus there are surplus and deficit areas that are linked by prices of feed and costs of transportation and handling. For example, dairy farmers in New England buy nearly all of their feed concentrates from the grain-producing and processing areas of the Midwest.

Price, Supply, and Demand for Meat Animals

The demand for meat animals affects the number of cows kept for milk by means of its influence on the price and supply of feed. But the number of cows kept for milk and the number of calves and heifers retained for building up future dairy herds are also affected directly by the price of meat animals in relation to prices of milk. The direct effect occurs in two major ways. First, some cattle are dual-purpose. When the price of beef is high in relation to the price of milk, dual-purpose cows are used primarily to produce calves that will be classed as beef cattle rather than milk stock. On the other hand, if the price of milk is high in relation to the price of beef these cows are used to form milking herds.

The second direct effect reflects the relationship between the carcass value of milk cows for sale as beef and the market value of cows kept for milk. This relation affects the rate at which milk cows and young milk stock are culled from the herd. Physically, the number of cows kept for milk can be increased or decreased by changing the rate at which milk cows are sold for beef and by changing the rate at which new stock is added to the herd. The rate at which heifers are freshened and brought into milking herds depends on previous decisions which affected the number of young stock retained for future milking herds. Obviously, the aggregate number of cows milked cannot be increased unless sufficient young stock are available to more than replace the minimum number of culls and death losses. On the other

hand, herds can be reduced rapidly but, in general, economic conditions are of such a nature that year-to-year changes in the national milking herd do not exceed 2 to 3 percent of the total number of cows.

In decisions of this type, the basic economic problem revolves around the question whether milk cows or heifers should be kept for current or future milk production, or sold for beef or veal. The answer depends on the dairyman's estimate of the future outlook for dairying, which is conditioned by many factors. Since the income earning capacity of a milk cow continues over several years, its market value as a milker includes the "capitalized" value of the total anticipated net income over the prospective productive life of the cow plus the estimate of carcass value at the end of her productive period. It is assumed that future incomes from dairying are discounted at rates comparable to the earning capacity of an investment in the nearest alternative.

Carcass value frequently equals around half the market price for average milk cows. The extent to which the market value exceeds the carcass value determines in part whether dairymen liquidate or build up their herds. If the market value exceeds the carcass value by more than the expected value of future incomes discounted to the present, including a reward for uncertainty, dairymen tend to increase the size of their herds by reducing the culling rate. On the other hand, if the difference is not sufficient to cover these anticipated values, they probably decide to sell milk cows for beef and thereby reduce the size of the herd. Because changes in the costs of dairying and the costs of raising meat animals tend to move in the same direction, changes in the prices of milk in relation to prices of beef cattle in general result in changes in the profitability of dairying in relation to raising animals for meat.

These economic decisions as to saving heifer calves for future milk production also are conditioned by the anticipated productivity of the heifer, which varies widely among individuals. In the past, these expectations were based largely on the performance of the dam, and the distributions of expectations had much the same pattern as the distribution of performances in the existing herd. With artificial insemination, the sire's quality would be given more weight, and there would be less basis for selection among heifers saved; hence, more might be saved from current crops than formerly, other things being equal.

The foregoing is a simplified explanation of the integration of dairy farming as part of the total farm picture. The whole production phase of dairying will be discussed in more detail in a subsequent study.

GENERAL ECONOMIC RELATIONS WITHIN THE DAIRY INDUSTRY

The preceding section contains a discussion of the major economic relationships between the dairy industry and the rest of the economy. It enables the reader to put the dairy industry in proper perspective in relation to the total economy. In contrast, the discussions to follow deal with the development and analysis of the internal economic structure of the dairy industry.

The dairy industry is complex, and any analysis involving the study of its economic structure needs some systematic method to ferret out the relevant elements. Several economic formulations or models of the dairy industry are developed to assist in this task. The first model shows the economic structure of the dairy industry in its simplest form. Of necessity, this requires many rigid assumptions, some of which may appear unreasonable. In succeeding models, some of these are lifted. The assumptions underlying each model are made as realistic as the general framework permits. In each case, statistical measurements of the various relationships are provided where possible.

Before discussing the individual economic formulations, four brief sections are given that focus attention on certain aspects to facilitate the understanding of the separate models. The first defines various types of economic relations. The second discusses the nature and purpose of economic models. The third portrays the complexity of the dairy industry by showing the many uses for milk. The last considers the focal points at which the supply and demand for individual dairy products, taken separately or in combination, are equated.

TYPES OF ECONOMIC RELATIONS

The discussion of any economic structure can be simplified by dividing the various relations into the following types:

1. *Technological and behavior relations which show how individual farmers and firms behave in supplying goods to market and in using the various factors of production.* An example of a technological relation in dairying is the relation between the amount of feed fed to milk cows and the amount of milk produced. An example of the type of behavior relations included here is the relation between changes in the cost of feed per ton and changes in the amount of feed fed per cow. In short, this category includes the relations that explain the behavior of firms in the dairy industry which are engaged in the production of milk or in providing marketing services.

2. *Relations which explain behavior of decision maker in households concerning demand for goods and services and in supplying labor.* The demand relations for individual dairy products which relate the quantities taken by the individual or household to prices, income, and other factors are examples of this type.

3. *Market clearing relations which equate supply and demand in each sector and in the whole industry.* These are behavior relations that integrate the plans of consumers and producers. They reflect the aggregate behavior of all firms and households in the sector to which they apply. The important market clearing relations in the dairy industry include the following: (1) Those which equate supply and demand for individual dairy products and for total milk for the country as a whole; (2) those needed to balance supply and demand for total milk and individual products by geographic areas; and (3) those needed to link together the different levels of the marketing chain as milk and milk products move from the farm through processing, wholesale, and retail channels, to the consumer.

4. *Legal and institutional relations which impose certain conditions on technological and behavior relations.* These are particularly im-

portant for the dairy industry. For example, the price of Class I milk in some markets is determined by a formula based on factors outside, but related to, the dairy industry rather than by the more direct market clearing relations which might be employed.

In the development of the several economic models of the dairy industry, we begin with market clearing relations. These are as simple as any that are meaningful.

WHAT ARE ECONOMIC MODELS?

The operation of the economic system for the country as a whole is most complex, involving many independent (but in effect mutually related) decisions by individuals who head the multitude of producing and marketing firms and households. Taking account of his institutional environment, each decision-maker is guided by certain economic signals or stimuli. The outcome of the decision is considered satisfactory if profits are increased or maximized in the case of an operator of a firm, or if he has attained the highest level on a preference scale for a given cash outlay when he is the head of a household.

The research worker who undertakes the study of the operation of a particular segment of the economy must base his analysis on data (economic constants and variables) that give rise to, and result from, the decision-making processes. Since most economic problems are complex, some simplification is required to reduce the problem to manageable terms. Research models are constructed to bring about this simplification and, at the same time, to present in an orderly fashion the network of the significant "stimuli" and "responses" that have relevance to the economic problem being studied. In essence, constructing an economic model means the specification of a set of economic relationships, including a description of the nature of each and the relevant variables that enter into them. Naturally, the model must be consistent with the assumptions that the investigator develops from considerations of economic theory and knowledge of existing institutions.

The characteristic nature of a specific model and the particular function it serves depend largely on the purpose or use for which the model is intended. Some models are designed primarily to aid in the identification of influential variables, with no thought of attempting to measure these influences. These models may be presented in relatively simple graphical form; they are considered primarily as starting points for the development of statistical analyses. They assume that true functional economic relationships exist in the segment being studied, which would be capable of precise measurement if the data were available.

Models also may be presented as a system of equations that are designed to measure economic relationships quantitatively. They must take into account the nature and availability of data, statistical techniques, and manpower, in addition to considerations drawn from economic theory. Models designed to provide statistically consistent estimates of certain coefficients, such as elasticities of demand with respect to price and income, are examples. The logical specification of the relations, the relevant variables in each relation, and the description of the economic processes which generated the data used in

these models come essentially from the field of economics. Methods of handling errors of measurement in the basic relationships and data, and ways of allowing for unexplained variation of omitted variables, are problems of statistics. Choice of the dependent and independent variables in the single-equation analysis, and of the variables (endogenous) whose values are simultaneously-determined by the economic structure described by the model and the variables (exogenous) whose values are determined outside the structure, is partly within the framework of logic and economics, and partly a matter of statistical considerations. The same is true for the decision to use a single-equation analysis or a system of simultaneous equations. Decisions as to whether the relationship essentially is linear, logarithmic, or of some other form also are based on considerations from all these fields.

Models also may be classed according to whether they are designed to be used (1) to predict future economic behavior or (2) as "norms" or "benchmarks" for evaluating current economic behavior. Examples of the first group are single equations used to estimate or forecast prices of different agricultural commodities from changes in selected factors, such as supply and consumer incomes. Examples of the second are models based on conditions of "pure" competition. They are not presumed to hold precisely in actual life but rather indicate what might be expected if conditions of pure competition were to prevail.

The different functions and purposes for which economic models are constructed suggest that if the model is to be useful, the assumptions underlying it must be explicitly stated. Further, the assumptions must permit realistic answers, for that is the true test of the value of the model. If the model is based on incorrect assumptions, results derived from it are equally unreliable.

THE COMPLEX FLOW OF DAIRY PRODUCTS

Milk is utilized in many ways. This adds to the complexity of studies of the economic influences that affect prices and consumption. Difficulties arise not from the number of products but rather from their diverse nature, and because the price structure for each is associated with that of all other dairy products.

If milk is considered as a product in three parts—water, fat solids, and solids-not-fat—rather than as a single product, the impact of the diverse nature of the different dairy products on the dairy price structure can be better understood. On the average, milk when produced consists of 87 percent water, 4 percent fat solids, and 9 percent solids-not-fat. It is relatively homogeneous, though differing in bacteria count and, to some extent, in content of butterfat and other food nutrients. On the other hand, milk may be consumed as fluid milk or used to produce several processed dairy products, each differing in physical characteristics. Dairy products can be divided into three general groups—(1) those consisting almost entirely of fat, mainly butter; (2) those consisting almost entirely of milk solids-not-fat, such as nonfat dry milk; and (3) those in which milk fat and solids-

not-fat appear in combination, as in evaporated and dried whole milk, fluid milk, cream, ice cream, and whole milk cheese.

Figure 3 and table 13 show the relative importance of fat solids and solids-not-fat in the flow of milk into its different outlets. Figure 3 shows the utilization of milk in terms of product weight. This form takes account of the relative densities of the different dairy products. The narrowness of the bars for some major end products, such as butter and cheese, indicates essentially the removal of water during processing. Differences in densities tend to determine where the milk is produced and the milk products manufactured, since it costs more per unit of value to transport bulkier products. Figure 3 shows that a substantial part of the total milk produced never leaves the farm. In 1955, 3.3 billion pounds of whole milk were fed directly to calves and 12.3 billion pounds of skim milk and buttermilk were fed directly to livestock, including poultry. Figure 3 also shows that substantial quantities of skimmed milk, buttermilk, and cheese whey as byproducts from manufacturing plants are used in the manufacture of animal feed or fed to livestock directly or wasted. The low value of the unprocessed skimmed milk and buttermilk in relation to its weight explains in part why much of it remains in the producing area.

Table 13 shows the 1952 percentage utilization of total milk in selected dairy products based on several different criteria—milk equivalent (fat-solids basis), product weight, fat solids, solids-not-fat, and total milk solids. The year 1952 was used rather than a more recent period, because the sizable surplus accumulated by the Government under the support program in 1953–56 was channeled primarily into butter, cheese, and nonfat dry milk solids. Because the data—except those for milk equivalent—refer to final use, they differ to some extent from those normally published. For example, butter and condensed milk are used in the manufacture of ice cream. In this table, such uses are reflected in the total for ice cream; figures that apply to direct consumption of butter and condensed milk are reduced accordingly. Many tables on utilization are based on the quantities of the various products manufactured directly from milk. That explains why products used as raw materials for other dairy products receive a larger weight than they should in terms of final consumption, while the products made from them receive a smaller weight.

Normally we might expect the percentage utilization figure to remain the same for fluid whole milk regardless of the method of computation. However, milk is commonly standardized to a fixed butterfat content, which is usually lower than the fat test of the milk received. This is done by adding a small portion of skim milk to the milk as received. This process reduces the fat content, but at the same time increases the relative proportion of solids-not-fat. The figures in the several columns for products other than fluid whole milk vary greatly, because the relative proportions of fat and nonfat milk solids and of water in them differ greatly from the average for milk as produced.

Although the milk equivalent figures are on a fat-solids basis, they may, for several reasons, differ from the fat-solids figures. First, as illustrated above for ice cream, the fat-solids figure refers to final con-

427487—57——4

TABLE 13.—*Utilization of milk in specified ways: Actual weight and percentage of total, 1952*

Use	Actual weight					Percentage of all uses				
	Milk equivalent [1]	Product weight [2]	Milk solids [2]			Milk equivalent [1]	Product weight	Milk solids		
			Fat	Nonfat	Total			Fat	Nonfat	Total
	Mil. lb.	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Food uses:										
Fluid:										
Milk	45, 700	47, 200	1, 760	4, 250	6, 010	39. 7	48. 9	39. 2	41. 1	40. 5
Skim items	1, 500	8, 500	60	765	825	1. 3	8. 8	1. 3	7. 4	5. 5
Cream	7, 700	1, 200	300	85	385	6. 7	1. 2	6. 7	. 8	2. 6
All fluid	54, 900	56, 900	2, 120	5, 100	7, 220	47. 7	58. 9	47. 2	49. 3	48. 6
Butter:										
Creamery	23, 563	1, 140	919	12	931	20. 5	1. 2	20. 5	. 1	6. 2
Farm	4, 215	214	172	2	174	3. 7	. 2	3. 8	(3)	1. 2
All butter	27, 778	1, 354	1, 091	14	1, 105	24. 2	1. 4	24. 3	. 1	7. 4
Cheese:										
American	8, 551	851	274	262	536	7. 4	. 9	6. 1	2. 5	3. 6
Other	3, 088	319	100	92	192	2. 7	. 3	2. 2	. 9	1. 3
All cheese	11, 639	1, 170	374	354	728	10. 1	1. 2	8. 3	3. 4	4. 9
Frozen products:										
Ice cream	8, 378	2, 845	341	285	626	7. 3	2. 9	7. 6	2. 8	4. 2
Other [4]	563	559	22	55	77	. 5	. 6	. 5	. 5	. 5
All frozen	[5] 7, 541	3, 404	363	340	703	[5] 6. 6	3. 5	8. 1	3. 3	4. 7

Processed milk:										
Evaporated	6,087	2,840	224	523	747	5.3	2.9	5.0	5.1	5.0
Condensed	765	145	12	31	43	.7	.2	.3	.3	.3
Dried whole	774	102	27	72	99	.7	.1	.6	.7	.7
Nonfat dry	--------	703	7	673	680	--------	.7	.1	6.5	4.6
Other [6]	2,239	1,300	124	428	552	1.9	1.4	2.8	4.1	3.7
All food uses:										
Excluding fluid and butter	29,045	9,664	1,131	2,421	3,552	25.2	10.0	25.2	23.4	23.9
Including fluid and butter	111,723	67,918	4,342	7,535	11,877	97.1	70.3	96.7	72.8	80.0
Nonfood uses:										
Fed to calves	3,348	3,348	131	301	432	2.9	3.5	2.9	2.9	2.9
Skim milk for animal feed	--------	25	--------	23	23	--------	[3]	--------	.2	.2
Processed animal feed	--------	298	4	190	194	--------	.3	.1	1.8	1.3
Fed direct to livestock or wasted	--------	25,000	15	2,300	2,315	--------	25.9	.3	22.2	15.6
Other manufacturing uses	--------	7	--------	7	7	--------	[3]	--------	.1	[3]
All nonfood uses	3,348	28,678	150	2,821	2,971	2.9	29.7	3.3	27.2	20.0
All uses	115,071	96,596	4,492	10,356	14,848	100.0	100.0	100.0	100.0	100.0

[1] From Milk: Farm Production, Disposition and Income (*152*) except data for fluid whole milk, skim items, and cream, which are estimates. These data refer to first use of milk.

[2] Data on product weight and milk solids refer to final use. See text. Product weight of specified manufactured dairy products from Production of Manufactured Dairy Products (*153*), adjusted for final use where necessary. All other items are estimates.

[3] Less than 0.05 percent.

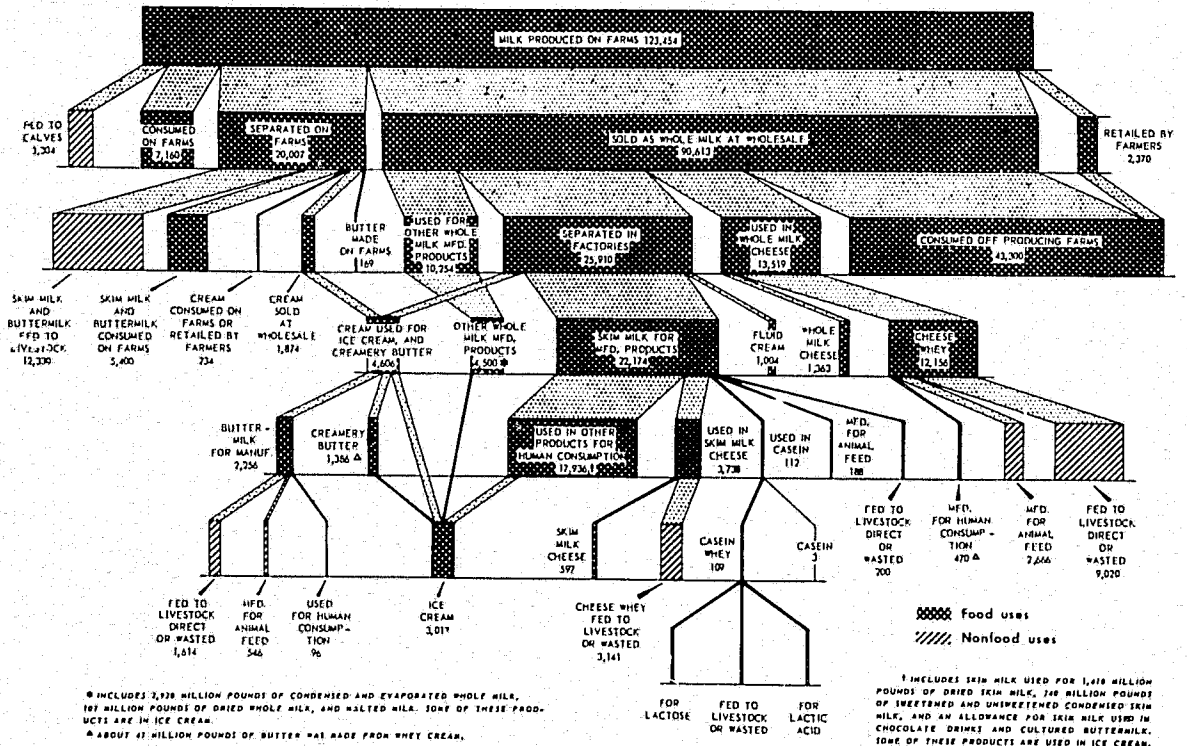
[4] Milk sherbert, ice milk, frozen custard, and miscellaneous minor frozen products.

[5] Excludes milk equivalent of butter and condensed milk used in ice cream.

[6] Includes dry cream, malted milk, dry part skim milk, dry ice cream mix, cottage cheese, minor dairy items, and any inaccuracies of independently determined production and use items.

STATISTICAL FLOW CHART FOR MILK AND DAIRY PRODUCTS, 1955

(FIGURES IN MILLIONS OF POUNDS)



* INCLUDES 7,930 MILLION POUNDS OF CONDENSED AND EVAPORATED WHOLE MILK, 107 MILLION POUNDS OF DRIED WHOLE MILK, AND MALTED MILK. SOME OF THESE PRODUCTS ARE IN ICE CREAM.

Δ ABOUT 41 MILLION POUNDS OF BUTTER WAS MADE FROM WHEY CREAM.

† INCLUDES SKIM MILK USED FOR 1,410 MILLION POUNDS OF DRIED SKIM MILK, 340 MILLION POUNDS OF SWEETENED AND UNSWEETENED CONDENSED SKIM MILK, AND AN ALLOWANCE FOR SKIM MILK USED IN CHOCOLATE DRINKS AND CULTURED BUTTERMILK. SOME OF THESE PRODUCTS ARE USED IN ICE CREAM.

U. S. DEPARTMENT OF AGRICULTURE

NEG. 3624-56 (10) AGRICULTURAL MARKETING SERVICE

sumption, while the milk equivalent figure refers to the net milk used in the first product produced. Second, as in the case for fluid milk, the fat-solids and the product weight figures are consistent with the final product, whereas the milk equivalent figure is based on the actual amount of butterfat present in the product converted to milk equivalent by a factor corresponding to the butterfat content of all milk received in that outlet or group of outlets.

One way in which these data can be used is to show the relative importance of the various end products as an outlet for each of the solid components of milk. For example, the total demand for fat solids equals the demand for each end product weighted by the proportion of fat solids that the product contains. Actually, people buy the numerous different dairy products for the specific want-satisfying qualities provided. Purchases of these products result in a demand for the two main components of milk. The relative contribution of each to the total can be measured directly from the percentages shown in the column for milk fat solids in the second section. This indicates that almost 50 percent of the demand for milk fat comes from the fluid milk and cream sector and only 24 percent from butter as such. For solids-not-fat, on the other hand, about 50 percent of the total demand comes from the fluid sector, 23 percent from all other food uses, and 27 percent from nonfood outlets. In recent years, the wholesale value of fat solids per pound in butter has been about 4 times as high as that for solids-not-fat per pound in nonfat dry milk. In some fluid products, at retail prices, solids-not-fat is worth nearly as much as fat.

Tables 14 to 16 show the supply and distribution of total milk (fat-solids basis), total fat solids, and total solids-not-fat from 1924 to date. Tables 60 to 66 in the appendix show the supply and distribution of the major dairy products in terms of product weight.

These tables illustrate two aspects of the supply and demand analysis. In the first place, they give some perspective to changes over time for the data in figure 3 and table 13. For example, table 15 shows that approximately 97 percent of the total milk fat produced has been continually utilized for human consumption. On the other hand, in the mid-1920's only 50 percent of the total solids-not-fat produced was utilized for human consumption; but in recent years this has been around 80 percent (table 16).

The second aspect of the supply and demand analysis that tables 60 to 66 illustrate is their stress on the relative importance of changes in stocks and of imports and exports for each of the products and for total milk. These are of negligible importance for perishable items like fluid milk and cream, but are of considerable importance for items like butter, cheese, and dried milks that can be stored fairly easily and have a high value per unit of product weight.

FIGURE 3.—This chart shows the flow of milk from farm to end product. The relative magnitude of the different flows reflect the relative densities of the different dairy products. Dairy products with high value in relation to density may be shipped long distances, while those with low value in relation to product weight tend to be consumed as close to the farm as possible. This explains in part why a substantial amount of skim milk is fed to animals on the farms where it is produced.

TABLE 14.—*Total milk (fat-solids basis): Supply and distribution, 1924–56* [1]

Year	Supply				Distribution									
								Department of Agriculture				Disappearance		
													Civilian	
	Production [2]	Beginning commercial stocks	Imports	Total supply	Ending commercial stocks	Commercial exports and shipments	Fed to calves	Beginning stocks	Ending stocks	Deliveries	Net purchases	Military [3]	Total [4]	Per capita [5]
	Billion pounds	*Billion pounds*	*Billion pounds*	*Billion pounds*	*Billion pounds*	*Billion pounds*	*Billion pounds*	*Billion pounds*	*Billion pounds*	*Billion pounds*	*Billion pounds*	*Billion pounds*	*Billion pounds*	*Pounds*
1924	93.7	1.7	1.4	96.7	2.3	.8	2.7						90.8	785
1925	94.9	2.3	1.3	98.5	2.2	.7	2.8						92.8	790
1926	97.4	2.2	1.5	101.1	1.6	.5	2.9						96.0	807
1927	99.0	1.6	1.4	102.1	2.0	.5	2.9						96.7	801
1928	99.4	2.0	1.3	102.6	2.1	.5	2.9						96.9	793
1929	102.1	2.2	1.1	105.4	3.1	.5	3.0						98.8	800
1930	103.0	3.1	.9	106.9	2.6	.5	3.0						100.8	808
1931	105.6	[6] 2.8	.7	109.1	1.7	.4	3.0						103.9	826
1932	106.3	1.7	.6	108.6	1.6	.3	2.9						103.8	820
1933	107.2	1.6	.5	109.2	3.8	.3	2.9						102.2	803
1934	104.0	3.8	.5	108.3	2.4	.3	2.7						102.9	803
1935	103.6	2.4	1.0	107.0	2.1	.3	2.7						101.9	790
1936	104.7	2.1	.8	107.6	3.1	.3	2.8						101.5	782
1937	104.2	3.1	.8	108.1	2.4	.3	2.7						102.7	787
1938	108.1	2.4	.6	111.0	4.4	.4	2.8						103.4	785
1939	109.0	4.4	.6	114.0	2.7	.4	3.0						107.9	813
1940	111.5	2.7	.3	114.6	2.7	.7	3.0						108.2	807
1941	117.1	2.7	.3	120.0	4.9	1.0	3.1		.7	2.0	2.7	2.5	105.8	791
1942	120.4	4.9	.6	126.0	2.0	.5	3.3	.7	2.0	4.2	5.4	5.2	109.5	821
1943	118.5	2.0	.3	120.8	2.3	.3	3.3	2.0	4.7	5.1	7.8	10.6	96.6	740
1944	118.1	2.3	.1	120.5	1.8	.4	3.3	4.7	1.0	6.4	2.8	14.3	98.1	753
1945	120.6	1.8	.2	122.6	1.8	.7	3.3	1.0	2.4	4.5	5.8	9.2	101.7	777

1946	118.7	1.8	.3	120.9	2.7	1.2	3.2	2.4	.2	4.8	2.6	2.3	108.8	775
1947	118.1	2.7	.2	121.0	2.7	3.7	3.2	.2	(7)	.7	.5	1.3	109.6	758
1948	113.7	2.7	.2	116.6	3.6	2.7	3.1	(7)	(7)	.3	.3	1.9	105.1	714
1949	117.0	[6] 3.6	.3	120.9	3.0	2.6	3.2	(7)	2.4	.1	2.5	1.4	103.3	724
1950	117.3	3.0	.5	120.8	3.1	1.2	3.3	2.4	1.6	1.0	.3	1.6	111.3	731
1951	115.2	3.1	.6	118.9	3.5	1.6	3.4	1.6	.1	.9	−.7	2.9	108.1	705
1952	115.1	3.5	.8	119.4	4.8	.9	3.3	.1	.2	(7)	.1	2.7	107.4	691
1953	120.5	4.8	.6	126.0	3.2	.9	3.3	.2	7.4	.7	7.9	2.6	107.9	682
1954	122.3	3.2	.5	126.0	3.2	.9	3.3	7.4	10.4	1.3	4.3	2.8	111.4	691
1955	123.2	3.2	.5	126.9	3.6	1.1	3.3	10.4	5.5	5.8	.9	3.3	114.8	698
1956 [8]	125.7	3.6	.5	129.8	3.6	1.7	3.2	5.5	2.0	4.7	1.2	3.1	117.0	699

[1] Milk equivalent of milk and cream and manufactured dairy products, including butter, computed on basis of fat content.
[2] Production on farms plus allowance for milk produced by cows not on farms.
[3] Includes quantities from the United States used by the military abroad.
[4] Includes milk equivalent of butter used in making margarine, which ranged from 40–60 million pounds during 1924–30.
[5] Approximation to the per capita consumption levels for total milk from 1909–23 are as follows:

1909 759 pounds	1912 752 pounds	1915 739 pounds	1918 716 pounds	1921 757 pounds
1910 748 pounds	1913 743 pounds	1916 737 pounds	1919 724 pounds	1922 772 pounds
1911 739 pounds	1914 736 pounds	1917 718 pounds	1920 726 pounds	1923 777 pounds

[6] Cold-storage holdings of cream included beginning January 1, 1931; condensed milk (bulk) beginning January 1, 1949.
[7] Less than 50 million pounds.
[8] Preliminary.

TABLE 15.—*Milk fat: Supply and distribution, 1924–56* [1]

Year	Supply				Distribution										Production per capita	Percentage of total production utilized for human use
									Department of Agriculture				Domestic disappearance			
														Civilian		
	Production	Beginning commercial stocks	Imports	Total	Ending commercial stocks	Commercial exports and shipments	Fed to calves	Other uses	Beginning stocks	Ending stocks	Deliveries	Net purchases	Military [2]	Total	Per capita	
	Million pounds	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Pounds*	*Percent*
1924	3,668	59	50	3,777	84	31	107	2						3,553	30.7	31.7	97.1
1925	3,717	84	45	3,846	80	24	109	2						3,631	30.9	31.6	97.1
1926	3,819	80	51	3,950	59	20	112	2						3,757	31.6	32.1	97.1
1927	3,885	59	50	3,994	72	18	114	2						3,788	31.4	32.2	97.1
1928	3,900	72	43	4,015	78	20	116	2						3,799	31.1	31.9	97.0
1929	4,007	78	39	4,124	113	19	118	2						3,872	31.4	32.4	97.1
1930	4,040	113	30	4,183	96	17	117	2						3,951	31.7	32.4	97.1
1931	4,147	[3] 103	22	4,272	61	16	118							4,077	32.4	33.0	97.2
1932	4,177	61	19	4,257	55	13	112							4,077	32.2	33.0	97.3
1933	4,208	55	16	4,279	143	11	113							4,012	31.5	33.1	97.3
1934	4,094	143	16	4,253	86	12	106							4,049	31.6	32.0	97.4
1935	4,095	86	34	4,215	75	13	106							4,021	31.2	31.7	97.4
1936	4,132	75	28	4,235	111	11	109							4,004	30.8	31.8	97.4
1937	4,116	111	29	4,256	84	12	108							4,052	31.0	31.5	97.4
1938	4,271	84	19	4,374	167	14	113							4,080	31.0	32.5	97.4
1939	4,310	167	19	4,496	99	16	117							4,264	32.1	32.5	97.3
1940	4,426	99	11	4,536	95	28	119							4,294	32.0	33.0	97.3
1941	4,650	95	9	4,754	180	36	124			25	69	94	97	4,223	31.6	34.4	97.3
1942	4,779	180	24	4,983	70	19	131		25	71	140	186	200	4,377	32.8	35.0	97.3
1943	4,711	70	10	4,791	82	12	130		71	172	183	284	402	3,881	29.7	34.0	97.2
1944	4,701	82	4	4,787	64	14	130		172	36	228	92	539	3,948	30.3	33.5	97.2
1945	4,796	64	6	4,866	65	26	131		36	85	158	207	356	4,081	31.2	33.8	97.3
1946	4,717	65	12	4,794	98	44	128		85	.6	168	89	87	4,348	31.0	32.9	97.3
1947	4,691	98	6	4,795	93	130	127		6	1	23	18	51	4,376	30.3	32.1	97.3
1948	4,518	93	8	4,619	128	95	122		1	[4]	10	9	71	4,194	28.5	30.4	97.3
1949	4,631	[3] 129	10	4,770	105	89	125		[4]	94	3	97	54	4,300	28.7	30.6	97.3
1950	4,646	105	18	4,769	109	43	130		94	63	36	5	62	4,420	29.0	30.2	97.2
1951	4,529	109	19	4,657	121	56	136		63	3	31	−29	111	4,262	27.8	28.9	97.0
1952	4,492	121	26	4,639	173	32	131		3	8	[4]	5	103	4,195	27.0	28.2	97.1
1953	4,667	173	19	4,859	114	33	129		8	281	27	300	99	4,184	26.4	28.8	97.2
1954	4,725	114	17	4,856	111	33	129		281	392	52	163	109	4,311	26.7	28.7	97.3
1955	4,746	111	17	4,874	123	41	127		392	199	224	31	124	4,428	26.9	28.9	97.3
1956 [5]	4,823	123	17	4,963	124	62	123		199	64	177	42	120	4,492	26.8	28.8	97.4

[1] Quantities produced (col. 1) and fed to calves (col. 7) determined by applying annual fat test to reported quantities of milk. Quantities in remaining columns except civilian disappearance were determined by applying percentages of milk fat in each product to amount of product. Civilian disappearance computed from data on production, stocks, trade, military purchases, quantities fed to calves, and uses in other outlets.

[2] Includes quantities used by military in civilian feeding programs abroad.

[3] Cold-storage holdings of cream included beginning Jan. 1, 1931; condensed milk (bulk) beginning Jan. 1, 1949.

[4] Less than 500,000 pounds.

[5] Preliminary.

TABLE 16.—*Milk solids-not-fat: Supply and distribution, 1924–56* [1]

Year	Supply				Distribution									Production per capita	Percentage of total production utilized for human use
								Department of Agriculture				Domestic disappearance			
													Civilian		
	Production	Beginning commercial stocks	Imports	Total	Fed to animals or wasted	Ending commercial stocks	Commercial exports and shipments	Beginning stocks	Ending stocks	Deliveries	Net purchases	Military [2]	Total	Per capita	
	Million pounds	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Pounds*	*Pounds*	*Percent*
1924	8,429	53	26	8,508	4,111	43	50						4,364	37.2	72.9	51.2
1925	8,545	43	32	8,620	4,144	53	40						4,383	37.3	72.7	51.5
1926	8,766	53	36	8,855	4,309	41	31						4,474	37.6	73.7	50.8
1927	8,912	41	34	8,987	4,392	52	29						4,514	37.4	73.8	50.7
1928	8,943	52	33	9,028	4,330	60	31						4,607	37.7	73.2	51.6
1929	9,192	60	29	9,281	4,398	73	31						4,779	38.7	74.4	52.2
1930	9,269	[3] 90	23	9,382	4,470	91	29						4,792	38.4	74.3	51.8
1931	9,507	[3] 92	19	9,618	4,728	66	31						4,793	38.1	75.6	50.3
1932	9,568	66	16	9,650	4,729	54	18						4,849	38.3	75.6	50.6
1933	9,645	54	14	9,713	4,734	88	15						4,876	38.3	75.8	50.9
1934	9,362	88	14	9,464	4,535	83	17						4,829	37.7	73.1	51.6
1935	9,324	83	16	9,423	4,372	55	17						4,979	38.6	72.3	53.1
1936	9,424	55	40	9,519	4,307	108	16						5,088	39.2	72.6	54.3
1937	9,379	108	20	9,507	4,201	89	19						5,198	39.8	71.8	55.2
1938	9,730	89	16	9,835	4,439	108	24						5,264	40.0	73.9	54.4
1939	9,809	108	20	9,937	4,473	81	22						5,361	40.4	73.9	54.4
1940	10,036	81	10	10,127	4,502	105	53						5,467	40.8	74.9	55.1
1941	10,538	105	6	10,649	4,607	136	69		35	148	183	92	5,562	41.6	77.9	56.3
1942	10,839	136	7	10,982	4,264	83	29	35	225	294	484	217	5,905	44.3	79.3	60.7
1943	10,667	83	7	10,757	3,933	88	17	225	155	415	345	393	5,981	45.3	77.0	63.1
1944	10,631	88	3	10,722	3,533	100	23	155	148	446	439	633	5,994	46.0	75.8	66.8
1945	10,857	100	3	10,960	3,382	64	55	148	220	390	462	596	6,401	48.9	76.6	68.8
1946	10,683	64	6	10,753	3,065	116	113	220	35	458	273	129	7,057	50.3	74.5	71.3
1947	10,630	116	3	10,749	3,144	102	303	35	17	133	115	173	6,912	47.8	72.8	70.4
1948	10,230	102	12	10,344	2,941	184	213	17	16	107	100	120	6,771	46.0	68.8	71.3
1949	10,530	[3] 185	15	10,730	2,999	155	201	16	249	61	294	184	6,897	46.1	69.6	71.5
1950	10,557	155	20	10,732	3,004	117	120	249	262	323	336	73	7,082	46.5	68.6	71.5
1951	10,366	117	24	10,507	2,895	166	164	262	50	192	−20	148	7,154	46.7	66.2	72.1
1952	10,356	166	55	10,577	2,579	280	118	50	37	22	9	158	7,433	47.8	65.1	75.1
1953	10,847	280	21	11,148	2,615	187	104	37	523	162	648	138	7,456	47.1	67.0	75.9
1954	11,006	187	16	11,209	3,004	153	90	523	342	252	71	116	7,775	48.2	66.8	72.7
1955	11,091	153	17	11,261	2,333	199	131	342	222	552	432	138	8,028	48.8	66.2	73.0
1956 [4]	11,313	199	16	11,528	2,274	203	133	222	215	601	594	133	8,191	48.9	66.4	73.9

[1] Production determined by applying percentage of solids-not-fat in whole milk to quantity of milk produced. Total consumption by civilians determined from percentage of solids-not-fat in individual dairy products consumed per capita and number of people. Quantities in remaining columns except "fed to animals or wasted" were determined by applying percentages of solids-not-fat in each product to amount of product. The quantity "fed to animals or wasted" is the difference between total supply and total distribution among consumption, exports, and ending stocks.

[2] Includes quantities used by military in civilian feeding programs abroad.

[3] Nonfat dry milk solids included beginning January 1, 1930; cold-storage holdings of cream beginning January 1, 1931, and condensed milk (bulk) beginning January 1, 1949.

[4] Preliminary.

WHERE ARE SUPPLIES AND DEMANDS EQUATED?

Because of the complexity of the dairy economy, supply and demand are equated at many intermediate points. Thus there are many market clearing relations. A study of the data in table 13 suggests that market clearing relations are needed for individual dairy products as well as for total milk. Also, aggregate supply and demand relations for the United States as a whole could be broken down into those for smaller geographic units. Theoretically, this subdivision could continue until only a single buyer and seller were left, since aggregate supply and demand relations represent the summation of those for all buyers and sellers. Geographic analyses, if made at all, generally are based on a fairly high degree of aggregation because of cost and the availability of data.

Market clearing relations for the different levels of the marketing chain can be broken down into three distinct sectors. These are the producing or farm level, the wholesale level, and the consumer or retail level. Each may be looked upon as a key focal point.

At the retail level, the final consumer with given income, tastes, and preferences apportions his expenditures, including net savings, among various commodities and services by comparing their relative prices. The aggregate behavior of these individuals comprises the total demand by consumers for all milk and for individual dairy products as compared with total goods and services.

Demand at the wholesale level may represent mainly a derivation of that at retail. The wholesale level can be thought of as the point at which changing demand and supply conditions for individual dairy products become most clearly evident. Prices for the several products as determined here affect the utilization of available milk at manufacturing plants because prices cannot change materially without more milk being diverted to the higher-priced product. On the other hand, if the final consumer demand for one product increases relative to the demand for others, this will be reflected in the wholesale market through increased demands of retailers, and prices of that product relative to those for other dairy products will tend to rise sufficiently to result in the necessary increase in production. The price of butter on the Chicago Produce Exchange is an example of a quotation at this level.

In the final analysis, for a free market, demand and supply for total milk is equated at the farm or f. o. b. plant level. Prices received by farmers at the point of first sale as published by the Agricultural Marketing Service are appropriate for use at this level. Such prices might apply to all milk sold at wholesale or butterfat in farm-separated cream, or more specifically to prices received by farmers for milk or butterfat delivered to creameries or milk sold to cheese factories, condenseries, or country and city receiving plants for fluid milk uses.

Figure 4 illustrates these relationships. The upper section of the chart indicates that all demand is derived ultimately from consumers, so that the demand at both the wholesale and the farm level is a "derived" demand in the economic sense. Supplies of the processed milk items at wholesale and retail levels include marketing services as well as the farm produced milk. The middle section illustrates that prices at all three levels are interrelated, the differences reflecting

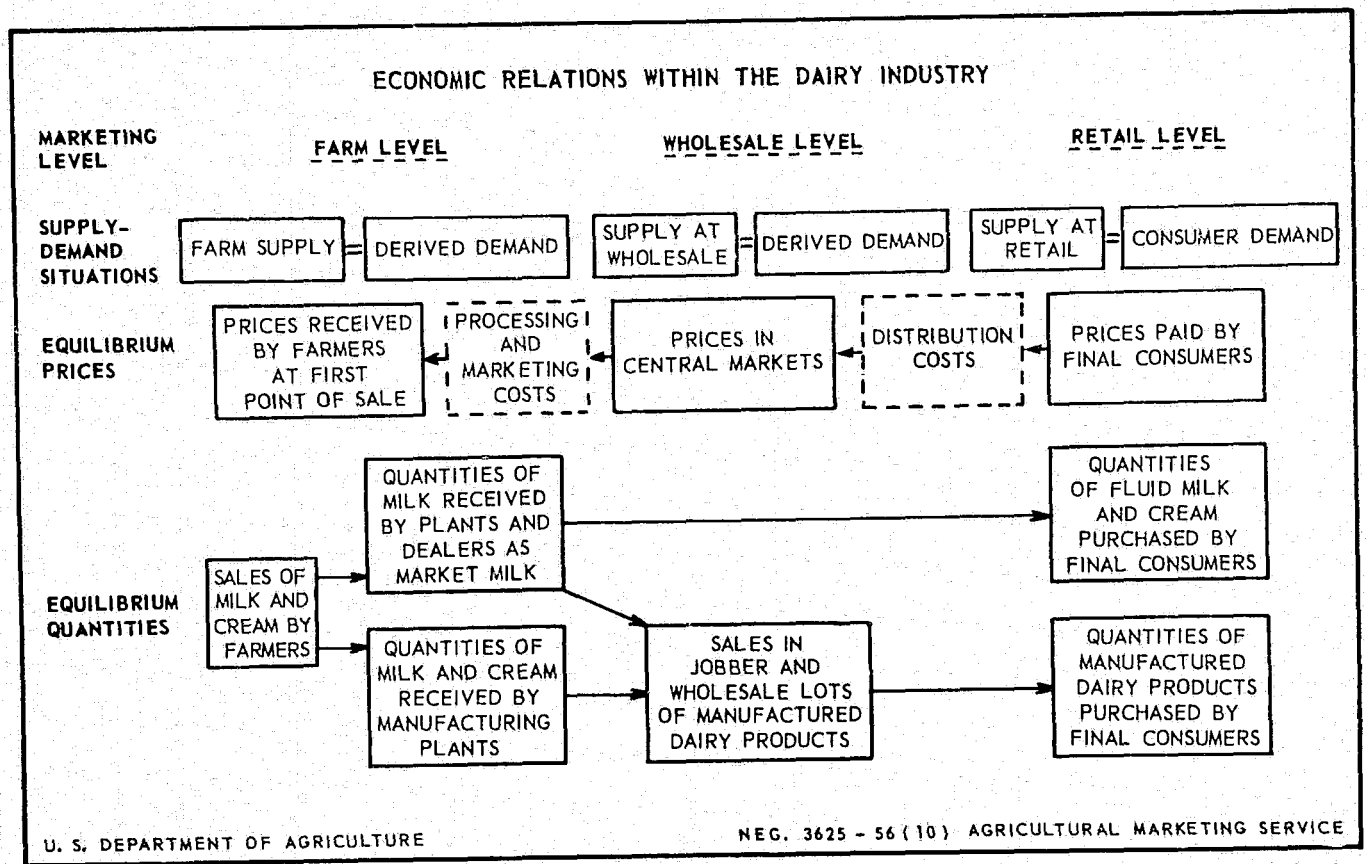


FIGURE 4.—Market clearing relations or the equating of supply and demand occurs at three levels of marketing—retail, wholesale, and farm. The supply and demand for total milk is equated at the farm or f. o. b. plant level. The demand and supply for individual products is equated chiefly at the wholesale level.

chiefly intervening costs. The lower section shows the relationships between the quantities of milk and products involved. Only milk or cream sold by farmers enters commercial channels; that retained on farms is an alternative choice made by farmers; it has little economic effect except as it reduces the supply available for sale. At the farm level, one important division relates to milk sold as (1) market milk for use chiefly as a source for fluid milk and cream and (2) milk for use in manufacturing plants. Another division that could be used is milk sold as whole milk versus cream separated on the farm. Or a combination of these two could have been shown in the diagram. Fluid milk and cream largely move directly from processing plants into retail or consumer channels, thus bypassing the wholesale level. Most manufactured products move through wholesale and jobbing channels.

Decisions regarding how milk is to be channeled are important because once milk has been converted into a particular dairy product, in most instances it cannot be reconstituted into its original form. At the producer level, farmers choose to sell their milk either as whole milk or farm-separated cream. In selling their milk, farmers also may choose among creameries, cheese factories, condenseries, or fluid markets. When a manufacturing plant has facilities to produce several dairy products, decisions regarding conversions to particular products also are made at the plant. Decisions that affect imports and in- and out-of-storage movements are determined chiefly at the wholesale level. Ice cream usually is manufactured at the city plant (wholesale level) or in small retail outlets.

These three levels of the marketing chain are closely related, and decisions made at any one have almost immediate effects on both the others. From an accounting standpoint, the total quantity flow in terms of milk equivalents should be the same at each. Likewise, prices at each level are related. They tend to differ only by the average cost of performing processing and marketing services, or by factors reflecting differences in amounts of fat and non-fat-solids or non-milk ingredients in the various products. Conceptually, if a variable could be included to measure shifts in processing and marketing costs, it should be immaterial at whatever level the supply and demand analysis was conducted. In most cases, the analysis need be done at one level only; the results then can be translated to apply at any other level.

AGGREGATE DEMAND AND PRICE ANALYSES FOR TOTAL MILK

The discussion of the economic structure of the dairy industry in this section involves a relatively simple form. In any industry, equilibrium exists only when the many individual supplies and demands are equated at all points. Because of its complexity, the dairy industry has a whole multitude of such points. The many equilibrium positions, which result from the aggregate behavior of buyers and sellers in their particular sectors, reflect the nature of the industry itself. A complete study of the price, supply, and demand structure logically would involve a study of each sector separately, and of the

aggregation of the results, to permit evaluation of the total structure. Data are not available to carry out such studies in detail and, in general, studies involving subaggregates are more complex than are those for total milk. In this bulletin, the economic structure is first studied by considering the largest possible aggregate, then by breaking this into smaller parts. Statistical analyses are included wherever possible.

A SIMPLIFIED DEMAND RELATION

The economic structure of the dairy industry in its simplest form includes only a single supply and demand relation for total milk for the country as a whole. The market clearing relation in this instance explains the aggregate behavior of all those who supply or demand milk or dairy products. As the aggregate demand is determined at retail, the analysis is applied at that level of the marketing chain. However, similar relations could be worked out for other levels.

Let us reexamine figure 1 (page 8) to see whether any clues are given as to the type of relationships needed to explain the price, supply, and demand structure for all milk at retail. The striking feature is that few two-way relations result when aggregate supply and demand are considered. The diagram also suggests lags in the adjustment of production to price. Thus, in any given period of a year or less, production of milk can be assumed to affect the price received by farmers, but price may not affect current production to a significant degree. This results because many decisions regarding production adjustments are made well in advance of the production period. The time needed for adjustment varies, depending on its nature. For example, the quantity of milk produced may be altered by changing the rate of feeding, and thereby milk production per cow, or by changing the number of cows milked. The time needed for the former is short compared to that needed to increase the milking herd. Because of the importance of the law of diminishing returns in dairying, changes in production achieved by varying the rate of feeding are relatively expensive. Hence, major changes in aggregate production usually result from changing the number of cows milked or, in a longer-run situation, by increasing production per cow by improved breeding and other basic practices. In contrast to the production of crops, where production plans are made chiefly before planting season each year, production plans in dairying to some extent are subject to continual change.

The quantity of milk and dairy products going into domestic human consumption in any period depends not only on the quantity produced but also on the quantity fed to animals, the net change in dairy products in storage, and net foreign trade. If the changes in these outlets are small in relation to total production, changes in the amount of milk used for consumption are highly associated with changes in production. This is shown to have been true for the period between World Wars I and II (see page 61). Under these circumstances, production and consumption statistics can be used interchangeably in supply and demand analyses for total dairy products at retail.

Since aggregate milk production within a given year is affected only slightly by current price, the supply equation for total milk for any

period becomes essentially fixed, as does the aggregate supply of dairy products at the consumer level. In a graphic presentation of supply and demand curves where quantity is plotted on the horizontal axis, the supply curve for the dairy industry for total milk becomes essentially a vertical line (see fig. 5, p. 70). Under these circumstances, the economic structure for aggregate milk at retail can be quantified by making use of a single demand curve, with price as the dependent variable. The relationship might be stated in words as follows: Price is a function of consumption (or production), consumer income, and consumer habits that change gradually over time. Such a demand equation can be represented by the line DD on part A of figure 5, p. 70. This formulation is believed to be useful chiefly for years before World War II. In these years, substitute commodities are assumed to have affected the price of total milk only slightly.

STATISTICAL ANALYSES OF DEMAND AT RETAIL

Using the general approach discussed above, several statistical analyses were run to estimate the coefficients of the demand equation. The analyses were based on data for the period 1924–41, because conditions during and after World War II did not meet those implied by this simple economic framework. The economic variables are the same in each analysis but they are expressed in various ways. These variations include (1) current or constant dollars, (2) actual or first differences of arithmetic values and (3) first differences of logarithms. A brief description of each variable is given below.

Variables

Prices.—Price is used as the dependent variable in these analyses because the other variables are assumed to be determined chiefly by economic factors in a previous period, or by conditions outside the dairy economy. The Bureau of Labor Statistics index of retail prices of dairy products on a calendar year basis is used. Use of a composite price is permissible, on the assumption that all dairy prices under equilibrium conditions are closely related and differ only by a constant or proportionate amount. The extent to which prices of dairy products actually are related at retail is discussed later.

Consumption.—Estimates by the Agricultural Marketing Service of per capita disappearance of total milk, in pounds of milk equivalent per year, are used for the consumption variable. Consumption in any year is assumed as given and is used as an independent variable in this analysis. The following steps are involved in arriving at this conclusion: (1) As discussed previously, production is affected mostly by economic conditions in the previous year, and only slightly by current prices; (2) retail prices adjust so that in any given marketing year (April through March) consumption is approximately equal to production; (3) estimates of per capita disappearance derived from data on a calendar year basis do not differ significantly from those derived from data on a marketing year basis. For these reasons, yearly fluctuations in the quantity consumed are mainly the result of variations in production, with appropriate changes in current prices to induce consumers to use the quantity produced.

Variations in consumption are highly associated with variations in production if the following conditions hold in any marketing year:

1.—Variation in carryover stocks from one marketing year to another is small in relation to total milk production. For the period 1924–41, year-to-year variations in stocks of manufactured dairy products (excluding stocks of fluid cream) on April 1 averaged 0.4 percent of total milk production. Only in 1930, 1939 and 1940 were these variations greater than 0.5 percent.

2.—The net import-export balance for dairy products changes little from year-to-year, or the change is small in relation to total milk production. For the period 1924–41, year-to-year variation in the net import-export balance for dairy products (in terms of milk equivalent) averaged 0.2 percent of total milk production. Only in one instance did the percentage equal 0.5 percent or more. In addition, some of the foreign-type cheeses imported probably competed only slightly with domestic cheeses, owing to their relatively high price; this was particularly true before World War II.

3.—Year-to-year changes in the quantity of milk fed to animals in relation to total milk production are small. For the interwar period, the average change was less than 0.1 percent of total milk production.

In each of the above computations, the direction of change was disregarded in obtaining the average.

The above data suggest that, for the period between World Wars I and II, production and consumption data can be used interchangeably in statistical analyses designed to measure the price and demand structure for all milk.

Other variables.—Per capita disposable income in dollars per year is used as one variable causing shifts in demand over time. Income is assumed to affect the dairy economy, but not to be materially affected by it. Time is included as a variable in analyses not based on first differences to allow for gradual long-range changes in consumer habits. The constant value in first difference analyses reflects similar effects if it differs significantly from zero.

Coefficients Obtained

The upper section of table 17 shows the coefficients derived by the method of least squares from analyses in which the economic variables were expressed as arithmetic values. Data in the lower section of the table show the percentage effect on product prices of a 1-percent change in the disappearance of total milk, or of disposable personal income, and of a change of a year in time. They were derived as follows: (1) For analyses I to IV, these percentage relations were computed, using the average values of the economic variables and the coefficients of the equations shown in the upper section of the table; and (2) for analysis V, they represent regression coefficients obtained from an analysis based on first differences of logarithms. In these analyses, all of the regression coefficients except one differed significantly from zero when tested at the 5-percent level.

In all of the analyses except one, the coefficient expressing the relation between price and consumption in percentage terms, which can be thought of as the reciprocal of the coefficient of demand elasticity

TABLE 17.—*All dairy products: Factors that affect changes in index numbers of retail prices, based on data for 1924–41* [1]

Item	Analysis [2]				
	I	II	III	IV	V
Coefficient of multiple determination	0.98	0.91	0.89	0.84	0.93
Standard error of estimate	2.70	2.80	2.02	1.90	([3])
Constant term or intercept value	142.77	−1.15	178.69	−.28	
Effect on price of a unit change in—					
Disappearance of total milk, pounds per capita: [4]					
Net effect	[5] −.11	−.16	−.14	−.15	
Standard error	.06	.06	.04	.04	
Coefficient of partial determination	[5].23	.36	.44	.53	.45
Disposable personal income, dollars per capita: [6]					
Net effect	.12	.12	.07	.08	
Standard error	.01	.01	.01	.01	
Coefficient of partial determination	.95	.88	.82	.75	.92
Time, 1924=1:					
Net effect	−1.28		−.33		
Standard error	.13		.10		
Coefficient of partial determination	.88		.42		
Net effect on price of a 1-percent change in—[7]					
Disappearance of total milk, per capita [4]	*Percent* [5]−.81	*Percent* −1.17	*Percent* −1.11	*Percent* −1.22	*Percent* [8]−1.26
Disposable personal income, per capita [6]	.62	.59	.36	.38	[8].60
Time	−1.17	[9]−1.05	−.33	[9]−.28	[9]−.93
Elasticities—[10]					
With respect to price based on—					
Average values of economic variables, 1924–41	[5]−1.23	−.85	−.90	−.82	−.80
1953 values of economic variables	[5]−2.76	−1.91	−1.15	−1.05	−.80
With respect to income based on—					
Average values of economic variables, 1924–41			.32	.31	.48
1953 values of economic variables			.60	.58	.48

[1] 1935–39=100. Index of prices from the Bureau of Labor Statistics.

[2] Type of data used: I—actual data in current dollars; II—year-to-year changes of actual data in current dollars; III—actual data in constant dollars; IV—year-to-year changes of actual data in constant dollars; V—year-to-year changes in logarithms of data in current dollars. Series based on constant dollars obtained by dividing prices and consumer income by the Bureau of Labor Statistics index of consumer prices, 1935–39=100.

[3] The standard error of estimate is 2.26 percent of the expected value for the index of retail prices.

[4] Apparent consumption by civilians, Agricultural Marketing Service.

with respect to price, was between —1.1 and —1.3. The exception is for the analysis based on actual data in current dollars, for which this coefficient was —0.8. In general, analyses based either on constant dollars or on first differences are expected to give more reliable estimates of the degree of elasticity than are those based on current dollars. Hence these analyses suggest that the price elasticity for the aggregate demand for milk at retail was around —0.8 to —0.9 for the years included in the analyses. If the coefficients for elasticity are based on current (1953) values of the economic variables, they are more than doubled for analyses I and II based on data in current dollars, but are only about a fourth higher for analyses III and IV, which are based on data in constant dollars. Analyses based on logarithms or first differences of logarithms assume that the elasticity coefficient remains the same for all values of the economic variables. It is likely that the elasticities indicated by analyses I and II for current years are too high.

In the analyses based on data in current dollars, a 1-percent change in per capita disposable income was accompanied by about a 0.6 percent change in the same direction in the price of dairy products. On the other hand, when data in constant dollars were used, prices changed about 0.4 percent with every 1-percent change in consumer income. A higher coefficient is expected when actual data are used, since this reflects the effects both of changes in real income and of changes in the general price level.

Income elasticities were computed from algebraically-transformed equations which place quantity in the dependent position. Based on analyses for data in constant dollars, a 1-percent increase in real income was accompanied by a 0.3 percent increase in consumption of total milk for the years included in the analysis. Coefficients were almost doubled when the elasticities were based on current (1953) values of the economic variables.

In the analyses based on data in current dollars, prices of dairy products tended to decrease about 1 percent per year in the period between World Wars I and II, after allowing for the effects of the other variables. But when data are expressed in constant dollars, prices of dairy products decreased only about 0.3 percent per year during the same period. The two values differ because, on the one hand, the former reflects effects on price both of long-run changes in the general price level and of long-run shifts in the demand for total milk that occurred from 1924 to 1941; and, on the other hand, the

Table 17 Footnotes—Continued

[5] Differs significantly from zero when tested at the 10-percent probability level but not at the 5-percent level.

[6] Department of Commerce and Agricultural Marketing Service.

[7] Derived as follows: In analyses I to IV, based on average values of the economic variables for the years included in the analyses and the coefficients shown in the upper part of the table; in analysis V, coefficients obtained from the analysis.

[8] Standard errors in logarithms are 0.37 for disappearance of total milk and 0.05 for income.

[9] In analyses II and IV, based on average values of the index of retail prices for the years included in the analyses and the constant or intercept values shown in the upper part of the table. In analysis V, based on the constant or intercept value obtained from the analysis.

[10] Computed at the given values of the economic variable from algebraically transformed equations which place quantity in the dependent position.

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latter allows only for the gradual changes in consumer habits over time. If no change in the level of prices had occurred during this period, the coefficients for time on a percentage basis would have been nearly identical.

The analyses suggest that variations in per capita disposable income explain a greater proportion of the total variation in prices than do variations in per capita disappearance. During the period 1924–41, the coefficients of partial determination ranged from 0.75 to 0.95 for income as compared to 0.23 to 0.53 for disappearance of milk. These coefficients indicate the percentage of variation in prices explained by the respective independent variables after allowing for the effects of the other variables in the analysis.

Attention should be called to the fact that important shifts in the demand function for a given commodity can result from changes in the supply and demand position of substitute products. Before World War II, influences of this sort apparently were not important for total milk. However, in recent years, the substitution of margarine for butter has resulted in a shift in the demand function for butter and for total milk. Statistical analyses relating to this are discussed later.

ANALYSES OF DEMAND FOR MILK AT THE FARM LEVEL

An alternative method of determining the demand and price structure for total milk is to estimate coefficients for the market clearing relation at the farm level. Based on a logarithmic first difference analysis for 1924–41, this relation is:

$$X_0' = -0.0026 \underset{(0.64)}{-2.12}\ X_1' + \underset{(0.08)}{0.99}\ X_2'^{8}$$

where X_0 is the price received by farmers for all milk at wholesale, X_1 is the per capita disappearance of total milk, and X_2 is per capita disposable personal income. Numbers in parentheses beneath the regression coefficients are their respective standard errors.

The coefficients of partial and multiple determination for this analysis are practically the same as for the comparable analysis at the retail level (see analysis V, table 17). This indicates a close relationship between retail and farm prices. Based on a logarithmic first difference analysis for the same period, 97 percent of the variation in prices received by farmers was associated with fluctuations in retail prices.[9] On the average, a 1-percent change in the index of

[8] The following statistical coefficients pertain to this analysis:

$R^2_{0\,12} = 0.93 \quad r^2_{01\,2} = 0.44$

$s_{0\,12} \quad 0.02 \quad r^2_{02\,1} = 0.91$

[9] Relationships between retail and farm prices are discussed on page 187. The following equation and statistical coefficients were obtained in this analysis when all variables are expressed as first differences of logarithms:

$$X_0' \quad \underset{(0.08)}{0.0017 + 1.62\ X_1'}$$

$s_{0.1} \quad 0.01 \quad r^2_{01} \quad 0.97$

The constant value in the regression equation does not differ significantly from zero.

retail prices of all dairy products was associated with a change of 1.6 percent in the price received by farmers for all milk at wholesale.

As expected, prices vary relatively more at the farm level than at the retail; conversely, the elasticity of demand with respect to price is less elastic at the farm level than at the retail level. The two elasticity coefficients are —0.5 and —0.8, respectively. When the estimating equation is transformed algebraically to place quantity in the dependent position, a 1-percent increase in income is followed by a 0.5 percent increase in total milk consumption, the same as at the retail level for the analysis based on first differences of logarithms.

PROBABLE POSTWAR RELATIONSHIPS FOR AGGREGATE DEMAND

The equation for aggregate demand is in a form that can be used directly to estimate prices. If the demand and price structure now is essentially the same as for the years used in the analysis, the equation can be used to estimate prices in the period following World War II. Table 18 presents information needed to test the usefulness of the pre-World War II relationships for estimating postwar prices (farm and retail). Poor forecasting ability suggests a change in the underlying economic structure.

The first row of table 18 shows, for each of the regression analyses, an "error tolerance" equal to two standard errors of estimate from the analyses based on data for the period between World Wars I and II. If the demand-supply structure represented by these regression equations and the probability distribution of residual errors still apply, about 1 predicted price in 20 might be expected to deviate from that based on the regression equation by more than 2 standard errors of forecast, provided the values of the independent variables for the new observation fall within the range established by the values for the years included in the analysis. As the standard error of estimate always is smaller than the standard error of forecast, the error tolerance shown is somewhat too small. Since the coefficient of multiple determination is practically identical for the farm and retail regressions, the higher error tolerance obtained for the regression applying at the farm level reflects the higher degree of price flexibility at this level.

For the prewar regression equations, differences between the actual and estimated change in price in the postwar years exceeded the applicable error tolerance oftener than 1 time in 20. Thus these equations appear to be inadequate as a forecasting mechanism. Their inadequacy probably stems from the following reasons:

1.—They do not allow for changes in export demand. Commercial exports and shipments to United States Territories (milk equivalent, fat-solids basis) never until 1946 exceeded a billion pounds annually—usually they were substantially less. They increased to 3.7 billion pounds in 1947, receded rapidly thereafter, and were again less than a billion pounds per year for 1952–55.

2.—The pre-World War II regressions do not take into account the influence of the fats and oils economy on the consumption of butter, and thereby on the prices of all dairy products. Per capita consumption of butter dropped from 11.1 pounds in 1947 to 8.9 pounds in

TABLE 18.—*Milk and dairy products: "Error tolerance" and differences between actual year-to-year price changes and estimates from regression equations based on data for 1925–41, percentage of expected price, 1947–56*

Item	Analysis based on prices at—	
	Retail, all dairy products [1]	Farm, all milk, wholesale [2]
	Percent	*Percent*
Error tolerance for single observation [3]	4.6	7.9
Difference between actual and estimated change in price:		
1947	[4] 8.0	−1.4
1948	−2.3	−7.1
1949	[4] −5.5	[4] −14.9
1950	−3.4	−6.1
1951	3.8	1.9
1952	.8	−.9
1953	[4] −4.7	[4] −16.4
1954	−.7	−5.0
1955	.6	2.0
1956	1.2	.6

[1] Coefficients in the regression equations are shown in table 17.

[2] See page 64 for regression equation.

[3] Twice the standard error of estimate. If the real economic relationships and the factors making for residual errors or disturbances are the same as in 1924—41, about 1 actual price change in 20 would be expected to deviate from the estimated price by more than 2 standard errors of forecast, provided the values of the independent variables for the new observation fall within the range established by the values for the years included in the analysis. The error of tolerance as computed is slightly to considerably smaller than this, and deviations of larger size would be expected somewhat more frequently.

[4] Difference greater than the error tolerance shown in the first row.

1955, while per capita consumption of margarine increased from 4.9 pounds in 1947 to 8.0 pounds in 1955.

3.—Because price supports were in effect during years following World War II, it is possible that the supply of milk cannot be considered as given for these years. As discussed on page 59, current prices during the years included in the analysis were assumed to have only a negligible effect on current production. However, when support prices are announced by the Government for a year or more in advance, it is likely that they do affect farmers' short-term decisions regarding rates of feeding and culling. Such effects can result either from supports on prices of milk and dairy products, on feeds, or on animal products that compete for resources used in milk production, such as hogs or beef cattle. In the years before World War II, Government price supports probably had less direct effect on dairy production.

4.—Temporary factors, such as the outbreak and aftermath of the Korean conflict, affected prices in ways not allowed for by the regression equations.

To study the economic structure for the post World War II period in a statistical way, several logarithmic first difference analyses were run based on data for 1947–53. Because of the few years used, results of these analyses are only suggestive of the current economic structure. Table 19 presents the results of 3 different approaches at both the farm and retail level. The first shows price as dependent on disappearances of total milk and disposable income and is of the same type as the pre-World War II regressions. The second replaces the income variable with the price of margarine to allow for the possible effect of the substitution of fats and oils for milk fat, primarily butter. This analysis assumes that the price of margarine is unaffected by the price of dairy products. The third analysis includes both the effects of income and of the substitute commodity.

The results (table 19) show that the percentage of variation in price of dairy products associated with the price of margarine is greater at the retail level than at the farm level. This is logical, as the initial and most direct impact of margarine is on the retail price of butter. The percentage of variation in prices explained by changes in income is considerably lower for the post World War II equations than for those based on prewar data. But in two analyses for the farm level, the income elasticity coefficient is of approximately the same magnitude as that obtained from analyses based on data for the prewar period. On the other hand, the percentage of variation in price explained by changes in the supply variable is practically identical for comparable analyses based on postwar or prewar data. The inclusion of the price of margarine as a variable in the analysis increased the percentage of variation in price explained by changes in supply. In all instances, the regression coefficient relating price and consumption for the postwar equations was substantially higher than comparable coefficients obtained from analyses based on prewar data, resulting in smaller coefficients of elasticity. The lower estimates of price elasticity for all milk for the postwar period may in part be explained by the greater proportion of milk channeled into fluid outlets. As shown later, this item has a lower price elasticity than most other dairy products.

STRUCTURAL RELATIONSHIPS WITH MULTIPLE OUTLETS

A study of the price, supply, and demand structure for individual dairy products cannot be handled in the same simplified manner as that for the aggregate demand for all milk. Production (and consumption) of *any one product* depends on that of other dairy products, because in a relatively short period of time all must be produced from a fixed supply of milk. That is to say, the supply of milk going into any one outlet depends (1) not only on the demand for milk in that outlet but (2) also on the simultaneous interaction of the supplies and demand in each of the other outlets. No determinate supply function exists for a single dairy product, and the quantity of milk going into each outlet becomes known only after equilibrium has been reached in the industry. At equilibrium, the sum of the demands for milk in each outlet is assumed to equal the total supply of milk,

TABLE 19.—*Milk and all dairy products: Factors that affect year-to-year changes in retail and farm prices, based on data for 1947–53* [1]

Item	Based on prices at—					
	Retail, all dairy products for analysis—[2] [3]			Farm, all milk wholesale, for analysis—[3] [4]		
	I	II	III	I	II	III
Coefficient of multiple determination	0.72	0.88	0.88	0.79	0.74	0.80
Standard error of estimate	.02	.01	.02	.03	.04	.04
Constant term or intercept value	−.01	−.004	.002	−.05	−.02	−.04
Effect on price of a 1-percent change in—						
Disappearance of total milk per capita, percent:[5]						
Net effect	[6] −2.02	−2.10	−2.20	[6] −2.93	−3.91	[6] −3.00
Standard error	1.05	.57	.79	1.55	1.42	1.77
Coefficient of partial determination	[6] .48	.77	.72	[6] .47	.66	[6] .49
Disposable personal income per capita, percent:[7]						
Net effect	[6] .57	------	[6] −.14	[6] 1.54	------	[6] 1.27
Standard error	.70	------	.63	1.04	------	1.40
Coefficient of partial determination	[6] .14	------	[8] .02	[6] .36	------	[8] .22
Retail price of margarine, percent:[2]						
Net effect	------	.18	[8] .19	------	[8] .18	[6] .07
Standard error	------	.07	.09	------	.17	.21
Coefficient of partial determination	------	.63	[8] .58	------	[8] .21	[8] .04
Elasticities, based on average values of economic variables, with respect to—[9]						
Price	[6] −.50	−.48	−.45	[6] −.34	−.25	[6] −.33
Income	[6] .28	------	[6] −.06	[6] .52	------	[6] .42

[1] All analyses based on first differences of logarithms.

[2] All dairy products relate to index numbers, 1935–39=100. Bureau of Labor Statistics.

[3] All analyses include disappearance of total milk as a variable. Analysis I also includes disposable income; analysis II, price of margarine; and analysis III, disposable income and price of margarine.

[4] Price received by farmers for all milk sold at wholesale to plants and dealers. Agricultural Marketing Service.

[5] Apparent consumption by civilians. Agricultural Marketing Service.

[6] Does not differ significantly from zero when tested at the 10-percent probability level.

[7] United States Department of Commerce and Agricultural Marketing Service.

[8] Differs significantly from zero when tested at the 10-percent probability level but not at the 5-percent level.

[9] Coefficients obtained when the fitted price-estimating equation is transformed algebraically to put quantity in the dependent position.

less net exports and net increases in stocks. Therefore, statistical analyses for the several products must take into account the simultaneous determination of the supply and demand for each.

A description of the economic relationships that show the interaction of all the individual supply and demand relationships can be simplified by considering the interaction for two dairy products. The economic principles involved in these relationships can be extended readily to include three or more products. The discussion is built around the graphic presentations in figures 5 and 6.

EQUILIBRIUM UNDER GIVEN SUPPLY AND DEMAND CONDITIONS

The assumptions discussed on page 59 regarding the aggregate supply and demand for all milk will be continued. This aggregate demand can be represented by line DD in section A of figure 5. Likewise, the aggregate supply of milk can be represented by the vertical line, SS. Equilibrium is reached when the price (line PP) is at a level which permits the given fixed supply of total milk (line SS) to clear the market within the specified time period under given conditions of aggregate demand (line DD). Prices are at the point where line DD intersects line SS.

The aggregate demand for milk at the retail level can be thought of as the sum of the individual demands for (1) fluid milk and cream and (2) all milk in manufactured dairy products. In section A of figure 5, the line FF represents the demand for fluid milk and cream, and the line MM, the demand for milk used in manufactured dairy products. Given the demand for milk in these two outlets, the question to be answered is, how will the total supply of milk (line SS) be apportioned? In the mid-1920's, about 40 percent of the total milk was channeled into fluid milk and cream. In recent years this has increased to about 50 percent.

The answer to this question, under equilibrium conditions, can be read directly from section A of figure 5. Prices in the two outlets must be equivalent. If the price in one is higher than in others, all of the milk eventually would be channeled into this use. Therefore, a single price, P, is used for all outlets in explaining the interaction of their individual supplies and demands. Retail prices of the products are derived from this price, after allowing for differences in processing and marketing costs and nutritional composition (see page 83). The quantity of milk used for fluid purposes, OX, plus the quantity used for manufactured products, OY, must equal the fixed total supply, OS. If the total supply is to clear the market, prices must be at a point equivalent to that at which the line representing the aggregate demand, DD, intersects the line representing the aggregate supply, SS. All of these conditions are met by the price line PP; hence, this is the price under equilibrium conditions.

These principles can be clarified further by considering another price, P'. With this price, the quantity OW is used for fluid purposes and the quantity OZ, for manufacturing. But OW plus OZ is greater than the total supply, OS. Competitive bidding by dealers for milk under these conditions would drive the price upward until it reached the equilibrium level, P.

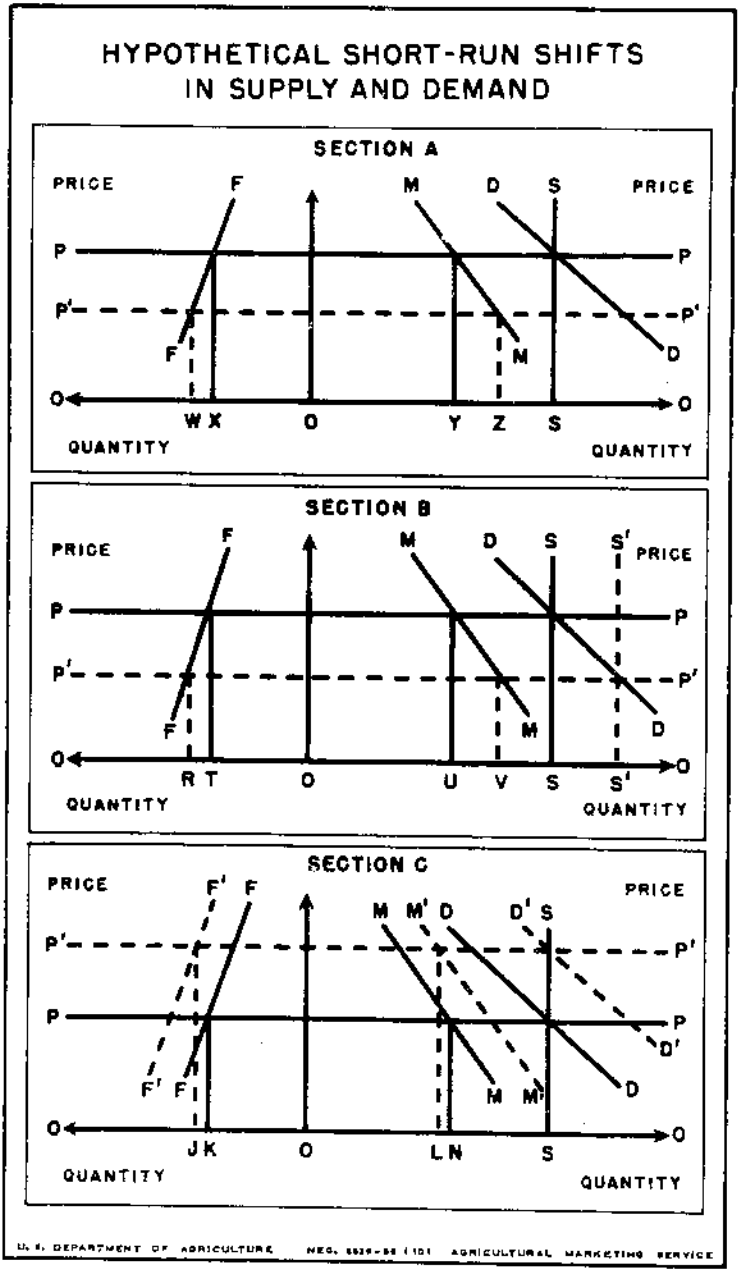


FIGURE 5.—This chart illustrates (1) the equilibrium price, P, and quantities of milk channeled into fluid, F, and manufacturing, M, outlets for a given level of milk supply, S (Section A), and (2) the effects on prices and quantities in each outlet of short-run shifts in supply (Section B) and demand (Section C).

The conditions specified always hold because DD represents the sum of the separate demands, FF and MM.

EFFECTS OF SHORT-RUN CHANGES IN SUPPLY AND DEMAND

The effects on the demand and price structure of short-run shifts in the aggregate supply of, or demand for milk are next considered.

Supply

Suppose that favorable weather conditions result in a sudden increase in the production of milk. This can be shown by letting the aggregate supply of milk increase from the quantity OS to the quantity OS′ (see section B of fig. 5). In this situation, the supply function shifts from the line SS to the line S′S′.

The same considerations that prevailed in establishing the old equilibrium position must prevail now in establishing the new one. Assuming no change in the demand structure, the new equilibrium price must be lower than the former one, so that the sum of the quantities of milk going into each outlet equals the new total supply. Specifically, the new quantity, OR, of milk going into fluid uses, and the new quantity, OV, going into manufactured uses must add to the new total supply, OS′.

The diagram in section B of figure 5 is drawn so that a greater portion of the increase in production is channeled into manufactured uses, that is, the quantity UV is greater than the quantity RT. This happens in real life when consumers alter their purchases of manufactured dairy products more than their purchases of fluid milk and cream, with equivalent changes in prices of the two products. In general, short-run or year-to-year variations in production with no changes in demand structure are apportioned among the different outlets according to the comparative price elasticities of demand of the several commodities. Price elasticity represents the percentage change in consumption normally associated with a 1-percent change in price. If the price elasticities are the same for all outlets, any increase in production is reflected equally in all of them. On the other hand, if the response to price is greater in any one outlet, variations in total supply result in a larger increase in that outlet than in the others.

Traditionally, butter has been considered as the buffer for sudden shifts in the supply position due to weather and other unexpected circumstances. Undoubtedly this has reflected, in part, the general availability of equipment for making butter, as opposed to that for making cheese and other manufactured dairy products, the ease with which butter can be stored, and its overall importance as an outlet for milk. From an economic standpoint this role suggests a higher price elasticity of demand for butter than for other major products such as fluid milk and cream. Elasticities for individual products derived from statistical data are discussed in a later section.

Demand

Section C of figure 5 illustrates the effect of short-run changes in demand for dairy products on the quantities of milk channeled into

each outlet, and the resulting equilibrium price for the dairy industry. Shifts in demand occur when people wish to buy either more or less products at a given price. Some of the factors responsible for short-run shifts in demand are changes in money incomes or in prices, supplies, and demands for substitute commodities.

Suppose that the tax laws are amended in such a way as to result in a substantial decrease in the amount of taxes withheld from the pay envelopes of wage earners. Suppose further that the resulting sudden increase in disposable income brings about an increased demand for dairy products. This situation can be illustrated graphically by shifting (1) the demand for fluid milk and cream from the line FF to the line F'F'; (2) the demand for manufactured dairy products from the line MM to the line M'M'; and (3) the aggregate demand for total milk from the line DD to the line D'D'. The latter equals the sum of the shifts in the other lines. With the aggregate supply of milk fixed at the line SS, prices must rise. At the new equilibrium price, P'P', the quantities OJ and OL of fluid milk and cream and manufactured dairy products, respectively, clear the market. In this case, the *increase* in the quantity of fluid milk and cream, JK, is offset by a *decrease* in the quantity of milk going into manufactured dairy products, LN. Although the two demand functions are drawn to show an increase in each of the same amount, consumption of fluid milk and cream increases, while consumption of manufactured dairy products decreases.

This example illustrates an important principle. When short-run shifts in the total demand for milk occur, if either the income elasticities or the price elasticities are different in any two outlets, a shift in the quantity of milk going into each outlet takes place. If the income elasticities are different, but the price elasticities are the same, and total supply is fixed, the quantity of milk going into the outlet with the higher income elasticity increases, while the quantity channeled into the outlet with the lower income elasticity decreases with every increase in demand. If the income elasticities are the same in both outlets and the total supply is fixed but the price elasticities are not the same, the quantity of milk in the outlet with the lower price elasticity increases, and that outlet with the higher price elasticity decreases, with every increase in demand. Obviously, it is possible for unique combinations of price and income elasticities to have such offsetting effects that no shift in milk utilization takes place.

The same principles hold when the shift in demand occurs in only one outlet. For example, in recent years the competition of margarine has shifted the demand curve for butter to the left. This shift in the demand for butter affected the quantities of milk going into other outlets in the same way as would an equivalent decrease in consumer income. It should be obvious that these rules can be extended to apply to any number of outlets.

LONGER-RUN SHIFTS IN SUPPLY AND DEMAND

In an analytical sense, short-run and long-run effects operate in much the same way. Perhaps the most striking difference is the randomness of the former and the frequent persistence of the latter. Two examples are illustrative. Year-to-year variations in the quantity of

milk produced resulting from variations in weather are essentially random. On the other hand, trends in consumption arising from population growth or changes in tastes are gradual but persistent.

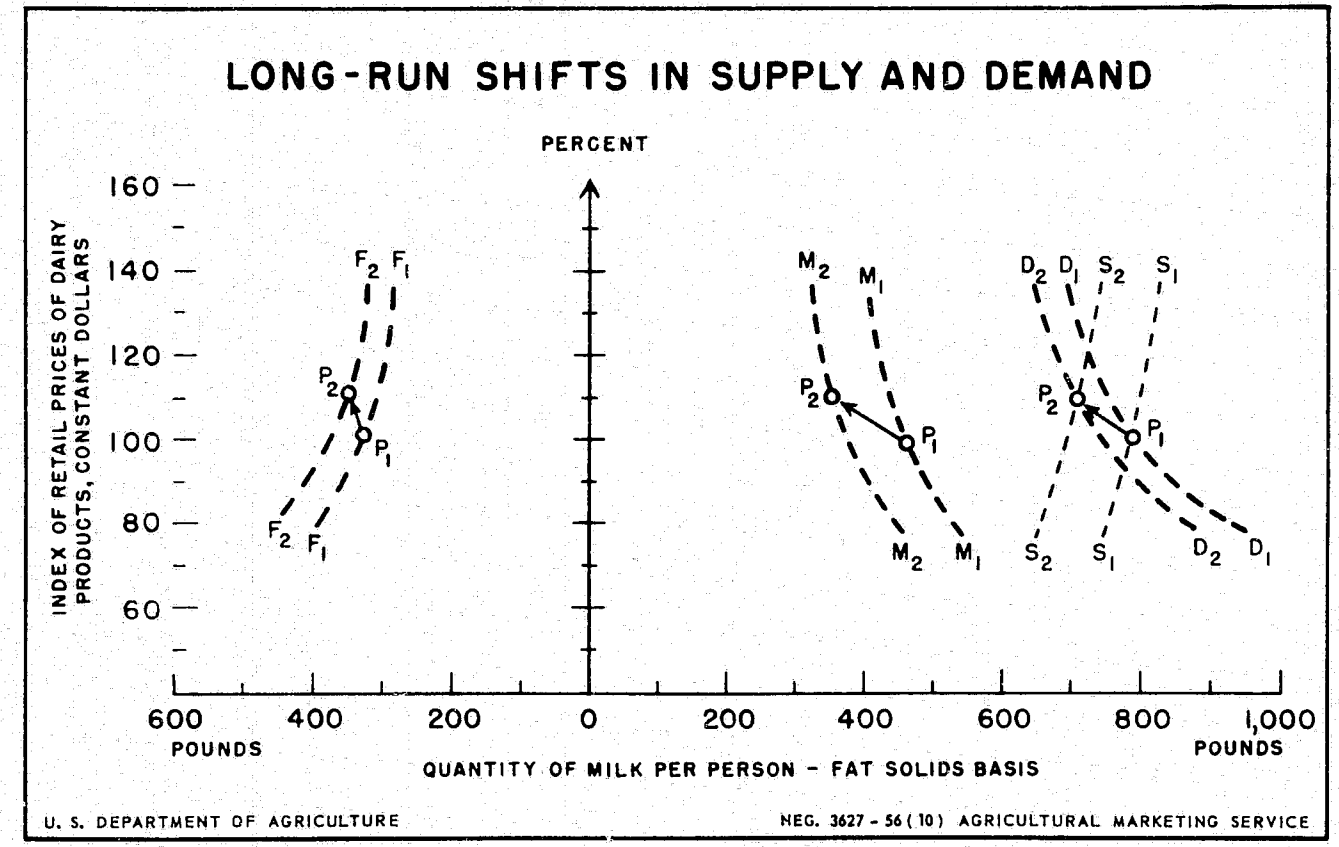
Figure 6 illustrates the combined effects on equilibrium prices and quantities of milk channeled into each outlet of simultaneous shifts in (1) the supply of total milk and (2) the demands for fluid milk and cream and milk used in manufactured dairy products. It is drawn to show, primarily, effects of longer-run persistent shifts in supplies and demands. It also attempts to incorporate empirical evidence into what up to now have been hypothetical illustrations. This is done by using prices and quantities for two periods—1935-39 and 1950-52—to represent equilibrium prices and quantities. It remains theoretical in part, however, because it imposes on these equilibrium prices and quantities some arbitrarily-drawn supply and demand curves of assumed shapes.

In figure 6 the lines D_1D_1 and D_2D_2 are assumed to represent aggregate demand curves for milk during the 1935-39 and 1950-52 periods, respectively. Likewise, the lines S_1S_1 and S_2S_2 represent supply curves for total milk during these periods. These curves are drawn so that they intersect at the prices that prevailed in these periods, namely P_1 and P_2. The index of retail prices of all dairy products expressed in constant 1935-39 dollars increased from 100 in 1935-39 to 111 in 1950-52. Per capita disappearance of total milk declined from 791 pounds (P_1) in the pre-World War II period, to 709 pounds (P_2) in 1950-52, a decline of 10 percent. The diagram suggests that the per capita demand for total milk declined between the 2 periods.

During the same period, disappearance of fluid milk and cream per capita, in terms of milk equivalent, increased from 330 pounds to 351 pounds. Retail prices, in constant dollars, increased about 2 percent. This is less than might have been expected, based on the theory discussed above, since prices of all dairy products increased about 11 percent. The smaller increase for prices of fluid milk and cream probably reflects a relative reduction in marketing costs growing out of increased sales through stores and a shift to every-other-day delivery on routes. The curves on the chart are based on a price elasticity of demand of -0.3, and the prices are consistent with those for all dairy products. The curves suggest that the demand for fluid milk and cream increased. Such a result would be expected, given a rise in real income. Available data indicate that real income increased by over 50 percent between these two periods.

Disappearance of milk in manufactured dairy products (fat-solids basis) declined from 461 pounds per person in 1935-39 to 358 pounds in 1950-52. This was associated with a decline in consumption of all milk and an expansion in consumption of fluid products. The chart suggests a decline in demand for manufactured dairy products. Further analysis of the data indicates that this reflects a decline in the demand for butter; disappearance of manufactured products other than butter increased in about the same way as did disappearance of fluid milk and cream.

All of these comparisons are on a per capita basis. Had they been on a total basis, aggregate demand for all milk would appear to be increasing, a larger expansion in the demand for fluid products would


LONG-RUN SHIFTS IN SUPPLY AND DEMAND
PERCENT
INDEX OF RETAIL PRICES OF DAIRY PRODUCTS, CONSTANT DOLLARS
160
140
120
100
80
60
F2 F1
P2
P1
F2 F1
M2 M1
P2
P1
M2 M1
D2 D1 S2 S1
P2
P1
S2 S1 D2 D1
600
400
200
0
200
400
600
800
1,000
POUNDS
POUNDS
QUANTITY OF MILK PER PERSON - FAT SOLIDS BASIS
U. S. DEPARTMENT OF AGRICULTURE
NEG. 3627 - 56 (10) AGRICULTURAL MARKETING SERVICE

be suggested, while the decline in manufactured products would be reduced to a smaller proportional amount.

This analysis is consistent with the theoretical considerations set forth in the preceding section.

STATISTICAL ANALYSES OF DEMAND FOR INDIVIDUAL DAIRY PRODUCTS

This section suggests ways to estimate consumers' response to prices and incomes that are consistent with the economic theory developed in the previous section. Specifically, we attempt to clothe our qualitative economic relationships with quantitative data. Both the single- and multiple-equation approaches are used to estimate the coefficients in the economic relations that explain the price and demand structure for dairy products. Unless otherwise specified, the analyses are based on data for the period between World Wars I and II. The coefficients obtained in the simultaneous- or multiple-equation approach are compared with those obtained by the single-equation approach, and the results of these two approaches in turn are compared with results of other studies. Preliminary estimates are given, and these are based on a post World War II model that takes into account the effects of substitute products—especially fats and oils—on the dairy economy.

STRUCTURAL DEMAND RELATIONS

Model I

Statistical demand relations for the several dairy products must be consistent with the theory outlined in the previous section. For this reason, the discussion of these relations is associated with figures 5 and 6. Their development continues the assumptions stated in the previous sections which dealt with economic theory and the aggregate demand for total milk.

This theory suggests that the quantities of milk channeled into each outlet are determined simultaneously. Suppose, as before, that the demand for total milk, Q_t, is comprised of the demand for fluid milk and cream, Q_f, and the demand for milk used in manufactured dairy products, Q_m. Suppose also that the consumption of dairy products is dependent on two factors—that of a single price, P, and disposable personal income, Y. The structural relations which take

FIGURE 6.—This chart shows the probable shifts that occurred between 1935–39 and 1950–52 in the supply for total milk, S_t, and the demands for total milk, D_t, for fluid milk and cream, F_t, and for milk in manufacturing outlets, M_t. The supply-demand curves for the two periods are hypothetical, but are drawn through the prices and quantities which prevailed during the 1935–39 period, P_1, and the 1950–52 period, P_2. Comparison of these two periods suggests that the decline in the demand for milk in manufacturing outlets more than offset the increase in the demand for milk in fluid outlets, thus resulting in a decrease in the overall demand for milk.

into account the simultaneous interactions among these demands are shown by equations (1) through (4) in the following tabulation:

MODEL I

Demand for total milk

$$P=A_t+B_tQ_t+C_tY+U_t \quad (1)$$

Demand for fluid milk and cream

$$Q_f=a_f+b_fP+c_fY+u_f \quad (2)$$

Demand for manufactured dairy products

$$Q_m=a_m+b_mP+c_mY+u_m \quad (3)$$

Identity

$$Q_t=Q_f+Q_m \quad (4)$$

In these relations the jointly determined or *endogenous* variables are P, Q_f and Q_m, while the given or *predetermined* variables are Q_t and Y. The symbols U_t, u_f and u_m represent random disturbances.

Equation (1) is the aggregate demand for total milk at retail. This demand relation, as well as those for the individual products, could have been built at the farm level. The formulation in equation (1) corresponds to the line DD in figure 5. Because the supply of total milk for any given year is assumed to be fixed, no equation is needed to explain changes in this variable. The effect on price, P, of variations in the level of milk supplies, Q_t, is shown by the coefficient B_t in the aggregate demand relation, assuming no change in income. Shifts in demand may result from variations in income or from other less important factors such as the supply and demand of substitute products. The effect of income in the demand relation for total milk is shown by the coefficient C_t. For example, if no change in the supply of milk occurs, a unit change in disposable personal income, Y, is reflected in the price, P, by a change equal to C_t. The effect of income on the quantity of total milk consumed is the sum of the effects of income on the quantities consumed of the individual dairy products. The inclusion of U_t (in equation 1) represents random disturbances affecting the retail price for dairy products. In the analyses that apply to the years prior to World War II, affects of substitutes are included in U_t.

Equations (2) and (3) are demand relations for fluid milk and cream and manufactured dairy products, respectively. These two relations are represented in graphic form by the lines FF and MM in figure 5. Each relation uses the same composite price. The reasons for this are discussed on pp. 60, 69. Variations in the quantities, Q_t and Q_m, consumed that are associated inversely with variations in price, P, are shown by the coefficients b_f and b_m, assuming no change in income. As in equation (1), per capita disposable income is used as a demand shifter. Variations in the quantities of the individual products, Q_f and Q_m, consumed are related directly with variations

in disposable personal income, Y, by the coefficients c_f and c_m, while holding supply of total milk constant. These shifts correspond to the shifts from line FF to line F'F' for the demand for fluid milk and cream and from line MM to line M'M' for the demand for manufactured products in section C of figure 5.

The quantity in each outlet becomes known only after equilibrium has been reached in the dairy industry. At equilibrium, the quantity of milk channeled into fluid milk and cream, Q_f, and the quantity channeled into manufactured products, Q_m, equal the supply of total milk, Q_t. This condition is shown by the identity expressed in equation (4). Implicit from this identity is that

$$1/B_t = b_f + b_m \text{ or } b_f B_t + b_m B_t = 1 \tag{5}$$

that is, the sum of the individual demand coefficients with respect to price equals the demand coefficient for total milk—the reciprocal of coefficient B_t in equation (1). Similarly the relation

$$C_t B_t = c_f + c_m \tag{6}$$

shows the relationship for demand coefficients with respect to income where the income coefficient for total milk is C_t/B_t. Relations (5) and (6), if desired, can be used as a computational check on the internal consistency of the demand coefficients.

The interrelationships expressed in equations (1) through (4) may be summed up as follows: Equation (1) determines the level of dairy product prices necessary for the fixed supply of milk to clear the market in any given period. Equations (2) and (3) determine the quantities of milk that are channeled into each outlet at given prices and incomes. Equation (4) shows that these quantities must equal the total supply of milk available.

Model II

The use of a single (composite) price at the retail level in all the structural demand relations results in biased coefficients with respect to price because of differences in the flexibility of prices of individual dairy products relative to prices of all dairy products. These differences can be observed in table 48, p. 198. The reader will remember that it is the price at the farm level that must be identical in all outlets, and that at retail, *equivalent* prices must be equal (see p. 69). In model I, the demand coefficient for fluid milk and cream, b_f, has a downward bias and the demand coefficient for manufactured dairy products, b_m, has an upward bias. For this reason, we need a formulation, say model II, which has a price variable in each demand equation that corresponds to the price of the individual product. If P_f is the price of fluid milk and cream and P_m, the price of manufactured dairy products, the demand relations (2) and (3) may be modified as shown in the following tabulation:

Retail demand equations

$$Q_f = d_f + e_f P_f + e_f Y + v_f \tag{2a}$$

$$Q_m = d_m + e_m P_m + e_m Y + v_m \tag{3a}$$

Model II has 5 variables that are simultaneously determined (P, P_f, P_m, Q_f and Q_m) but only 3 independent relations—equations (1), (2a) or (3a), and (4). Because the price for any individual dairy product is related to the price for all dairy products, the two additional equations shown in the following tabulation may be obtained.

Retail price relationships

$$P_f = g_f + k_f P + U_f \tag{7}$$

$$P_m = g_m + k_m P + U_m \tag{8}$$

In relations (7) and (8) the coefficients k_f and k_m are the price flexibilities for fluid milk and cream and manufactured dairy products, respectively, relative to the composite price for all dairy products. Thus the complete formulation for model II includes equation (1), (2a) or (3a), (4), (7), and (8).

If equation (7) is substituted for the variable P_f in equation (2a) and equation (8) is substituted for P_m in equation (3a), the following equations are obtained:

$$Q_f = (d_f + e_f g_f) + e_f k_f P + e_f Y + (v_f + e_f U_f) \tag{2c}$$

$$Q_m = (d_m + e_m g_m) + e_m k_m P + e_m Y + (v_m + e_m U_m) \tag{3c}$$

Because equations (2c) and (3c) are structurally equivalent to equations (2) and (3), it follows that $b_f = e_f k_f$ and $b_m = e_m k_m$ and relation (5) becomes:

$$1 - B_t = e_f k_f + e_m k_m \tag{5a}$$

However, the relationship between the income coefficients (relation 6) is unaffected by this substitution.

Model III

If equation (1) is substituted for the variable P in equations (7) and (8), the price equations take the form:

Retail price-estimating equations

$$P_f = A_f + B_f Q_t + C_f Y + V_f \tag{7a}$$

$$P_m = A_m + B_m Q_t + C_m Y + V_m \tag{8a}$$

where $A_f = (g_f + k_f A_t)$, $B_f = k_f B_t$ and so forth in terms of the coefficients in equations (1), (7) and (8).

The *two* demand equations (2a) and (3a), the *two* price equations (7a) and (8a), and the *identity* (4) include all the relations which take into account the simultaneous interactions among the supply of total milk and the demand for fluid milk and cream and for milk in manufactured dairy products. This formulation is referred to as model III. The relationships between the individual and the ag-

gregate demand coefficients with respect to price and income implicit in model III are shown by relations (5a) and (6).

Model IV

So far the formulations have been designed to measure price and demand relationships at the retail level. As shown on page 56, decisions to purchase the final dairy product are made at the consumer or retail level, while decisions that affect the channeling of milk into the several outlets are made at the farm and plant level. Thus a simplified formulation, say model IV, that takes into account the simultaneous interactions of demand and price at and between these two marketing levels can be shown by equations (1a), (2a), (3a), (4), (7b), and (8b).

Equation (1a) is the farm demand for milk such that

Farm demand for milk

$$P_w = A_w + B_w Q_t + C_w Y + U_w \tag{1a}$$

where the only new variable is P_w, the price received by farmers for milk delivered to the plant or the price at point of first sale. Equation (1a) is the farm equivalent of equation (1).

The retail demand equations (2a) and (3a) for fluid milk and cream and manufactured dairy products, respectively, and the identity (4) have been discussed.

Equations (7b) and (8b) relate the consumer sector with the farm sector in a simplified way as shown in the following tabulation:

Retail-farm price relationships

$$P_f = G_f + K_f P_w + U_d \tag{7b}$$

$$P_m = G_m + K_m P_w + U_e \tag{8b}$$

In these relations, G_f, K_f, G_m and K_m reflect marketing costs and the marketing structure which are discussed beginning on page 180. Farm and retail prices, of course, are determined simultaneously. The relationship between individual demand coefficients at retail and the aggregate demand coefficients at the farm level with respect to price is shown by equation (5b) and with respect to income, by equation (6b).

$$1/B_w = c_f K_f + c_m K_m \tag{5b}$$

$$C_w/B_w = c_f + c_m \tag{6b}$$

Model IV is identical to model II with respect to number of simultaneously determined and predetermined variables, as well as the type of equations formulated, with equation (1a) equivalent to (1) and equations (7b) and (8b) similar to (7) and (8). As in model II, if equation (1a) is substituted for the variable P_w in equations (7b) and (8b), the price equations (7a) and (8a) can be derived. Thus model III also follows from model IV, as it did from model II.

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Complex Dairy Models

These simplified models (I through IV) readily can be extended to include more than two outlets for milk. Model I, for n dairy products, contains $(n+1)$ endogenous variables, n quantities, and 1 price variable. The complete model needs $(n+1)$ relations; these might include 1 price-determining equation, $(n-1)$ demand equations for individual dairy products, and an identity. Model II, for n dairy products, consists of $(2n+1)$ endogenous variables, n quantities, and $(n+1)$ prices. A complete model needs $(2n+1)$ relations; these might be comprised of 1 price equation establishing the level of all prices, n price equations relating individual prices to the composite price, $(n-1)$ demand equations, and an identity. For model III, in which there are $2n$ endogenous variables, n prices and n quantities, the complete model needs $2n$ equations. These might consist of n price equations, $(n-1)$ demand equations, and an identity. Model IV is similar to model II except that it has mn prices, where n refers to the number of products and m the number of marketing levels for which prices are determined.

STATISTICAL ESTIMATES OF STRUCTURAL COEFFICIENTS

Method of Analysis

When working with time series on prices, quantities, and income, the method used to estimate the coefficients in the several relations for models I through IV discussed in the previous section depends on assumptions that are made regarding the type of functional relations which generated the observed data.

Model I.- The level of prices for dairy products in any given period can be determined directly from the demand relation for total milk (equation 1) because the only unknown variable is price. For essentially the same reason, the estimates for the coefficients in equation (1) can be obtained by the use of the least squares regression technique. But unbiased estimates of the coefficients in the demand relations for individual dairy products (equations 2 and 3) cannot be determined by the least squares technique because the quantity of milk channeled into fluid milk and cream is affected by the quantity of milk channeled into manufactured dairy products, and vice versa. To obtain estimates of demand coefficients that are statistically consistent, the parameters in the structural demand equations (2) and (3) must be estimated by a statistical method that allows for this simultaneity. Each of these relations in model I is just identified.[10] Hence, the reduced-form method or a modified limited information method of

[10] A counting rule tells us that if the number of variables in the system (endogenous plus all predetermined variables, counted separately) minus the number of variables in a particular equation *is equal* to the number of endogenous variables in the system less one, we have a *just identified equation*. This rule applies only when a single variable is multiplied by each regression coefficient. Several rules of thumb like this are available to determine the degree of identification; more exact rules depend on the rank of certain matrices. For an elementary discussion of the mathematical meaning of identification, see Foote (*46*, pp. 985–987).

fitting simultaneous equations can be used to estimate the coefficients.[11]

Model II.—Estimation of equation (1) has been discussed. Equations (2a) and (3a), like equations (2) and (3), are just identified and thus were fitted by the reduced-form method. The price equations (7) and (8) are over-identified.[12] Hence, the limited information method was used to obtain unbiased estimates of the coefficients and their standard errors in these equations. These estimates differ from those that would have been obtained had equations (7) and (8) been fitted by the least squares method, as is frequently done when the relationships between prices at the same or different marketing levels are analyzed. (See, for example, the discussion beginning on page 186).

Model III.—Unbiased estimates of the coefficients in the retail price equations (7a) and (8a), the only coefficients whose estimation has not been discussed, can be obtained by the least squares method because the retail price is the only unknown variable.

Model IV.—The estimation procedure in this model parallels the method used in model II. The coefficients in the farm demand equation (1a) are estimated by the least squares method because the farm price is the only unknown variable. The other equations not yet discussed, the retail-farm price equations (7b) and (8b), are over-identified. Thus, the limited information method is used to obtain unbiased estimates of their coefficients.

Results of Analyses

For the period between World Wars I and II, estimates of coefficients in the price and demand relations discussed in the previous section were obtained for total milk, fluid milk and cream, butter, and milk used in manufactured dairy products excluding butter.

Variables.—Estimates of coefficients in the structural relations were obtained from analyses based on calendar year data for 1924–41. The economic variables used in these analyses were expressed in constant 1935–39 dollars either as actual data or as first differences

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[11] The computational procedure used in the reduced-form method can be summarized in three steps: (1) Algebraically recombine and rearrange the variables in the structural demand equations in such a manner that each of the jointly-determined variables (P, Q_f and Q_m) is expressed separately as a function of all the predetermined variables (Q, and Y) appearing in the structural equations of the system. (2) Fit these equations (known as reduced-form equations) by the ordinary least squares method. (3) Compute algebraically the structural demand coefficients from the estimates obtained in (2) above. Step 3 is essentially the reverse of step 1. For a somewhat more detailed discussion of the reduced-form method see Foote (*46*, p. 986). Standard errors of the coefficients were obtained by a method suggested by Klein (*74*, pp. 258–259).

Another approach for estimating coefficients and their standard errors in equations that are just identified is described in a computational handbook by Friedman and Foote (*53*, pp. 28–62). This method is similar to the limited information method used for equations that are overidentified and has certain computational advantages over the method of reduced-forms. Coefficients obtained by the 2 methods are identical. The reduced-form method was used in the analyses based on data for the period between World Wars I and II because the analyses were run prior to the preparation of this handbook.

[12] The counting rule tells us that if the number of variables in the system (endogenous plus all predetermined variables, counted separately) minus the number of variables in a particular equation *is greater* than the number of endogenous variables in the system less one, we have an overidentified equation. For further comments on identification, see footnote 10.

of arithmetic values. The economic variables assumed to be jointly or simultaneously determined are as follows:

Q_f=Apparent annual per capita civilian consumption of fluid milk and cream, pounds milk equivalent, fat-solids basis, Agricultural Marketing Service.

Q_b=Apparent annual per capita civilian consumption of butter, pounds milk equivalent, fat-solids basis, Agricultural Marketing Service.

Q_r=Apparent annual per capita civilian consumption of manufactured dairy products excluding butter, pounds milk equivalent, fat-solids basis, Agricultural Marketing Service.

P =Index numbers of retail prices of all dairy products divided by BLS consumers' price index, 1935–39=100, Bureau of Labor Statistics.

P_f=Index numbers of retail prices of fluid milk and cream divided by BLS consumers' price index, 1935–39=100. These prices were computed by the Agricultural Marketing Service to make them applicable to quantities consumed in farm households and by all nonfarm people.

P_b=Index numbers of retail prices of butter divided by BLS consumers' price index, 1935–39=100. These prices were computed by the Agricultural Marketing Service to make them applicable to quantities consumed in farm households and by all nonfarm people.

P_r=Estimates of index numbers of prices of manufactured dairy products excluding butter divided by BLS consumers' price index, 1935–39=100. These estimates are based on the prices of butter, American cheese and evaporated milk, weighted to make them applicable to the quantity Q_r. The price of butter was used to represent price movements applicable to that component of Q_r which had no data on prices.

P_t=Index numbers of prices received by farmers for whole milk delivered to plants and dealers divided by BLS index of wholesale prices of all commodities, 1935–39=100, Agricultural Marketing Service. Farm prices and wholesale prices tend to lead retail prices during periods of inflation and deflation. Thus, the consumers' price index is used to deflate retail prices, but the index of wholesale prices of all commodities is assumed to be the best indicator of changes in the farm price series resulting from changes in the general price level.

The economic variables assumed to be given or predetermined are as follows:

Q_t=Apparent annual per capita civilian disappearance of total milk, pounds milk equivalent, fat-solids basis, Agricultural Marketing Service.

Y_t=Annual per capita disposable personal income divided by BLS consumers' price index, 1935–39=100, Bureau of Agricultural Economics and Department of Commerce.

Y_{t-1}=Y_t lagged one year.

T =Time, 1924=1. Linear trend assumed.

Data for the quantity variables may be obtained from table 7, p. 9; and for price variables from table 67, p. 52. The analyses were run prior to revision of the data.

Analysis I—Statistical methods used to estimate the coefficients in analysis I were discussed in connection with model I. From analyses based on data in constant 1935–39 dollars for the period 1924–41, the following coefficients were obtained:

Total milk at retail

$$P = 178.7 - 0.139\ Q_t + 0.072\ Y_t - 0.328\ T \qquad (9)$$
$$(.042) \quad (.009) \quad (.103)$$
$$R^2_{0.123} = 0.89 \qquad s_{0.123} = 2.02$$

Fluid milk and cream

$$Q_f = 395.8 - 1.080\ P + 0.113\ Y_t - 1.053\ T \qquad (10)$$
$$(.644) \quad (.057) \quad (.352)$$

Butter

$$Q_b = 631.9 - 3.201\ P + 0.131\ Y_t - 2.934\ T \qquad (11)$$
$$(1.249) \quad (.111) \quad (.683)$$

Manufactured dairy products excluding butter

$$Q_r = 255.1 - 2.897\ P + 0.273\ Y_t + 1.632\ T \qquad (12)$$
$$(1.067) \quad (.095) \quad (.584)$$

The figures in brackets are standard errors of the structural coefficients.

If adequate price series are available for individual dairy products, the statistician normally would fit demand relations that utilize these series, as suggested by equations (2a) and (3a) in models II through IV. The results in analysis I primarily are presented for purposes of comparison, especially to illustrate the extent to which estimates of demand coefficients with respect to price are biased when a composite price is used.

If no published price series are available as for the aggregate of manufactured products, or if the price estimates for individual dairy products are subject to considerable error, the following approach probably will yield better estimates of demand coefficients with respect to price, income, and other factors than those given by models I to IV: (1) Fit the demand relations making use of a composite price as in analysis I. (2) Adjust these estimates by a factor which represents the relationship between the price flexibility of the individual dairy product and the price flexibility of all dairy products. When this approach is used, errors in the estimated price affect only the demand coefficient with respect to price; whereas, if the estimated price is used directly in estimating the demand relations, the errors also affect the demand coefficients with respect to income and other factors. The coefficients, k_f and k_m, in relations (5a), (7) and (8) can be used to adjust the price coefficients. Estimates of k_f and k_m can be obtained by fitting equations such as (7) and (8) by the least squares method.

However, if reliable price series are available, it is preferable to estimate these factors by the limited information method, which takes into account the simultaneous factors that determine these prices. (Coefficients estimated in this manner are shown in equations (16) through (18) below.) As expected, use of the structural coefficients in equations (16) through (18) raised the absolute value of the price coefficient for fluid milk and cream to −1.2, compared with the coefficient of −1.1 given by analysis I, and reduced the absolute values of the price coefficients for butter and manufactured dairy products to −1.6 and −2.4 respectively, compared with coefficients of −3.2 and −2.9 given by analysis I. The standard errors of the adjusted coefficients are 0.8, 0.7, and 1.1, respectively. These standard errors are larger relative to the respective coefficients than the standard errors associated with the composite price, but this probably would not necessarily be true in all such analyses.

Analysis II.—Analyses II and III are based on relations similar to those formulated in models II through IV. The economic variables are similar in each analysis; they are expressed as actual or arithmetic values in analysis II and as first differences of arithmetic values in analysis III. Based on data for the period 1924–41, analysis II gave the following structural coefficients. As for all analyses in this section, numbers in parentheses are the standard errors of the respective coefficients.

Retail demand equations

$$Q_f = 487.6 - \underset{(2.230)}{2.683}\, P_f + \underset{(.122)}{0.182}\, Y_t + \underset{(1.538)}{1.245}\, T \qquad (13)$$

$$Q_b = 473.0 - \underset{(.504)}{1.316}\, P_b + \underset{(.099)}{0.104}\, Y_t - \underset{(1.077)}{4.134}\, T \qquad (14)$$

$$Q_r = 184.7 - \underset{(.737)}{1.807}\, P_r + \underset{(.092)}{0.240}\, Y_t + \underset{(1.217)}{0.081}\, T \qquad (15)$$

Retail price relationships [13]

$$P_f = 6.23 + \underset{(.283)}{0.892}\, P \qquad (16)$$

$$P_b = -97.0 + \underset{(.295)}{2.006}\, P \qquad (17)$$

$$P_r = -16.1 + \underset{(.280)}{1.201}\, P \qquad (18)$$

Retail price-estimating equations

$$P_f = 106.2 - \underset{(.037)}{0.056}\, Q_t + \underset{(.008)}{0.055}\, Y_t + \underset{(.090)}{0.724}\, T \qquad (19)$$

$R^2_{0\cdot123} = 0.93 \quad s_{0\cdot123} = 1.78$

$$P_b = 313.9 - \underset{(.099)}{0.339}\, Q_t + \underset{(.022)}{0.155}\, Y_t - \underset{(.242)}{1.709}\, T \qquad (20)$$

$R^2_{0\cdot123} = 0.91 \quad s_{0\cdot123} = 4.77$

$$P_r = 247.6 - \underset{(.078)}{0.223}\, Q_t + \underset{(.017)}{0.097}\, Y_t - \underset{(.191)}{1.385}\, T \qquad (21)$$
$$R^2_{0.123} = 0.89 \quad s_{0.123} = 4.09$$

Retail-farm price relationships [13]

$$P_f = 17.7 + \underset{(.292)}{0.748}\, P_w \qquad (22)$$

$$P_b = -91.9 + \underset{(.405)}{1.920}\, P_w + \underset{(.494)}{0.408}\, T \qquad (23)$$

$$P_r = 157.1 + \underset{(.229)}{0.431}\, P_w - \underset{(.270)}{0.946}\, T \qquad (24)$$

Farm demand for total milk

$$P_w = 146.3 - \underset{(.109)}{0.262}\, Q_t + \underset{(.024)}{0.345}\, Y_t - \underset{(.267)}{0.450}\, T \qquad (25)$$
$$R^2_{0.123} = 0.74 \quad s_{0.123} = 1.24$$

Ordinarily, one would expect a closer relationship between prices for the individual products and P in equations (16) to (18) and P_w in equations (22) to (24) than that suggested by the size of the standard errors relative to their coefficients. The addition of a variable to represent changes in marketing costs probably would have improved the relationship. However, some of the reduction in association between prices, in part, may result because during the early 1930's retail price change appeared to lag behind farm price when these prices were falling. This would affect the coefficients in the retail-farm price equations and also those in the retail price equations if the price lags were different for each product.

As noted on page 190, marketing margins deflated by the index of wholesale prices for all commodities were reduced each year, on the average, by 0.4 cent per pound for butter and 0.1 cent per pound for evaporated milk. Therefore, the variable time was included in the retail-farm price equations for butter and other manufactured dairy products.

[13] Least squares estimates of the coefficient relating the retail price of all dairy products with the retail price of the dairy product concerned are 0.551, 2.340 and 1.557 for equations (16), (17) and (18), respectively. The corresponding standard errors are 0.237, 0.250 and 0.233, respectively.

Least squares estimates for the coefficient relating the farm price with the retail price of the dairy product concerned are 0.230, 1.289 and 0.909, respectively, for equations (22), (23) and (24). The corresponding standard errors are 0.153, 0.202 and 0.148, respectively.

In each case, the coefficients shown in the tabulation and their standard errors were obtained by the limited information method. In fitting the equations, the variable for time was omitted from the M_{zz} matrix for all the equation except when fitting equation (23) for butter. It has been shown that often when a variable is only a crude approximation of the true behavior, as the time variable is for changing tastes and technology in this instance, more consistent results are obtained when that variable is omitted from the M_{zz} matrix. For example, see Friedman and Foote (*53*, pp. 66, 70, 74). When time was omitted from M_{zz} a negative sign was obtained for the coefficient on P_w in equation (23).

The same factors explain only 74 percent of the variation in the farm price in equation (25) as compared with 89 percent of the variation in the index of retail prices for all dairy products in equation (9) on page 83. The lower percentage figure in the analysis of farm demand for total milk may be due, in part, to price level effects which may not have been entirely eliminated when farm prices were deflated by the index of wholesale prices of all commodities. Retail prices that lag behind farm prices as discussed above also may be a contributing factor.

Analysis III.—Based on first differences for the years 1925–41, analysis III gave the following structural coefficients:

Retail demand equations

$$Q_t = -0.263 + \underset{(1.132)}{0.125}\ P_t + \underset{(.070)}{0.001}\ Y_t \qquad (26)$$

$$Q_t = 0.570 - \underset{(1.082)}{1.676}\ P_t + \underset{(.066)}{0.118}\ Y_t \qquad (26a)$$

$$Q_b = -5.686 - \underset{(.656)}{2.097}\ P_b + \underset{(.066)}{0.275}\ Y_t \qquad (27)$$

$$Q_r = 0.866 - \underset{(.344)}{1.252}\ P_r + \underset{(.065)}{0.197}\ Y_t \qquad (28)$$

Retail price relationships [14]

$$P_f = 0.954 + \underset{(.069)}{0.629}\ P \qquad (29)$$

$$P_b = -1.028 + \underset{(.166)}{2.158}\ P \qquad (30)$$

$$P_r = -0.883 + \underset{(.136)}{1.534}\ P \qquad (31)$$

Retail price-estimating equations

$$P_f = -0.757 - \underset{(.035)}{0.090}\ Q_t + \underset{(.011)}{0.050}\ Y_t \qquad (32)$$
$$R^2_{0.12} = 0.71 \qquad s_{0.12} = 1.68$$

$$P_b = -1.671 - \underset{(.081)}{0.318}\ Q_t + \underset{(.025)}{0.167}\ Y_t \qquad (33)$$
$$R^2_{0.12} = 0.84 \qquad s_{0.12} = 3.90$$

$$P_r = -1.186 - \underset{(.052)}{0.274}\ Q_t + \underset{(.016)}{0.107}\ Y_t \qquad (34)$$
$$R^2_{0.12} = 0.87 \qquad s_{0.12} = 2.49$$

Retail-farm price relationships [14]

$$P_t = \underset{}{0.842} + \underset{(.065)}{0.448}\ P_w \tag{35}$$

$$P_b = \underset{}{-1.436} + \underset{(.280)}{1.578}\ P_w \tag{36}$$

$$P_c = \underset{}{-1.225} + \underset{(.235)}{1.201}\ P_w \tag{37}$$

Farm demand for total milk

$$P_w = \underset{}{-0.522} - \underset{(.086)}{0.072}\ Q_t + \underset{(.027)}{0.134}\ Y_t \tag{38}$$

$$R^2_{0.12} = 0.68 \qquad s_{0.12} = 1.00$$

The coefficients in the demand equation for fluid milk and cream, equation (26a), were estimated based on a combination of results from analyses using respectively year-to-year changes (or first differences) and actual data. In this case, variations in level of actual data were assumed to be the best estimators of changes in the level of consumption, but year-to-year variations in the supply of milk were assumed to be the best estimators of price changes. The price coefficient in the demand equation (26) for fluid milk and cream does not differ from zero by a statistically significant amount. This probably reflects the small year-to-year variation in per capita consumption of fluid milk and cream. However, the change in the level of consumption over the entire period has been sufficient to permit a more accurate measurement of consumers' response to price, as shown by equation (13). On the other hand, comparison of the estimates of coefficients in retail price-estimating equations obtained from the analysis based on actual data (equation 19) and from the analysis based on first differences (equation 32) shows that the standard error of the coefficient relating supply of total milk and retail price is considerably higher relative to the coefficient in the analysis based on actual data than in that based on first differences. This suggests that year-to-year variations in the price of milk in fluid outlets move in the same direction as do other dairy product prices (which move inversely with variations in total supply of milk); but, over a period of several years, the spread between the two price series reflects changes in the marketing structure over time, which is not allowed for in the model.

As expected, the estimates of coefficients from price equations (29) to (31) and (35) to (37), based on first differences, are affected consid-

[14] Least squares estimates of the coefficient relating the retail price of all dairy products with the retail price of the dairy product concerned are 0.640, 2.073 and 1.430 for equations (29) through (31), respectively. The standard errors are 0.063, 0.151 and 0.122, respectively. Least squares estimates of the coefficients relating the farm price of all milk wholesale with the retail price of the dairy product concerned are 0.385, 1.139 and 0.788, respectively, for equations (35) through (37). The standard errors are 0.050, 0.191 and 0.137, respectively. Coefficients shown in the tabulation were obtained by the limited information approach.

erably less by changes in the size of the marketing margin resulting from lags in retail prices following a drop in farm prices than are the corresponding coefficients obtained in analysis II which is based on actual data.

As in analysis II, the given variables in the analysis explain a smaller portion of the variation in the farm price than the variations in retail prices. It will be recalled that 93 percent of the variation in the farm price was explained when an analysis for the same period was based on first differences of logarithms of data in current dollars (see p. 64).

Other analyses—When the analysis was extended to include separate demand equations for total cheese, American cheese, ice cream, and evaporated milk, the estimates for demand coefficients with respect to price were of wrong sign in all equations except evaporated milk. However, none of the coefficients differ significantly from zero.

Several analyses were run to estimate demand coefficients for smaller aggregates of manufactured dairy products. Estimates obtained for demand coefficients with respect to price for the aggregate, including cheese, dry whole milk, malted milk, and ice cream, were of wrong sign and did not differ significantly from zero. If the milk used in condensery products is added to this aggregate, the total comprises a major portion of the aggregate for manufactured dairy products excluding butter (analysis not shown). This new aggregate also gave estimates for demand coefficients with respect to price that did not differ significantly from zero (analysis not shown). The inability to get desired coefficients for this group may partially stem from the pronounced upward trend in consumption of these products and a downward trend in their prices. It is probable that the price effect and the trend effect were not completely separated in the analyses.

The extent to which reliable estimates of price coefficients can be obtained by using further breakdowns is shown later, when criteria for using a single- or multiple-equation model are discussed.

DEMAND ELASTICITIES [PRIOR TO WORLD WAR II]

Coefficients of equations that describe the demand and price structure of dairy products at the retail level can be presented in several ways. For the previous section, estimates for the coefficients were expressed in actual values. These coefficients indicate the quantity of dairy products consumed in pounds per person associated with given prices and income for each year, with each variable expressed in its original form. But to compare consumers' response for dairy products and other foods as estimated from the several methods of analysis, it is more meaningful to state in percentage terms the change in quantity of milk or dairy product consumed associated with a 1-percent change in price or income. Coefficients describing the economic structure in such a way are called, respectively, elasticities of demand with respect to (1) prices and (2) income. In table 20 the estimates of the structural demand coefficients for the period between World Wars I and II are presented in terms of price and income elasticities and percentage changes in quantities over time.

It will be recalled that the basic difference between analysis I and analysis II is the use of a single composite price in the former, and of individual product prices in the latter (see p. 83). In table 20, the

price elasticity coefficients are made comparable by adjusting the demand coefficients with respect to the single composite price by the difference in price flexibility in each product price relative to the composite price for all dairy products (see p. 84). Therefore, identical price elasticities should be obtained from each analysis. Substantial differences were found; the demand elasticity with respect to price obtained from analysis II is lower for butter and for other manufactured products but higher for fluid milk and cream. These variations can be explained as follows: Each analysis derives its price coefficient on the basis of relationships derived from different segments of the marketing structure. Analysis I assumes that dairy products are priced equivalently at the retail level, and measures the horizontal relationship existing among individual product prices at the retail level. Analysis II (and III) assumes that milk in all outlets is priced equivalently at the farm level and in essence measures the vertical relation (farm to retail) for each product separately. Analysis II, in effect, obtains estimates of the coefficients in the demand equations directly from the basic factors (that is, total milk supply and income) affecting the jointly determined variables of price and quantity of the dairy product concerned. Based on the discussion on page 56, analyses II and III appear more realistic.

Elasticity coefficients for butter, from analyses based on actual data, suggest that for each 1-percent change in prices, consumers in the period prior to World War II tended to change their purchases in the opposite direction around 0.4–0.5 percent, assuming no change in income or other factors. Based on first differences, the elasticity was

TABLE 20.—*Consumption of specified dairy products: Estimates of price and income elasticities and percentage coefficients for "time," based on single- and multiple-equation models, by type of analysis, based on data for 1924–41*[1]

Fluid milk and cream

Analysis	Effect of time per year[2]	Demand elasticity with respect to[3]			
		Own price		Income	
		Value	Standard error	Value	Standard error
Analysis based on data expressed as—					
Actual data:					
Simultaneous approach:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Analysis I[4]	−0.32	[5]−0.35	0.24	[6]0.17	0.09
Analysis II[7]	[5].37	[5]−.77	.64	[6].27	.18
Least squares method[8]	[5]−.01	[5]−.22	.15	[6].10	.05
Year-to-year differences:					
Simultaneous approach:					
Analysis III[9]	[5].17	[5]−.48	.31	[6].17	.09
Least squares method[8]	[5].12	[5]−.27	.17	[6].10	.06

See footnotes at end of table.

TABLE 20.—*Consumption of specified dairy products: Estimates of price and income elasticities and percentage coefficient for "time," based on single- and multiple-equation models, by type of analysis, based on data for 1924–41* [1]—Continued

Analysis	Effect of time per year [2]	Demand elasticity with respect to— [3]			
		Own price		Income	
		Value	Standard error	Value	Standard error
Butter					
Analysis based on data expressed as—					
Actual data:					
Simultaneous approach:					
Analysis I [4]	−0.81	−0.47	0.20	[5] 0.19	0.16
Analysis II [7]	−1.18	−.39	.15	[6] .15	.14
Least squares method [8]	−.77	[6] −.16	.09	[6] −.06	.09
Year-to-year differences:					
Simultaneous approach:					
Analysis III [9]	−1.63	−.62	.19	[6] .39	.20
Least squares method [8]	−.86	[6] −.25	.13	[6] .06	.15
Manufactured dairy products excluding butter					
Analysis based on data expressed as—					
Actual data:					
Simultaneous approach:					
Analysis I [4]	1.40	−2.15	0.94	1.16	0.45
Analysis II [7]	[6] .07	−1.61	.66	1.02	.39
Least squares method [8]	1.75	−.50	.30	.39	.20
Year-to-year differences:					
Simultaneous approach:					
Analysis III [9]	.74	−1.11	.30	.84	.28
Least squares method [8]	1.32	−.74	.29	.61	.23

[1] Variables used in these analyses are described on p. 82.

[2] Coefficient associated with time in the demand equation based on actual data and the constant in the demand equation based on first differences, each divided by average quantities consumed during 1924–41.

[3] Computed at the mean values of the economic variables.

[4] Based on coefficients in equations (10) through (12), p. 83, adjusted for bias resulting from use of composite price by coefficients in retail price relations (16) through (18), p. 84.

[5] Coefficient does not differ significantly from zero when tested at the 10-percent level.

[6] Coefficient differs significantly from zero when tested at the 10-percent level but not at the 5-percent level.

[7] Based on coefficients in equations (13) through (15), p. 84.

[8] Based on coefficients obtained from regression analyses using consumption as a function of price, income and time.

[9] Based on coefficients in equations (26a), (27) and (28), p. 86.

—0.6. A reasonable estimate probably lies between —0.4 and —0.6. As is shown later, these coefficients probably do not apply now, since margarine has become an important competitor.

For fluid milk, the analysis based on the composite price (analysis I) indicates that consumers tend to vary their purchases inversely midway between 0.3 and 0.4 percent for each 1-percent change in the retail price. A price elasticity coefficient —0.8 was obtained in analysis II. From the analysis based on a combination of results from analyses using year-to-year change and actual data, respectively, the estimate approaches —0.5. Based on these studies, a reasonable estimate for the price elasticity of demand for fluid milk and cream at retail for the years between World Wars I and II would fall in the range —0.4 and —0.5. As shown later, these coefficients are somewhat higher than those that appear to hold for current years.

Demand elasticity coefficients with respect to price for manufactured dairy products, excluding butter, exceed unity in all analyses. It is probable that some of the coefficients for this aggregate of dairy products, as well as the —0.8 for fluid milk and cream, are too high in absolute value. For the whole milk products, errors may result chiefly from problems of aggregation. To permit the summation of per capita disappearance in all outlets, a necessary step in the analysis, quantity data for all products were put on a milk equivalent (fat solids) basis. This tends to distort the weights given to commodities having a fat content different from the average for the group. In addition, no price series apply directly to either this group or total manufactured products excluding butter. Therefore, true differences in the price flexibility of these groups and of all dairy products are not known. Moreover, evidence to be presented later suggests that wide differences in price flexibilities exist among the products within the groups. For example, see the statistical relations shown in table 48, page 198, for evaporated milk and American cheese.

The reader will remember that income coefficients estimated in the multiequation approach should be the same whether the composite price (analysis I) or the individual product price (analysis II) is used (see p. 89). Some differences were found; these variations can be assumed to be caused by factors similar to those causing sampling variations. Estimates for income coefficients from analyses based on actual data were higher for fluid milk and cream and other dairy products, but were lower for butter, than were the estimates from analyses based on year-to-year changes in actual data. Given no change in retail prices, a 1-percent variation in income appears to result in a change in the same direction in quantity of fluid milk and cream consumed of between 0.2 and 0.3 percent. For butter, the estimated elasticities with respect to income range between 0.2 and 0.4. For the aggregate of the manufactured dairy products, excluding butter, the estimates range between 0.8 and 1.2. These appear reasonable. The inclusion of ice cream and similar products in the latter group probably accounts to a considerable extent for the higher income elasticity for this group.

On the basis of data for the period between World Wars I and II, two pronounced trends appear to have occurred in the consumption of manufactured dairy products. After allowing for changes in prices and income, consumption of butter tended to decline about 1

percent a year, while consumption of the aggregate of selected dairy products tended to increase about 1 percent a year.

ESTIMATES FROM SINGLE VERSUS SIMULTANEOUS EQUATIONS

This section is designed to serve a threefold purpose: (1) To compare estimates of price and income elasticities obtained from analyses using the single- and simultaneous-equations approach; (2) to explain differences that occur between the two sets of estimates; and (3) to suggest the conditions under which use of each method is appropriate.

In addition to the estimates for elasticities obtained from analyses based on the simultaneous-equations approach, table 20 presents estimates obtained from analyses based on the single-equation approach. The same data were used in each case. Estimates for the single-equation approach were derived from equations fitted by the usual least squares regression technique. For comparative purposes, all the elasticities are presented in the table even though some of them do not differ significantly from zero when tested statistically at the 10-percent probability level.

In general, higher coefficients, in terms of absolute value, were obtained from the multiequation approach. Price elasticities for fluid milk and cream estimated by the single-equation method range between —0.2 and —0.3 compared with coefficients of —0.4 to —0.5 for the simultaneous-equations method. Estimates of price elasticities for butter obtained from the single-equation method range between —0.2 and —0.3, compared to the coefficients of —0.4 to —0.6 in the structural model.

Differences also were observed in the income elasticities estimated from the two methods. The estimates for fluid milk were about 0.1 using the single-equation procedure, compared to a range of 0.2 to 0.3 obtained from the multiequation method. Differences also were obtained from the two methods for butter. One striking observation for butter is that the single-equation method did not provide any estimates for income coefficients that differ significantly from zero when tested at the 10-percent probability level.

Although the reasoning is beyond the scope of this bulletin, econometricians have shown that in general, when coefficients that should be estimated by the simultaneous-equations technique are instead estimated by the method of least-squares, the results tend to be biased in a statistical sense. However, the direction of the bias is not necessarily known.

Certain dairy products use such a small part of the total milk supply that changes in the demand for them have practically no effect on other dairy products. Our experiments suggest that when there are several end utilizations, each drawing substantially upon the same supply of milk, the simultaneous-equations procedure gives better estimates of structural coefficients, and should be used to reflect the interrelationships among these utilizations. For those dairy products which represent only a small part of the total milk supply, better estimates of structural coefficients, such as elasticities, probably can be obtained by a direct application of the method of least-squares.

To substantiate the foregoing conclusions, some of the assumptions implicit in each method of analysis are restated. Each method assumes that the price for milk as a whole is determined by the supply of total milk, after allowing for changes in income and other factors. The simultaneous-equations technique assumes that consumption and prices of each of the dairy products are interrelated and simultaneously determined. This technique also assumes that the quantity of one dairy product consumed affects consumption of other dairy products, because their combined consumption must come from the same supply of milk. Implicit in these statements is that consumption of each dairy product is affected by the supply of total milk. On the other hand, the single-equation method assumes that the price of the dairy product affects consumption, but its consumption does not materially affect the level of dairy prices in general. As dairy prices depend in part on the supply of total milk, the least-squares approach assumes no observable relationship between consumption of the individual product and supply of total milk. Table 21 shows results obtained from regression analyses which express consumption of selected dairy products as a function of either (1) disappearance of total milk and disposable income or (2) product prices and income. As these regressions are based on year-to-year variations in logarithmic form, the estimates obtained for the price and income coefficients can be interpreted directly as price and income elasticities. Estimates of the coefficients which measure variations in the consumption of American cheese, total cheese, evaporated milk, and ice cream associated with variations in disappearance of total milk do not differ significantly from zero when tested at commonly accepted probability levels. This confirms the judgment expressed in the preceding paragraph that year-to-year variations in demand for these individual items do not significantly affect the dairy economy as a whole. We realize that if several items are aggregated, the resulting combination may well have a significant effect on the total dairy economy.

Price Elasticities for Evaporated Milk

The estimate of —1.1 for the price elasticity coefficient for evaporated milk obtained from the single-equation technique differs significantly from zero in a probability sense. However, this regression does not take into account the movement of evaporated milk in and out of storage. Better estimates for the price elasticity should be obtained from a multi-equation model which took into account the simultaneous determination of prices, quantities, and stocks of evaporated milk in relation to the price and supply of total milk. Limited explorations within this framework failed to produce results which showed significant relationships among these variables.

Price Elasticities for Cheese

In the regression analysis for American cheese, the price coefficient does not differ significantly from zero when tested at the 10-percent probability level. This in part may result from the failure to include the substitution effect on consumption of cheese of the price and

TABLE 21.—*Selected dairy products: Factors affecting year-to-year changes in consumption, based on data for 1925–41*[1]

ANALYSES SHOWING RELATION BETWEEN CONSUMPTION OF SELECTED PRODUCTS AND DISAPPEARANCE OF ALL MILK

Item	Unit	Butter	Cheese		Evaporated milk	Ice cream
			American	All		
Coefficient of multiple determination		0.77	0.14	0.18	0.03	0.93
Constant term or intercept value		−.0033	.0071	.0063	.0144	.0077
Effect on consumption of a 1-percent change in—						
Disappearance of all milk:[1]						
Net effect[2]	Percent	1.56	[3] −.43	[3] −.29	[3] .44	[3] −.10
Standard error	do	.26	.74	.52	.84	.60
Coefficient of partial determination		.72	.02	.02	.02	.00
Disposable income:[4]						
Net effect[2]	Percent	[5] −.07	[3] .12	[3] .10	[3] −.03	1.01
Standard error	do	.03	.10	.07	.11	.08
Coefficient of partial determination		.22	.10	.14	.00	.93

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ANALYSES SHOWING EFFECT OF PRICE AND INCOME ON CONSUMPTION

Item	Unit	Fluid milk and cream	Butter	American cheese	Evaporated milk
Coefficient of multiple determination		0.12	0.39	0.17	0.39
Constant term or intercept value		−.0002	−.0010	.0095	.0050
Effect on consumption of a 1-percent change in—					
Product price: [6]					
Net effect [2]	Percent	[3] −.19	−.27	[3] −.25	−1.08
Standard error	do	.13	.12	.27	.37
Coefficient of partial determination		.12	.26	.06	.38
Disposable income: [4]					
Net effect [2]	Percent	[5] .10	[3] .16	[3] .32	.59
Standard error	do	.08	.13	.22	.23
Coefficient of partial determination		.11	.10	.13	.32

[1] Estimates of per capita consumption or disappearance from Agricultural Marketing Service.

[2] Regression coefficients from analyses based on first differences of logarithms. These coefficients also are estimates of price, income, and supply elasticities.

[3] Coefficient does not differ significantly from zero at the 10-percent probability level.

[4] Per capita estimates of disposable personal income from Agricultural Marketing Service and Department of Commerce.

[5] Coefficient differs significantly from zero when tested at the 10-percent probability level but not at the 5-percent level.

[6] Retail prices from Agricultural Marketing Service. Index numbers of prices for fluid milk and cream and butter applicable to quantities consumed in farm households and by all nonfarm people, computed by Agricultural Marketing Service.

supply of meat and poultry products. The addition of the index of retail prices of meat, chicken and fish to the regression analysis for American cheese, based on data for 1925–41, did not materially improve the estimates (table 22). Coefficients in the new regression analysis are of correct sign, as were those in the analysis omitting prices of substitute products, but they still do not differ significantly from zero when tested at the 10-percent probability level.

However, if the period of analysis is broken down into two periods, 1925–31 and 1932–41, interesting differences are observed (table 22). Income is an important economic variable in the period 1925–31 but not for the period 1932–41. In the earlier period a variation of

TABLE 22.—*American cheese: Factors affecting year-to-year changes in consumption* [1]

ANALYSES BASED ON PRICE AND DISPOSABLE INCOME

Item	Unit	Years			
		1925–41	1925–31	1932–41	1947–53
Coefficient of multiple determination.		0.17	0.69	0.08	0.13
Constant term or intercept value.		.0052	−.0242	.0137	.1573
Effect on consumption of a 1-percent change in—					
Price: [2]					
Net effect [3]	Percent	[4] −.25	[5] −.77	[4] .07	[4] .44
Standard error	do	.27	.32	.40	.68
Coefficient of partial determination.		.06	.59	.00	.10
Disposable income: [6]					
Net effect [3]	Percent	[4] .32	.97	[4] .04	[4] −1.26
Standard error	do	.22	.33	.30	1.62
Coefficient of partial determination.		.13	.69	.00	.13

ANALYSES BASED ON OWN PRICE AND PRICE OF SUBSTITUTES

Coefficient of multiple determination.		0.19	0.02	0.41	0.65
Constant term or intercept value.		.0063	−.0020	.0143	.0005
Effect on consumption of a 1-percent change in—					
Price: [2]					
Net effect [3]	Percent	[4] −.17	[4] .05	[4] −.25	[7] −.93
Standard error	do	.21	.60	.22	.46
Coefficient of partial determination.		.05	.00	.16	.51
Price of substitutes: [8]					
Net effect [3]	Percent	[4] .27	[4] .03	[5] .32	[5] .91
Standard error	do	.19	.67	.16	.33
Coefficient of partial determination.		.15	.00	.36	.65

See footnotes at end of table.

TABLE 22.—*American cheese: Factors affecting year-to-year changes in consumption*—Continued

ANALYSES BASED ON OWN PRICE, INCOME, AND PRICE OF SUBSTITUTES

Item	Unit	Years			
		1925–41	1925–31	1932–41	1947–53
Coefficient of multiple determination.		0.25			0.68
Constant term or intercept value.		.0048			.0027
Effect on consumption of a 1-percent change in—					
Price: [2]					
Net effect [3]	Percent	[4] −.36			[5] −.69
Standard error	do	.28			.69
Coefficient of partial determination.		.11			.25
Disposable income: [6]					
Net effect [3]	Percent	[4] .23			[7] −.62
Standard error	do	.23			1.17
Coefficient of partial determination.		.07			.09
Price of substitutes: [8]					
Net effect [3]	Percent	[4] .20			[5] .86
Standard error	do	.18			.38
Coefficient of partial determination.		.09			.63

[1] Per capita disappearance of American cheese from Agricultural Marketing Service.
[2] Retail price of American cheese from Agricultural Marketing Service.
[3] Regression coefficients from analyses based on first differences of logarithms. These coefficients are also estimates of own-price, income, and cross-price elasticities.
[4] Coefficient does not differ significantly from zero when tested at the 10-percent probability level.
[5] Coefficient differs significantly from zero when tested at the 10-percent probability level but not at the 5-percent level.
[6] Per capita estimates of disposable personal income from Agricultural Marketing Service and the Department of Commerce.
[7] Coefficient differs significantly from zero when tested at the 12-percent probability level.
[8] Index numbers of retail prices of meats, chicken, and fish from Bureau of Labor Statistics.

1-percent in personal income, after allowing for the effect of prices, resulted in a 1-percent variation in consumption. In the latter period a 1-percent change in income had almost no effect on consumption. But the effect on American cheese consumption of a 1-percent variation in retail prices of meats, poultry and fish for the 1932–41 period resulted in a 0.3 percent variation in quantity consumed. This variable had no apparent effect in the earlier years.

Similar analyses for the period following World War II (1947–53) yield a negative sign for the income coefficient, although the result does not differ from zero by a statistically significant amount. How-

ever, analyses based on consumer panel data suggest that for any given time, quantities of natural American cheese purchased usually increase as family incomes increase (see fig. 7. p. 111, and discussion on p. 110). For these years, however, a 1-percent change in the price of substitute commodities results in a change in the same direction of 0.9 percent in consumption after allowing for the effects of changes in the price of the product and income.

Although these results, in some cases, do not differ by a statistically significant amount, on the whole they appear logical. The increase in the kinds of processed cheeses, cheese foods and spreads and ways of packaging same has resulted in more widespread use of cheese. Cheese is being considered now more often than formerly as a substitute for meat or fish in planning a dinner meal, and as a substitute for spreads and meats in sandwiches, thereby increasing the effect of prices of substitute items.

The several analyses for each period suggest that the most accurate measure of price elasticity for the 1925–31 period is given by the analysis that uses income as a demand shifter, and for the 1947–53 period, by the analysis that uses prices of substitute products as a demand shifter. No analysis given here is satisfactory for the 1932–41 period. These studies suggest that the own-price elasticity in current years is about the same as in the period prior to World War II. Estimates for cheese for the period following World War II based on the simultaneous-equations method are discussed on p. 106.

Income Elasticities

The estimates of income elasticities obtained from the single-equation and multiequation techniques differed substantially, particularly for butter (tables 20 and 21). Because of the interrelationships among the quantities of milk channeled into different outlets, estimates of income elasticities obtained from the single-equation approach would be expected to be biased in a statistical sense. This bias arises from the failure of the single-equation approach to take into account the effect of variations in consumption of other dairy products resulting from variations in income on the consumption of the product concerned. When total supply is fixed, an increase in disposable income results in an increase in the consumption of those dairy products that have relatively high income elasticities or relatively low price elasticities. Consumption of the other products must decline by a corresponding amount. Thus it is possible to get negative coefficients of income elasticity for dairy products when the single-equation technique is employed, because the effect of the variations in other outlets is not included in the demand equation. For example, in table 20 the income coefficient was negative for butter in analysis II, using the single-equation method. This was true for none of the structural analyses. If the dairy product comprises a substantial part of the total milk supply, the estimate for the income coefficient obtained from the single-equation procedure measures relative *differences* in income and price elasticities rather than the income effect as such. On the other hand, if the dairy product comprises a very small portion of the total milk supply, estimates of the income coefficient obtained from the single-equation

model may be nearly equal to those obtained from the structural model. For example, the estimate for the income coefficient obtained from the single-equation model for ice cream was unity, and for American cheese it was 0.3 (table 21). When the simultaneous-equations procedure (analyses II and III) was used for the aggregate of total cheese, dry whole milk, malted milk and ice cream, the estimates for demand elasticity with respect to income were around 0.5, although the demand elasticity with respect to price was of wrong sign (analysis not shown).

Effect of Previous Income on Demand Elasticities

It is generally agreed that behavior patterns in the past affect the current consumption of food because changes in food habits come about slowly. Education and knowledge of the nutritive value of some foods tend to make their consumption relatively stable in the household diet. For these foods, even in periods of falling incomes, people attempt to maintain previous levels of consumption. This is particularly likely to hold if the food is identified as a chief source of an important nutrient, such as milk as a source of calcium. However, Brinegar (*20, 21*), in a case study of purchases of fluid milk in a small Connecticut community, found that changes in income in the short run (one month) tended to result in substantial changes in consumption. But, after the initial and substantial decrease in consumption associated with a decrease in income, consumption rose, it finally leveled off at some rate lower than consumption before the decrease.

Past statistical studies have allowed for the influence of past consumption rates, or of inherent stability in the consumption function, in several ways. Some studies have used previous consumption as one of the variables in the analysis; others have used income in the preceding year as a variable in addition to current income. A modification that yields equivalent coefficients to the latter approach is to use current income and the change in income from the preceding year as separate variables in the study.

From an analysis which uses the change in income from the preceding year and income lagged one year as the two income variables, we get the following demand equations based on data for the period 1924–41:

$$Q_f = 402.28 - 1.467\ P_f + 0.056\ (Y_t - Y_{t-1}) + 0.134\ Y_{t-1} + 0.554\ T \qquad (39)$$
$$\qquad\qquad (1.292) \quad (.074) \qquad\qquad (.096) \quad (.925)$$

$$Q_b = 514.45 - 1.747\ P_b + 0.297\ (Y_t - Y_{t-1}) + 0.130\ Y_{t-1} - 5.276\ T \qquad (40)$$
$$\qquad\qquad (.654) \quad (.195) \qquad\qquad (.185) \quad (1.454)$$

$$Q_r = 158.80 - 1.557\ P_r + 0.168\ (Y_t - Y_{t-1}) + 0.231\ Y_{t-1} + 0.581\ T \qquad (41)$$
$$\qquad\qquad (.712) \quad (.111) \qquad\qquad (.111) \quad (1.212)$$

The coefficients in equations (39) through (41) are shown as demand elasticities and percentage coefficients for time in table 23. Comparison of these results with those from previously discussed analyses shows that the inclusion of lagged income as a variable reduces the absolute values of the price elasticities for fluid milk and cream, and of manufactured dairy products excluding butter, to −0.4 and −1.4, respectively, compared with coefficients of −0.8 and −1.6 given by

analysis II (table 20, p. 89). However, the price elasticity for butter is raised to —0.5 compared with a coefficient of —0.4 given by analysis II. Also, for fluid milk and cream and dairy products excluding butter, the effect on consumption of changes in current income from the previous year is reduced, while the effect on consumption of butter is increased when the lagged income variable is added to the analysis. For example, income elasticities for fluid milk and cream and manufactured dairy products excluding butter are reduced to 0.1 and 0.7, respectively, compared with coefficients of 0.3 and 1.0 from analysis

TABLE 23.—*Consumption of specified dairy products: Estimates of price and income elasticities and percentage coefficients for "time", based on a simultaneous-equations approach and data for 1924–41* [1]

Product	Effect of time per year [2]		Demand elasticity with respect to—[3]					
			Own price		Change in income from preceding year		Income in preceding year	
	Value	Standard error	Value	Standard error	Value	Standard error	Value	Standard error
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Fluid milk and cream	[4] 0.17	0.28	[5] —0.42	0.37	[4] 0.08	0.11	[4] 0.20	0.14
Butter	—1.51	.42	—.52	.19	[4] .42	.28	[4] .18	.26
Manufactured dairy products [6]	[4] .50	1.04	—1.38	.63	[4] .71	.47	[6] .97	.47

[1] Estimates based on equations (39) through (41), p. 99. Variables used in this analysis are described on p. 82.

[2] Coefficient associated with time in the demand equation divided by average quantities consumed during 1924–41.

[3] Computed at the mean values of the economic variables.

[4] Coefficient does not differ significantly from zero when tested at the 10-percent probability level.

[5] Excludes milk used in butter.

[6] Coefficient differs significantly from zero when tested at the 10-percent probability level but not at the 5-percent level.

II. The income elasticity for butter is raised from 0.2 to 0.5. Level of income in the previous year appears to have a greater effect on the consumption of fluid milk and cream than does current income. This tends to confirm the idea that fluid milk is considered by the family as an important source of certain nutrients. On the other hand, changes in income from the preceding year during the period prior to World War II had a greater influence on the consumption of butter than did changes in the level of income in the preceding year, suggesting that butter was considered a less necessary dietary item than fluid milk.

PROBABLE POST-WORLD WAR II RELATIONSHIPS

Based on the analysis of aggregate demand for milk, prices of margarine appear to exert some influence on relationships within the dairy economy after World War II (table 19, p. 68). The pre-World War II models developed so far may have only limited applicability in the postwar period because of the increasing importance of margarine and "filled" milk products. Therefore, a postwar model was constructed to take account of interrelationships between the dairy and the fats and oils economies. In addition, the effects of the increasing importance of American cheese in the family diet as a substitute for meat, poultry, and fish (see p. 98), and in its contribution to total use of milk, were allowed for by including a separate equation for cheese in the postwar model. In 1955, about 9 percent of the milk produced was processed into American cheese compared with 5 percent during the 1935–39 period.

Analysis I

The complete structural model for the postwar period consists of 9 equations and 9 simultaneously determined or endogenous variables as described below:

Q_f, Q_b, Q_c, Q_r and Q_m represent the apparent annual per capita civilian consumption of fluid milk and cream, butter, American cheese, manufactured dairy products excluding butter and American cheese, and margarine, respectively, all in pounds milk equivalent except that product weight was used for margarine, Agricultural Marketing Service. Civilian domestic disappearance (consumption) includes quantities obtained from CCC supplies or bought with Government funds.

P_f=Retail price of fluid milk and cream computed by the Agricultural Marketing Service to make it applicable to quantities consumed in farm households and by all nonfarm people, cents per pound.

P_b=Retail price of butter, cents per pound, Agricultural Marketing Service.

P_c=Retail price of American process cheese, cents per pound, 1950 to date from Agricultural Marketing Service. Prices for 1946–49 were estimated on the basis of prices for American natural cheese from the Agricultural Marketing Service.

P_r=Index numbers of prices applicable to the quantity Q_r. These were estimated on the basis of United States average (wholesale and retail) prices for evaporated milk, condensed milk, dry whole milk and ice cream and the price of fluid cream in Boston, 1947–49=100.

The given or predetermined variables in the postwar model are as follows:

Q_t=Annual per capita civilian disappearance of total milk, pounds milk equivalent fat-solids basis, Agricultural Marketing Service.

Y_t=Annual per capita disposable personal income, dollars, Department of Commerce.

P_a=Index numbers of retail prices of meats, poultry and fish, 1947–49=100, Bureau of Labor Statistics.

P_m=Retail price of margarine, cents per pound, Bureau of Labor Statistics. Uncolored, 1946–49; colored beginning 1951; 1950 estimated by Agricultural Marketing Service to reflect both colored and uncolored.

Data for the quantity variables may be obtained from tables 7 and 8, pp. 29, 30, respectively; and for price variables from tables 9 and 67, pp. 34, 252, respectively. The analyses were run prior to revision of the data.

For this system, equations dealing with demand were fitted by the limited information method, as each contains 2 endogenous variables, while the price-estimating equations were fitted by least squares, as each equation contains only 1 endogenous variable. Data in current dollars for the period 1947–54 were used. The following results were obtained:

Demand equation

$$Q_f = -4.73 - 13.4P_f + 0.0700Y_t \quad (42)$$
$$(9.2) \quad (.10)$$

$$Q_b = -6.26 - 3.44P_b + 0.05Y_t + 3.24P_m \quad (43)$$
$$(2.30) \quad (.24) \quad (1.70)$$

$$Q_c = 2.18 - 0.70P_c - 0.04Y_t + 0.46P_s \quad (44)$$
$$(.59) \quad (.02) \quad (.22)$$

$$Q_r = -17.34 - 1.76P_r + 0.26Y_t \quad (45)$$
$$(1.18) \quad (.20)$$

$$Q_m = 0.998 - 0.048P_m - 0.008Y_t + 0.122P_h \quad (46)$$
$$(.044) \quad (.006) \quad (.060)$$

Price-estimating equations

$$P_f = 0.087 - 0.024Q_t + 0.023P_m - 0.001Y_t \quad (47)$$
$$(.007) \quad (.017) \quad (.003)$$

$$R^2_{0.123} = 0.87 \qquad s_{0.123} = 0.27$$

$$P_b = -4.16 - 0.17Q_t + 0.57P_m + 0.05Y_t \quad (48)$$
$$(.13) \quad (.29) \quad (.05)$$

$$R^2_{0.123} = 0.82 \qquad s_{0.123} = 4.7$$

$$P_c = 0.434 - 0.14Q_t + 0.41P_m + 0.003Y_t \quad (49)$$
$$(.05) \quad (.11) \quad (.018)$$

$$R^2_{0.123} = 0.93 \qquad s_{0.123} = 1.7$$

$$P_r = -6.78 - 0.17Q_t + 0.41P_m + 0.085Y_t \quad (50)$$
$$(.15) \quad (.34) \quad (.059)$$

$$R^2_{0.123} = 0.81 \qquad s_{0.123} = 5.4$$

As in the previous analyses based on the simultaneous-equations approach, estimates from the demand equations are subject to the following relation:

Identity

$$Q_t = Q_f + Q_b + Q_c + Q_r \qquad (51)$$

At intervals in earlier sections, we discussed assumptions underlying interrelationships among all variables except the price of margarine and the index of prices of meats, poultry, and fish. During the years used in this analysis, only about 20 percent of the supply of fats and oils, other than butter and lard, used in food products was used in margarine. Hence, it can be assumed that factors that affect consumption of margarine had only a minor effect on the prices of fats and oils used in this product.[15] As the price of margarine varies in about the same way as the price of the fats and oils used in it, the price of margarine can be taken in this analysis as a variable that affects the several variables determined simultaneously by the model, but which is affected only slightly by them. Also, during this period, only about 6 percent of the total amount spent by consumers on meats, poultry, fish, and cheese was spent for the purchase of American cheese. Thus, factors that affect consumption of American cheese probably had only a negligible effect on prices of meats, poultry, and fish and, for this reason, these prices can be assumed as given in the analysis.[16]

Analysis II

In analysis I, the variables for civilian domestic consumption included the quantities obtained from CCC supplies or bought with Government funds. During the period 1947–54, these amounts reached a maximum in 1954, when these quantities amounted to 2, 7, and 8 percent of the total consumption of fluid milk, butter, and cheese, respectively (table 38, p. 171). These quantities were distributed largely through the school lunch and special school milk programs, which are discussed on p. 177. As quantities of fluid milk consumed under the regular school lunch program are not affected significantly by the relative surpluses of dairy products, and because the special school milk program did not begin until late 1954, the quantities of fluid milk bought with Government funds were considered as another regular component of aggregate demand. Therefore, analysis II makes no adjustment in this quantity. However, the quantities of butter and cheese transferred from CCC to the school lunch program under Sections 6 and 32 funds, which are discussed on p. 178, may have replaced some margarine and meat, respectively, served in the lunches. As amounts transferred in any year are affected partly by surpluses of these commodities, consumption variables used in analysis II for butter, Q_b^*, for cheese, Q_c^*, and for

[15] For further details regarding the demand and price structure for edible fats and oils and their products, see Armore (*1*).

[16] In fitting the equations by the limited information approach, P_r was omitted from the M_{zz} matrix, as this price index at best is only a crude approximation to the price of meat, poultry, and fish items that compete directly with cheese.

total milk, Q_t*, exclude 75 percent for butter and 50 percent for cheese of that part of civilian domestic consumption obtained from CCC supplies or bought with Government funds.

Analysis II also includes additional demand equations for fluid milk and cream, and for fluid milk only, consumed by nonfarm people. The variables used in analysis II which have not been described are:

(1) Q_f* and Q_f° equal the apparent annual *nonfarm* per capita civilian consumption of fluid milk and cream and fluid milk only, respectively; Q_f*, Agricultural Marketing Service, Q_f° estimated from Q_f* on the basis of the proportion fluid milk is to fluid milk and cream from information available on Federal order markets.

(2) P_f* equals the retail price of fluid milk, Agricultural Marketing Service.

Except as noted above, analysis II is identical to analysis I. The following results were obtained:

Demand equations

$$Q_f = -5.82 - \underset{(11.3)}{17.2}\ P_f + \underset{(.12)}{0.11}\ Y \qquad (52)$$

$$Q_f^* = -3.48 - \underset{(9.5)}{16.4}\ P_f^* + \underset{(.10)}{0.07}\ Y \qquad (53)$$

$$Q_f^\circ = -0.99 - \underset{(10.8)}{13.4}\ P_f^* + \underset{(.11)}{0.05}\ Y \qquad (54)$$

$$Q_b^* = -7.34 - \underset{(3.15)}{3.22}\ P_b + \underset{(2.21)}{3.16} P_m + \underset{(.32)}{0.05} Y \qquad (55)$$

$$Q_c^* = 1.77 - \underset{(.95)}{0.84}\ P_c + \underset{(.31)}{0.50}\ P_s - \underset{(.04)}{0.03}\ Y \qquad (56)$$

$$Q_r = -19.81 - \underset{(1.39)}{1.97}\ P_r + \underset{(.24)}{0.30}\ Y \qquad (57)$$

$$Q_m = 1.21 - \underset{(.07)}{0.07}\ P_m + \underset{(.10)}{0.16}\ P_b - \underset{(.011)}{0.012}\ Y \qquad (58)$$

Price estimating equations

$$P_f = 0.015 - \underset{(.011)}{0.023}\ Q_t^* + \underset{(.023)}{0.025}\ P_m + \underset{(.004)}{0.001}\ Y \qquad (59)$$
$$R^2_{P.QPY} = 0.76 \qquad s_{P.QPY} = 0.37$$

$$P_f^* = 0.084 - \underset{(.013)}{0.025}\ Q_t^* + \underset{(.027)}{0.030}\ P_m - \underset{(.005)}{0.001}\ Y \qquad (60)$$
$$R^2_{P.QPY} = 0.71 \qquad s_{P.QPY} = 0.43$$

$$P_b = -4.76 - \underset{(.159)}{0.147}\ Q_t^* + \underset{(.329)}{0.589}\ P_m + \underset{(.057)}{0.059}\ Y \qquad (61)$$
$$R^2_{P.QPY} = 0.78 \qquad s_{P.QPY} = 5.2$$

$$P_c = -0.304 - 0.124\ Q_t^* + 0.370\ P_m + 0.013\ Y \qquad (62)$$
$$(.066) \quad (.138) \quad (.024)$$
$$R^2_{P.QPY} = 0.87 \qquad s_{P.QPY} = 2.2$$

$$P_r = -7.60 - 0.152\ Q_t^* + 0.411\ P_m + 0.097\ Y \qquad (63)$$
$$(.175) \quad (.363) \quad (.063)$$
$$R^2_{P.QPY} = 0.78 \qquad s_{P.QPY} = 5.8$$

Demand Elasticities

The coefficients in equations (42) through (46) and (52) through (58) are shown as demand elasticities and percentage coefficients for time in table 24. Although these analyses are based on the relatively short period 1947–54, results of the exploratory analyses give an indication of changes in the demand structure since World War II as compared with the prewar period.

TABLE 24.—*Consumption of specified dairy products: Estimates of price and income elasticities and percentage coefficients for "time," based on a simultaneous-equations approach and data for 1947–54* [1]

Product	Percentage effect of time per year [2]	Price elasticities [3]				Income elasticities [3]	
		Direct		Cross		Value	Standard error
		Value	Standard error	Value	Standard error		
Analysis I:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Dairy:	−1.32	−0.32	0.22			0.27	0.38
Fluid milk and cream	−3.22	−1.37	.92	[4] 0.55	0.29	.36	1.71
Butter	4.27	−.75	.63	[4] .92	.44	−.99	.63
American cheese	−14.73	−1.47	.99			3.06	2.34
Other products	15.78	−.25	.23	[4] 1.50	.74	−1.81	1.37
Margarine							
Analysis II:							
Dairy:							
Fluid milk and cream:							
Farm and nonfarm	−1.63	−.41	.27			.41	.45
Nonfarm only	−1.03	−.47	.27			.30	.41
Fluid milk (nonfarm)	−.35	−.45	.36			.24	.53
Butter	−3.82	−1.30	1.27	.54	.38	.33	2.26
American cheese	3.47	−.90	1.01	[4] 1.01	.63	−.79	.95
Other products	−16.80	−1.64	1.16			3.53	2.75
Margarine	19.08	−.35	.38	[4] 1.90	1.29	−2.55	2.29

[1] Estimates for analysis I are based on demand equations (42) through (46), p. 102, and those for analysis II on equations (52) through (58), p. 104. The variables used in these analyses are described on pp. 101 and 103.

[2] The constant value in the demand equation divided by average quantities consumed during the period of analysis.

[3] Computed at the average values of the economic variables during the period of analysis.

[4] Coefficient differs significantly from zero when tested at the 10-percent probability level.

The use of consumption variables for butter and cheese in analysis II, which corrected for the effects of the quantities obtained from CCC supplies or bought with Government funds, reduced the demand elasticities for butter, although they still were essentially the same as those obtained from analysis I. The income elasticity for cheese also decreased, but the demand elasticities with respect to its own price and the price of the substitute increased. Owing to our use of a simultaneous-equations technique, estimates of coefficients in the equations for other products also were affected, increasing in each instance.

The estimates of income elasticities of 0.3 and 0.4 for fluid milk and cream which are obtained from post-World War II analyses I and II, respectively, compare with elasticities of 0.2 to 0.3 from the prewar analyses. The price elasticity —0.3 for fluid milk and cream obtained from postwar analysis I is below the —0.4 to —0.5 range in the prewar analyses, but the —0.4 from analysis II approaches the prewar level. A drop in the price elasticity would have been expected as a result of the decline in the demand for fluid cream in recent years, the component of this aggregate which usually has been considered to have the higher price elasticity. However, the demand coefficient for nonfarm fluid milk only in analysis II is not significantly lower than the postwar coefficient for the combined nonfarm fluid milk and cream. Annual consumption of cream dropped to 7.8 pounds per person for the period 1951–55 compared with 10.5 pounds in 1935–39. In contrast, annual consumption of fluid whole milk increased to 302 pounds per person during 1951–55 compared with 264 pounds in 1935–39.

Results obtained for American cheese from the simultaneous-equations approach confirm those suggested by the single-equation approach with respect to cheese as a substitute for meats, poultry, and fish in preparing family meals (see p. 93). This is indicated by the obtaining of a statistically significant cross-price elasticity in the post-World War II analysis.

The following observations can be made from the postwar demand elasticities obtained for butter and margarine: (1) Consumption of butter is affected more by its price than by the price of margarine. This viewpoint has been commonly accepted in the past; for example, Thomsen and Foote (*137*, pp. 417–418). (2) The coefficient that relates consumption to price is higher than for the interwar model. This is logical because it indicates the increased substitution effect of margarine on butter. (3) The analysis shows that consumption of margarine is decidedly sensitive to changes in butter prices—considerably more so than to changes in its own price. Because of the short period used, the values of these elasticities should be considered only as indicative of the approximate magnitude. A further consideration is the trend in butter consumption. During this period it was mainly downward, while that in margarine consumption was upward. It is doubtful, therefore, that a price reduction in butter, while holding the price of margarine constant, would bring about the increase in the quantity of butter consumed implied by the direct and cross-price elasticities obtained in the postwar analysis. These elasticities, and particularly the cross-elasticities, may hold for a shift from butter to margarine, but not in the other direction. Per capita consumption of butter decreased from an average of 10.5

pounds for the 1947–49 period to 8.4 pounds for the 1952–53 period, while that of margarine increased from 5.5 pounds to 7.8 pounds. At the same time, the ratio of the price of butter at retail to that for margarine increased from 2.1 for 1947–49 to 2.8 for 1952–53.

Some indication of the response to changes in the price of butter to be expected when consumption shifts from margarine to butter may be observed by examining the change that occurred in the consumption of butter following the reduction in level of support for manufacturing milk and butterfat as of April 1, 1954. To appraise the effects of the resulting reduction in the retail price of butter, it is more meaningful to compare the 1955 and 1953 calendar years; more reliable data on consumption may be obtained on a calendar-year basis, and sufficient time is allowed for adjustments in consumption to take place. From 1953 to 1955, retail prices for butter and margarine declined 8.1 and 0.5 cents per pound, respectively, while per capita disposable income increased 62 dollars. These represent decreases of 10 percent for butter and 2 percent for margarine, and a 4-percent increase in income. Based on these changes in prices and income, an increase of 0.64 pound or 8 percent in the per capita consumption of butter would have been expected, using demand equation (55) for butter from analysis II. This net increase of 0.64 pound results from the following:

	Pounds
Trend	−0.73
Decline in price of—	
Butter	1.30
Margarine	−.08
Increase in income	.15
Net total	.64

From 1953 to 1955, per capita disappearance of butter increased 7 percent, but the increase is only 4 percent if 75 percent of the quantities obtained from CCC supplies or bought with Government funds are excluded from the consumption figures as were such quantities in analysis II (see p. 103). For the same period, the increase in per capita consumption of creamery butter (excluding consumption of farm butter) was 11 percent, which is reduced to 7 percent when 75 percent of the quantities obtained from CCC supplies or bought with Government funds are excluded. The 4 percent increase in actual consumption is the one that should be compared with the estimated increase of 8 percent from demand equation (55), as these two estimates are based on the same consumption data.

If the downward trend in the consumption of butter has ceased and a reasonable estimate of the demand elasticities with respect to the price of margarine and income are 0.3 in each instance, a net increase of 0.7 percent in the per capita consumption of butter would be expected. The assumed income elasticity is the average of those obtained from the prewar and postwar analyses (tables 20 and 24, pp. 89,105). If of the total increase of 4 percent in the consumption of butter, 1 percent is assumed to be due to the combined effect of price of margarine and income, the remaining 3 percent must reflect changes growing out of the 10 percent decline in the price of butter. This would suggest an elasticity of demand for butter of −0.3 compared with those of −0.4 to −0.6 obtained from prewar analyses based on

the simultaneous-equations approach (table 20, p. 89). If similar computations are made for creamery butter only, a postwar elasticity of —0.6 is suggested.

DEMAND ELASTICITIES FROM OTHER STUDIES

During the last 3 decades a considerable body of information has been obtained from numerous budget or survey studies that deal with factors that affect consumption of and demand for dairy products. Aspects covered by these studies include effects on consumption of prices, family income, household size, racial origin, age groups, other family characteristics, regional location, and type of sales outlets. Froker, MacLeod, and Spencer (*56*) give an excellent summary of these studies up to the late 1940's. For most of these studies, results usually are shown as average consumption by different categories, and usually no attempt was made to derive demand coefficients by statistical means [see, for example, recent studies by Blakley et al (*9*), Clark and LeBovit (*28*), Cotton (*32, 33*), Drake et al (*37*), LeBovit and Clark (*76*), and commodity summaries based on the 1948 food consumption survey (*158*)].

Based on average relationships among income groups found in data from the 1936 consumer purchase survey of nonrelief, nonfarm families, Schultz (*117*, p. 69) computes income-quantity elasticities of 0.36, 0.47 and 0.31 for milk, butter, and cheese, respectively, associated with the lower income range, and 0.26, 0.21, and 0.35, respectively, for the higher income range. The corresponding income-expenditure elasticities are 0.41, 0.37, and 0.59 for the lower income range and 0.31, 0.27, and 0.41 in the higher income range.

Least-squares analyses based on consumer surveys by Waugh (*137*) for Boston in 1930, Patzig and Hadary (*101*) for selected cities in Wisconsin and Indiana during 1940–42, and Baum and Corbridge (*4*) for Seattle, Washington, in 1950 showed no significant relationship between income and consumption of fluid milk. However, Black (*8*) states that a comparison of average consumption in different income levels based on data in the Patzig and Hadary study shows appreciable relationship between those two variables. From a least-squares analysis based on data from the 1948 food consumption survey, Fox (*48*, p. 81) obtains an income-quantity elasticity of 0.23 and an income-expenditure elasticity of 0.32 for dairy products, excluding butter. Similarly, from the same consumption survey, Clark et al (*29*, p. 43) gives an income-quantity elasticity of 0.17 and an income-expenditure elasticity of 0.22 for total milk equivalent of dairy products. Baum and Corbridge (*4*, p. iv) found an income-consumption elasticity of less than 0.5 for butter.

Several studies have shown estimates of consumer response to price obtained by relating the average change in sales or household purchases of fluid milk during the week, month, or some other designated period immediately following changes in the price for fluid milk, apparently assuming that other factors remained constant. Demand elasticities with respect to price reported by or computed from results of these studies are shown in table 25.

Some studies have presented demand coefficients obtained from single-equation least-squares analyses based on time series data.

Results of some of these studies based on national aggregates are shown in table 26.

Brinegar (*20*, p. 15), in a case study of a community in eastern Connecticut during 1948–49, reports that, "over the long run," income elasticity of demand for fluid milk was 0.42 when the analysis

TABLE 25.—*Fluid milk: Short-term elasticities of demand with respect to price for specified periods and markets*

Study	Period analyzed	Market	Elasticity
Ross (*113*, p. 509)	1920–22	Chicago	−0. 1
Do (*114*, p. 55)	1919–24	New York, metropolitan area.	−. 1
Cassels (*24*, pp. 108–9)	1922–31	Boston	−. 06
Do	Do	Connecticut	−. 14
Do	Do	Baltimore	−. 28
Caumnitz and Reed (*57*, p. 45).	1934–35	Several selected markets	−. 28
Blanford (*10*, p. 19)	1933–37	New York, metropolitan area.	0 to −. 2
Do (*11*, p. 36)	1938–40	New York City [1]	−. 33
Luke (*79*, p. 32)	1948	Portland, Me	−. 45
Brinegar (*20*, p. 9)	1948–49	Eastern Conn. community	−. 48
Dwoskin, Bayton and Hoofnagle (*89*, p. 8).	1952–53	Memphis, Tenn	−. 4

[1] Based on retail sales at stores only while other studies are based on total sales in market or area.

TABLE 26.—*Specified dairy products: Elasticities of demand with respect to price and income based on least squares analyses of national aggregate data for specified periods*

Study and commodity	Period analyzed	Elasticity of demand with respect to—	
		Price	Income
Fox (*48*, p. 76):			
Milk:			
Fluid	1922–41	−0. 30	
Evaporated	do	−. 84	
Butter	do	−. 25	
Kriesel (*75*, p. 14):			
Fluid milk and cream	1924–41	−. 40	0. 20
Johnson (*72*, p. 1):			
Fluid milk (Conn.)	1938–51	−. 40	. 30
Shepherd (*119*, p. 399):			
Butter	1920–41	−1. 30	
Pearson and Vial (*102*, p. 37):			
Ice cream production:			
June	do		. 76
October	do		1. 36

was based on average quantity-income relationships of household purchases and 0.24 when based on least-squares analysis of dealers sales; while, over the short run, income elasticity may exceed unity (p. 20).

A good deal of information on demand characteristics of household purchases of dairy products is to be found in recent periodic reports of the United States Agricultural Marketing Service (*150*) based on data obtained from a national consumer panel and in the several studies by Quackenbush and Shaffer (*105*, *106*, and *118*) based on data from the Michigan State University consumer panel. The relation of household purchases of fluid milk, butter, margarine, nonfat dry milk, natural American cheese, cottage cheese, and processed cheese foods to family income based on consumer panel data is shown in figure 7, which is adapted from the reports of the Agricultural Marketing Service. Results of several least-squares analyses for varying periods during 1951–53 from two of the Michigan studies (*118*, pp. 23, 30 and *106*, p. 14) are shown in table 27.

TABLE 27.—*Specified dairy products: Elasticities of demand with respect to price and income based on data from consumer panels for 1951–53* [1]

Commodity	Elasticity of demand with respect to—		
	Price		Income
	Own	Competing product	
Butter	−0.46	0.46	0.60
Margarine	Inelastic	.55	−.40
Ice cream	−.86		[2] .83

[1] Based on studies by Shaffer and Quackenbush (*118*, pp. 23, 30 and *106*, p. 14).
[2] This coefficient was 0.97 when based on deflated income.

Some studies have dealt with competition between several dairy products such as fluid milk, fluid skim milk, other fluid items, evaporated milk, and nonfat dry milk [see Spencer (*124*), Luke (*79*), Trout and Quackenbush (*138*), Dwoskin (*38*), Brinegar and Johnson (*22*), Ward (*185*), Quackenbush and Shaffer (*105*) and Berry et al (*6*)]. Brinegar and Johnson (*22*, p. 18) present what they call a price elasticity of demand for fluid skim milk of −4.5, but this actually is the coefficient associated with the fluid skim milk—fluid whole milk quantity ratio and the skim milk—whole milk price ratio after making each variable independent of units of measurement. Berry, et al (*6*) also present a price elasticity of demand for fluid skim milk of −1.3 derived in the same manner. As discussed by Meinken, Rojko, and King (*87*), a coefficient computed in this way is difficult to interpret in terms of meaningful elasticities.

A number of studies have dealt primarily with competition between butter and margarine [see Snodgrass (*122*), Roberts (*109*), Pabst (*100*),

By Family Income

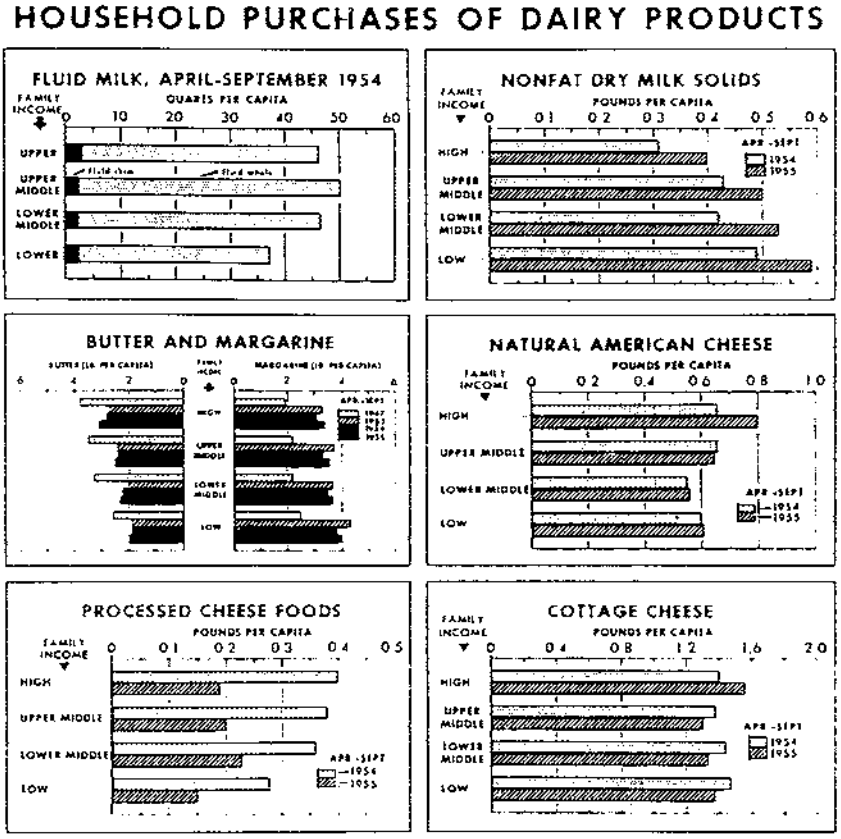

FIGURE 7.—Household purchases of fluid milk and butter tend to increase with rise in family income while purchases of margarine decrease. Household purchases of nonfat dry milk also decrease with family income. Purchases of natural American cheese, processed cheese foods, and cottage cheese appear to be affected only slightly by family income after allowing for substitution effects between the different classes.

Nicholls (*95*), Paarlberg (*89*), Brandow and Allison (*17*), Morgan (*90*) and Armore (*1*)]. Some of these analyses estimated elasticity of demand for butter as such. Pabst and Morgan attempted to measure the demand interrelationships between these two products by relating quantity ratios with price ratios and by use of the concept of the elasticity of substitution. As noted in the preceding paragraph, this approach is of questionable value.

No study discussed in this section has taken into account the simultaneous relations involved between all dairy products. Structural coefficients of demand for dairy products based on aggregate time series

data that are statistically consistent are obtained only when these interactions are allowed for in the demand analysis as was done in the studies discussed in this bulletin and in an earlier study by Rojko (*112*). Single-equation analyses based on data from consumer panels, on the other hand, do give elasticities of demand that are statistically consistent.

PRICE STRUCTURE OF THE DAIRY MARKETING SYSTEM

In this section and those following, several main facets are discussed: (1) How milk and dairy products are priced at key focal points within the dairy industry. Emphasis is placed on factors—physical, economic and institutional—that make pricing problems in the fluid sector different from those in the manufacturing sector. (2) Economic relations which relate to each other the key focal points or sectors in the dairy industry through price. As is shown, these relations differ from those designed to test the allocative efficiency of price within the dairy system.[17] (3) Components of demand which were not explicitly included in the statistical analyses but probably had some effect on prices and consumption in some of the years. These would include demand created by Government price support and food distribution programs, seasonal demand for stocks, and demand for imports and exports.

THE DAIRY MARKETING SYSTEM

In a predominantly agricultural economy, the complex dairy marketing system of today was nonexistent. Producers of milk and milk products were also the consumers or, at most, were in personal contact with the final consumer. Problems involved in transmitting consumers' wants back to producers or passing forward producers' intentions to consumers were at a minimum or nonexistent. But as the economy became industrialized and urbanized, a physical gap was created between the initial producer and the final consumer. In a progressive economy the gulf between producer and consumer tends to widen because (1) technological improvements often lead to a greater degree of specialization and (2) improved incomes per capita, followed with rising standards of living, increase the number and variety of goods and services demanded by consumers. In a highly industrialized country, a complex marketing mechanism for all commodities, including dairy products, is needed to integrate the plans of producers and consumers.

At this point, a definition of the dairy marketing system in relation to scope and functions may be helpful. If viewed from a physical standpoint, the dairy marketing system deals with the physical movement of milk and milk products from the time the milk leaves the farmyard until the milk or its derivative is purchased by the final consumer. From an economic standpoint, the dairy marketing system provides a framework which facilitates the integration of economic

[17] For studies of the latter type, see Hammerberg, Parker and Bressler (*60*) and Bredo and Rojko (*18*) for the fluid sector, and Hassler (*62*) for the manufacturing sector.

decisions made by milk producers, handlers, processors, and consumers. Thus, it provides a mechanism which simultaneously transmits back to producers the demands of consumers for milk products and marketing services, and passes on to the final consumer the results of earlier plans and intentions of producers. Within this framework, price is the prime motivating influence, supplemented to some degree at all times, and drastically at some times, by other considerations. For example, merchandising supplements price because it attempts to influence the decision-making process and, in periods of emergency such as war, rationing of scarce goods may be used to help prevent undue instability in prices.

Conceptually, at each point in the marketing chain at which there are changes in ownership, a demand schedule confronts a supply schedule. These transfers mean that some people have decided to sell while others have decided to buy at agreed-upon prices. In an earlier section, the major aggregate supply and demand relations or market clearing relations were identified for the three chief levels of the marketing chain—farm, wholesale, and retail. (See fig. 4, p. 57). Likewise, each level was described as a key focal point at which supplies and demands are equated at given prices.

The specific problems involved in pricing, and the analysis of the economic relations at each focal point and between focal points in the marketing sector, are discussed in the sections to follow. At this stage, it is sufficient to divide the major economic relations shown into two groups: (1) Vertical relations between the retail and wholesale level, and between the wholesale and farm level, for each dairy product, and (2) relations among the different dairy products at each level of the marketing chain. It should be noted that there exists a third group which reflects geographic differences for any given product at a particular level of the marketing chain.

Prices at each level are related. In a competitive market they should differ only by the average cost of processing and marketing services performed and factors that reflect differences in proportions of fat and nonfat solids, or other products used in their manufacture. Conceptually, if variables could be included to measure shifts in marketing costs and changes in composition of the individual product, it should be immaterial at what level a supply and demand analysis was conducted. In most cases, results from analyses dealing with one level can be translated to apply to any other level. The sections to follow analyze relations which aid in translations of this kind.

PRICING MANUFACTURING MILK AND MANUFACTURED DAIRY PRODUCTS

Manufactured dairy products and the milk used in them are priced under quite a different marketing framework from that in use for fluid milk. Prices for manufacturing milk and the derived products are established on a national competitive market through equating supply and demand for the country as a whole. Hassler (*62*) found that, "Although some persistent inconsistencies in the price relationships of the manufactured dairy products industry were disclosed, much of the evidence suggested that the pricing mechanism was remarkably compatible with a competitive system." Of course this

excludes the years when prices of dairy products were at the support level. Prices for manufactured dairy products are closely related over most of the country and differ chiefly by costs of transportation. For example, the price of butter in the New York wholesale market practically never exceeds the wholesale price of butter in the Chicago market by more than one cent per pound. This is about equal to the cost of transporting butter from the Midwest to New York. Since value of manufacturing milk in any locality is related to prices of products derived from it, regional differences also occur in the prices paid producers for manufacturing milk.

Storability of manufactured dairy products and low transportation costs in relation to total value are physical factors that encourage a close price relationship among regions. Two aspects of the marketing framework that assist in bringing about competitive pricing throughout the nation are discussed in the sections that follow.

Pricing and Marketing at Country Shipping Points

The pricing of manufactured dairy products at country shipping points, particularly at creameries and cheese factories, is inherently competitive primarily for three reasons: (1) The relatively large number of small manufacturing plants that are independently owned; (2) the ability of farmers in most cases to choose outlets by selling their milk either to creameries, cheese factories, or condenseries; and (3) the fact that the individual plant in general does not limit directly receipts of milk at the plant but rather accepts all milk delivered by farmers. Selling prices for the product and paying prices for milk at these plants are influenced by prices of manufactured dairy products established in central markets after allowing for processing and marketing costs. On the other hand, variations in prices and output at any single plant cannot affect the price in central markets significantly.

The 1947 Census of Manufactures (*156*) reported that of the 6,803 dairy plants classified according to major product produced, there were 2,157 plants making butter, 1,811 plants making natural cheese, 562 plants making concentrated milk (including dried milk), and 2,273 plants making ice cream. In the same group there were 11,144 plants in 1919 and 9,446 in 1939, indicating a fairly steady and substantial decrease through 1947. When the number of plants reporting the production of specified dairy products to the Agricultural Marketing Service in 1954 are compared with the number reporting in 1939, we find only ½ as many plants making butter in 1954, ⅓ as many making American cheese, ⅔ as many making evaporated milk, ¾ as many making ice cream but almost twice as many making nonfat dry milk solids for human consumption. Most cheese factories are small in relation to other dairy plants and many are operated by the cheesemaker and his family without additional help. More plants making cheese are located in Wisconsin than elsewhere. Much of the decrease in the number of cheese factories has resulted from improvements in transportation and increases in output per plant. In the days of horse transportation, cheese factories used milk from areas of little more than a 2- to 4-mile radius, but now these factories assemble

milk from 10 times the distance. Improved transportation also reduced the number of plants making butter, but the major drop resulted from the decline in production. Economies in scale of operation are a further factor contributing to increasing output per plant, thereby enlarging the size of the procurement area and decreasing the number of plants. In 1954, the average cheese factory produced approximately 741 thousand pounds of American cheese. This was more than 3 times the output per factory in 1939 and over 7 times that of 1919. The output per creamery of 585 thousand pounds of butter in 1954 was about 50 percent higher than the output in 1939, but over 2½ times the output in 1919. The output of about 26 million pounds of evaporated milk per plant was over 1½ times that of 1939 and almost 4 times the putput of 1919.

Cook, et al (*31*) in a recent study of creamery pricing practices in the North Central region found that the average creamery is relatively small and has limited financial resources. Because of limited capital, and in order to pay their milk producers regularly, most creameries sell their butter as soon as it is manufactured. They ordinarily can not store or hold butter to benefit from any prospective higher prices. Most plant managers are trained in the field of dairy manufactures and not marketing. Further, as a rule, managers of small creameries process all milk and cream delivered into butter, regardless of market conditions. This may result largely from a lack of equipment to make other kinds of products and the fact that butter can be stored more efficiently than can milk or cream.

Other findings from this study that pertain to pricing are as follows: Most creameries ship butter regularly to only one receiver, although half of the larger plants reported more than one buyer. Likewise, many creameries were at a disadvantage in selling butter because they lacked adequate market information. Creameries usually sold butter subject to a sales agreement with a receiver of butter. The sales agreement ordinarily provided that the creamery would be paid for its butter on the basis of a central market price quotation for butter on a certain day, frequently the day that the butter arrives at the destination. The price quotations most commonly used were that of the Urner-Barry Company (*136*) for the New York market and that of the Chicago Price Current (*26*) for the Chicago market. The sales agreements also specified premiums above quoted prices and, in some cases, discounts from the central market quotation. Likewise, more than two-thirds of the sales agreements stipulated that the shipper pay the cost of shipment to the receiving point. Other provisions were included which affected the net price received by creameries.

The findings of Miller (*89*) in a recent study suggest that American cheese at Wisconsin factories is priced in much the same way as is butter at creameries. For example, he found that during 1948 the price of American cheese to factories in Wisconsin was almost universally based on the prices prevailing on the Wisconsin Cheese Exchange, but in many cases the actual prices varied by a rather complicated system of premiums. These premiums, in addition to the usual one for moisture, were based on the fat content of the cheese or were in the form of hauling costs or supplies furnished free or at

less than cost. A resulting weakness from this complicated system of payment is that factory operators are poorly informed about the operation of the premium system used by their competitors. Hence, it is difficult to compare prices with neighbors or among alternative outlets for cheese.

The effects on pricing of the factors discussed above can be summarized as follows: Many creameries and cheese factories are in a poor bargaining position in relation to their buyers because of their smallness, lack of knowledge, limited financial strength, and the nature of the marketing system. They sell their output at the *going* market price because the output of an individual plant is too small to affect the price in the central market significantly. Further, since many of the creameries and cheese factories have inadequate capital to cope with changes in demands and supplies for dairy products, the price uncertainty and risk tends to be passed back to the producer of milk. In short, the price received by the milk producer tends to be the central market price less cost of manufacturing plus an allowance for profit. The profit margin (sometimes negative) is conditioned to a great extent by the degree of competition present in the supply area as determined by the number of alternatives available to the farmer for selling his milk. In many areas the competition by plants for the same supply of milk is substantial. For example, Blum and March (*13*, p. 14) found that 4 of the plants used in compiling the "18 condensery" milk price series competed with 9, 15, 23, and 28 plants, respectively, in obtaining their supply of milk.

On the other hand, most of the plants making evaporated milk are operated by one of the few large manufacturers of evaporated milk in the country—Carnation, Pet Milk, White House Milk, and the Borden Companies. The marketing of evaporated milk has been in the hands of the manufacturers, who distribute their products directly to wholesale grocers and chain stores. Unlike the small creamery or the family-type cheese factory, manufacturers of evaporated milk do attempt to regulate the supply of evaporated milk to some extent. The quantity of milk channeled into condenseries is affected by pricing policies of these firms that take into account the demand and stock position of evaporated milk in relation to the supplies of all milk and competitive prices in other outlets.

One of the important developments in recent years is that a number of manufacturing plants have been equipped to produce several dairy products. The more highly diversified of these plants—known variously as flexible, diversified, or multiple-product plants—are few in number, but quite important in volume of production. In a recent study, Cowden and Trelogan (*3,4*) reported that of 9,739 dairy plants reporting to the former Bureau of Agricultural Economics in 1944 there were about 100 diversified plants which together accounted for the following percentages of production: Butter, 6 percent; cheese, 2 percent; evaporated milk, 7 percent; and other important condensed and dried milk products, 20 percent. These diversified plants significantly affect the setting in which dairy products are priced because they add flexibility to the channeling of milk into different outlets.

Pricing in Central Markets

Wholesale prices of dairy products that are determined in central markets tend to reflect and influence the economic position of dairying. As discussed previously, central market prices are used as bases for determining selling prices of manufactured dairy products at most creameries and cheese factories. Likewise, owners of manufacturing plants use these prices as bases for paying farmers for milk and butterfat delivered to plants. Pricing in many fluid milk markets under the classified pricing system have as bases wholesale prices for dairy products determined on central markets. Therefore, it is important to understand how prices are established at these markets.

Conceptually, the wholesale level is the point at which changing demand and supply conditions for individual dairy products become most clearly evident. Prices for the several products as determined here affect the utilization of available milk at manufacturing plants. As discussed on p. 56, relationships among these prices cannot change materially without more milk being diverted to the higher-priced product. On the other hand, if the final consumer demand for one product increases relative to the demand for others, this is reflected in the wholesale market through the increased demands of retailers, and prices of that product relative to those for other dairy products tend to rise sufficiently to result in the necessary increase in production. Demand and supply for total milk, on the other hand, tends to be equated at the farm or plant level.

Since, in terms of value and market influence, butter is the most important single manufactured dairy product, pricing of it in central markets is discussed first.

Several studies, notably those of Quintus (*108*), Nicholls (*93*), Mathis and Hirsch (*84*), Cook, et al (*31*), and March and Herrmann (*83*), have dealt with problems of marketing butter and the establishment of prices for butter. The study by March and Herrmann dealt specifically with the establishment of butter prices at wholesale in Chicago and New York.

In the early 1900's, creamery butter generally was sold on a commission basis in the wholesale market. This was replaced later by a sales agreement system of direct procurement. Nicholls found that an important development in the marketing of butter between 1918 and 1938 was the dwindling in importance of wholesaler and jobber channels which had once dominated the market. Instrumental in this change were the development of (1) direct buying by firms that controlled the distribution of butter all the way to the retailer and (2) large dairy firms with facilities to handle butter all the way to the retailer. Findings of March and Herrmann showed that 85 to 90 percent of the butter bypassed open market wholesale channels and was handled directly by butter marketing cooperatives, chain stores, and large dairy corporations and meat packers.

Price quotations reported in the Chicago Market Report Service (*134*) [reported in the Chicago Price Current (*26*) until 1954] and Urner-Barry Market Report (*136*) are based exclusively on trading on the Chicago and New York Mercantile Exchanges, respectively. Trading on the spot butter markets of the exchanges takes place at a specified time each morning on the floor of the exchange and lasts

for 15 minutes in New York and 30 minutes in Chicago. The exchanges take the position that they merely provide a market place where buyer and seller may meet and that any interpretation which is made of the trading which takes place is not under their control.

Actually very few sales are made on these exchanges. March and Herrmann (*83*, p. iii) report that "only 10 to 15 percent of the butter handled by major receivers is bought or sold on the open market in transactions that could potentially be executed on the exchanges." Nevertheless, since the value-establishing function of exchange trading plays such an all-important part in establishing commercial quotations, certain findings by March and Herrmann (p. iv) are repeated below:

"Chicago and New York mercantile exchanges might broaden their functions as market places if certain changes in the spot butter rules were made, as follows:

"1. Make it possible for receivers to offer butter on the spot call which is located at various country concentrating points outside of Chicago or New York.

"2. Provide for a fuller description of butter offered on the exchange, including such factors as salt and color.

"3. Provide the buyer pay the seller a receiving and handling allowance for butter purchased on the spot call.

"Findings relating to certain criticisms of central market butter prices were as follows:

"1. Premiums over the commercial quotations are frequently paid to creameries and in the open market. This is not a serious weakness for those who understand the nature of the quotation. But, it would be desirable to develop periodic reports of the level of premiums being received by creameries.

"2. Butter prices have fluctuated considerably from day to day at certain times but are not more variable than the prices of several other agricultural commodities.

"3. Central butter market quotations are based on a limited volume of trading by a relatively few traders on the Chicago or New York mercantile exchanges. Such trading is generally undertaken primarily for the purpose of adjusting values and not for the purpose of buying or selling butter.

"4. Many of the major receivers and distributors trade only infrequently on the exchanges, but they are usually represented at the trading sessions and are prepared to buy or sell butter on the exchanges, if necessary, to protect their interests as to value. A trader cannot keep the market out of line with the sentiment of the trade for more than a short time unless he is willing to buy or sell sizable quantities of butter. Nevertheless, the thinness of the market makes it possible for an individual to occasionally exert disproportionate influence on the market for short periods of time."

Price quotations on the Mercantile Exchange and wholesale prices for butter reported by the United States Department of Agriculture for New York and Chicago differ in the following ways: (1) The USDA prices reflect wholesale transactions between dealers in the open market in addition to trading on the Exchanges. (2) Open market transactions between dealers take place throughout the day

instead of the 15- and 30-minute trading periods on the New York and Chicago Exchanges, respectively. (3) Wholesale selling prices reported by the USDA are usually higher than the quotations on the Mercantile Exchange because its prices include sales of bulk butter in the open market, which generally are made at a markup of ¼ to ½ cent over the commercial quotation.

In many respects, the pricing of cheese in central markets and at cheese factories is similar to that for butter. In a recent study, Miller (*89*, p. 2) found that "during 1948 the price of American cheese to factories in Wisconsin was almost universally based on the prices prevailing on the Wisconsin Cheese Exchange, but in many cases the actual prices paid factories varied by a rather complicated system of premiums. Wholesale prices for American cheese in such markets as Chicago and New York also followed closely the prices paid on the Exchange." He concluded that the membership on the Exchange had a broad enough base to represent an adequate cross section of the industry. He (p. 19) stated that the membership consisted of ". . . leading national distributing corporations, a number of independent cheese dealers and processors, at least one chain store, several cheese producer cooperatives and a consumer cooperative. The membership list in 1949 consisted of 49 members . . ."

The findings of Miller (*89*, p. 21) on the relation between Exchange prices and wholesale cheese prices in New York and Chicago are of interest:

"Correlations of Exchange prices with central market quotations of the following Monday were 0.994 for both New York and Chicago and even slightly higher for the following Tuesday in both cases. There were slight declines in both cases for the days later in the week than Tuesday. The central wholesale market quotations of the following Friday, however, still showed a higher correlation with Exchange prices (*0.991 for Chicago and 0.981 for New York*) than those established at the central markets on the same day as the Exchange session (*0.953 for Chicago and 0.937 for New York*)." Since the prices in New York and Chicago appear to follow rather than lead prices on the Cheese Exchange, prices on the Exchange appear to be a better indicator of prospective price trends in the cheese industry than central prices at Chicago and New York. Furthermore, because of the nature of rules on the Exchange and because of the broad board membership, probably it can be concluded that the national supply and demand position for cheese is more accurately reflected on the Exchange.

The marketing of cheese always has shown some centralization of control at the warehousing stage, the first step from the factory. The invention of processed cheese in 1916 (see p. 17) and the rising importance of processed cheese in the total cheese picture in the 1920's led to a further degree of centralization. Nicholls (*94*, p. 86) reports that by 1930 all the basic patents concerning processed cheese were in the hands of the National Dairy Products Corporation and the Borden Company, after a 3-year period of expansion, mergers, and consolidations. The patents have expired, but these companies continue to dominate the field of cheese marketing.

Froker et al (*54*) found that small producers and specialized middlemen never have been important factors in the handling of evaporated

milk. Marketing of evaporated milk has been in the hands of the manufacturers who chiefly distribute their products directly to wholesale grocers and chain stores. Obviously, central market pricing of the nature and magnitude found for butter and cheese does not exist. However, the manufacturers' selling prices for evaporated milk reported by the Agricultural Marketing Service are quite comparable. The Agricultural Marketing Service publishes average wholesale selling prices at manufacturers' distribution points for carlot sales by geographic divisions. These prices include both national and local brands and probably represent approximately a weighted average price.

Before September 1933 and after June 1947, manufacturers' selling prices were essentially those established under free market conditions. From September 1933 through May 1935, the industry operated under Marketing Agreement 7 under authority of section 8 of the Agricultural Adjustment Act of 1933.[18] This agreement established minimum and maximum prices for selling evaporated milk and set minimum paying prices for milk used. From May 1935 through June 1947, the industry operated under Marketing Agreement 60 and License 100 under the Agricultural Act of 1933, as amended, and the Agricultural Marketing Agreements Act of 1937. In the area of selling prices, manufacturers, as in the earlier agreement, were bound to prices established by zones f. o. b. distribution points, but they now were free to make changes by submitting a price list that was eventually distributed to all other suppliers. On the buying side, minimum prices to be paid farmers were established by a formula based on the price of American cheese at Plymouth, Wis., in combination with the price of 92-score butter at Chicago. During this period, however, prices actually paid farmers always were above the minimum prices; formula prices, therefore, never were effective.

As noted earlier, the average manufacturers' selling prices as published by the Agricultural Marketing Service include both national and local brands. Hassler (*62*), in a recent study of pricing efficiency in the manufactured dairy products industry, found that nationally distributed brand prices for evaporated milk were somewhat higher than local brand prices, which were more nearly in line with equivalent prices for butter and cheese. On the procurement side, divergences were small even for the nationally advertised brands because of direct competition of condenseries with cheese factories and creameries for the same supply of milk.

Generally, cream—particularly cream for table use—is priced under the same kind of classified pricing system as milk for fluid use. For this reason, cream often is not considered a part of the manufacturing segment of the dairy industry. However, in some instances cream of bottling quality, and also cream of manufacturing quality for use in ice cream, are priced on an open wholesale market. Whether the wholesale cream market is truly open and competitive depends on the extent to which sanitation requirements permit the free movement of cream supplies regionally. For example, the Federal order in Boston permits cream that is bought on the open wholesale market in that city to be sold as cream for fluid use, and the formula for

[18] For a detailed study of the evaporated milk industry under Federal Marketing Agreements, see Baker and Froker (*21*).

pricing fluid cream at retail is based on the prices established on the open market. Since western cream is sold on this market, prices there probably reflect the supply and demand position for cream for the country as a whole.

The United States Department of Agriculture reports three wholesale prices for 40-percent cream of bottling quality for the Philadelphia market. Differences are primarily a result of quality requirements. In this market, the wholesale price of cream approved for Pennsylvania only probably is as much a competitive price as the price in Boston. The wholesale price for cream approved for Pennsylvania and New Jersey, and the price for Pennsylvania, Newark, and Lower Merion township, also are competitive, as cream can be purchased from a wide area. The quoted wholesale price for 40-percent bottling cream for New York City, on the other hand, is less competitive, because sources of supply are limited to specified approved areas. A large market also exists for cream of manufacturing quality for use in ice cream as represented, for example, by the Pennsylvania approved price in Philadelphia, and by the price at Atlanta, Georgia.

Wholesale selling prices are available for other manufactured dairy products such as dry whole milk, nonfat dry milk and casein, but usually only for the markets in New York, Chicago, and San Francisco.

PRICING MILK IN FLUID MILK MARKETS[19]

Striking differences exist in the marketing of fluid milk and milk used in manufacturing outlets. Many of the particular institutional arrangements in the fluid sector have risen in part from the attempt to solve milk marketing and pricing problems. These problems, to a large extent, were the result of pricing problems closely associated with the nature of the product and the maintenance of the seasonal and cyclical supply-consumption balance.

Fluid milk, because of its bulkiness and perishability, is not adapted for trading on any kind of a central market for the purpose of price determination. Historically, prices for fluid use were determined by advance negotiation between producers and users or distributors. But as marketing areas expanded, an overall milk marketing procedure became necessary to overcome the inherent instability of fluid milk prices and of fluid markets. To correct this, and to promote orderly marketing, a system of classified pricing and pooling was developed. Nevertheless, prices of milk producers often became seriously depressed because of disparities in bargaining strength between producers and distributors. The weaknesses of producers in bargaining for the sale of their milk were closely associated with the bulk and perishability of the product, their inability to market milk not needed for direct consumption, and the different seasonal patterns of milk production and consumption. Before public regulation, the effectiveness of classified pricing and pooling often became negligible when the market was in a surplus supply position, because both handlers and producers

[19] For detailed studies dealing with factors that affect prices in fluid milk markets and concerned with the theoretical considerations and problems involved in pricing milk in fluid markets, see Black (*7*), Cassels (*24, 25*), Gaumnitz and Reed (*57*), Hammerberg, Parker, and Bressler (*60*), and Bredo and Rojko (*18*).

in the short run found it profitable to transact business at a price that reflected the average or "blend" price, plus a nominal premium, but one that was lower than the class-use price for fluid milk. As a result of these marketing difficulties, milk producers in many areas requested Government intervention in the marketing and pricing of milk, especially during and after the depression in the 1930's.

Fluid Milk Markets as Local Markets

Historically, each fluid milk market has been considered a separate local market. Usually, local supplies of milk were equated with local demands for fluid milk, and only when local supply exceeded local demand by a substantial amount did these markets become part of the national market. Several factors were important in keeping fluid milk markets local: (1) In days of poor refrigeration, perishability of fluid milk made it mandatory that milk be produced locally. Improved transportation, refrigeration, and methods of handling milk have in recent years eliminated this restriction to a considerable degree. (2) Sanitation and quality control had its origin in local health ordinances. Uniform sanitary regulations and reciprocity,[20] a requirement for intermarket and interregional movement of fluid milk, followed next; only recently has it applied over wide geographic areas. (3) Cost of transporting fluid milk, fluid cream, butter, cheese, and other concentrated dairy products differ. To illustrate, a hundredweight of 4-percent milk can be converted approximately into (a) 10 pounds of 40-percent cream and 8 pounds of skim milk powder, or (b) 10 pounds of American cheese, or (c) 5 pounds of butter and 8 pounds of skim milk powder. Even if transportation costs were identical for the same weight of final product, these differences in densities would indicate substantial differences in the costs of shipping milk in the different forms. In addition to density, weight and perishability have a tendency to cause transportation costs to vary directly with the value of the product in relation to these factors.

Thus the ratio of transportation costs of milk to an equivalent amount of cream is roughly 7 to 1, to skim milk powder 15 to 1, to American cheese 12 to 1, and to butter 25 to 1. Concentrated dairy products, whose values are high relative to their weight, can be shipped economically for longer distances than relatively bulky and perishable fluid milk.

For all of these reasons, city milk markets tend to obtain their supplies of milk for fluid use from the closest production area. Fluid cream may be obtained from more distant areas, and concentrated dairy products, such as butter and cheese, from even more distant areas. The tendency toward a concentration of specialized areas of production around consuming centers would prevail even in the absence of sanitary regulations for the production and handling of milk for fluid use, or in the absence of similar institutional factors. Local sanitary regulations may tend to maintain existing areas of supply, but they did not cause the original pattern. Milk producers

[20] An arrangement whereby milk that is approved for fluid use in one market is accepted in another market, and vice versa.

whose farms are near urban areas usually enjoy a natural competitive location advantage in the fluid market.[21]

Theoretical Relationships Between Local Fluid Milk Markets and the National Market for Manufacturing Milk

Local fluid milk markets obviously are to some extent related to the national market for manufacturing milk, because part of the milk shipped to the fluid milk market is used in manufacturing. For most producers who regularly sell on the fluid market, however, prices for fluid use are higher than prices the milk could command from manufacturing plants; therefore, more complicated economic relations are involved for milk sold to fluid markets.

To gain insight into the nature of the relationships between local fluid milk markets and the national market for milk for manufacturing, let us suppose that there exists a single large isolated consuming center in the midst of a milk-producing area. Suppose also that the demand for milk for fluid use at the f. o. b. city plant level can be represented by the curve MN, on the extreme right in figure 8. Specifically, this demand curve represents the quantities of fluid milk that will clear the market at retail prices less costs of city distribution and processing in city bottling plants. Such prices correspond approximately to the dealers' buying price for milk for fluid use for selected individual cities as reported by the Agricultural Marketing Service in the Fluid Milk and Cream Report (*149*).

Suppose that milk producers in the supply area surrounding the consuming center have two choices of selling milk: (1) To ship to the city plant or to country plants which ship milk to the local market, and (2) to sell to nearby plants which produce manufactured dairy products. Naturally, they will sell to that outlet that returns the highest price for their milk.

The left-hand part of figure 8 shows the price received by farmers in the supply area for milk sold in alternative outlets in relation to the distance of the producer from the local market. If producers sell milk to manufacturing plants, they receive a price at the level of line DBIE. As discussed previously, this price is established through the interaction of supply and demand forces for manufacturing milk (in form of manufactured products) on the national market. If we are dealing with a small supply area, the quantity of milk produced in this area cannot affect significantly the price of milk for manufacturing uses. Therefore, the price line DBIE may be looked upon as a base milk price, which is approximately equivalent to the average price received by farmers, f. o. b. plants, for milk for manufacturing purposes as reported by the Agricultural Marketing Service (*146*). Obviously, if any milk from this area is to be channeled into fluid outlets, the price received by the farmer must be at least as high as the base price line DBIE.

In contrast to prices for milk for manufacturing, prices received by farmers for milk in fluid outlets result from the simultaneous interaction of four main factors within the local supply area. These are:

[21] Location theory and the effect of location on regional prices and production zones is discussed in the sections that follow. The studies cited in footnote 19 also deal with this aspect of the subject.

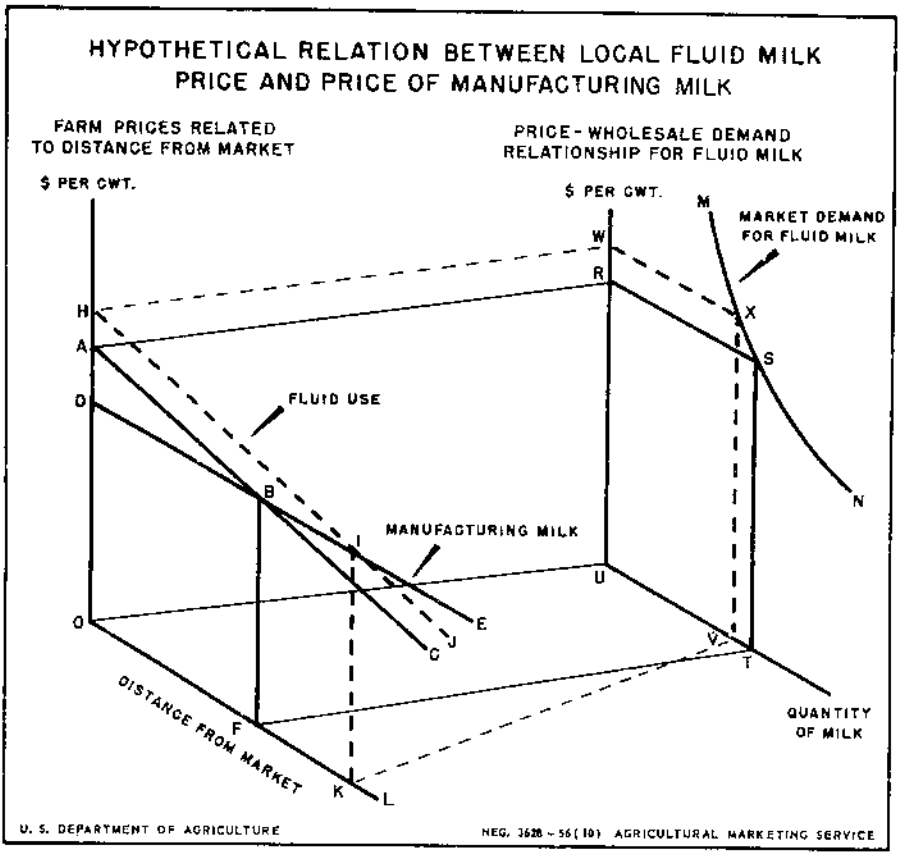

FIGURE 8.—Prices of milk for fluid use in city markets are determined by (1) special demand factors in the market such as consumer income; (2) local supply conditions with reference to costs of production, distance of milk supplies to market, density of production of milk and marketing costs; (3) prices of milk for fluid use in competing supply and market areas; and (4) prices of milk in available manufacturing outlets.

(1) The relatively inelastic demand for milk at the fluid market as represented by the line MN. Statistical analyses shown earlier suggest that for a 10-percent change in the retail price, the quantity consumed in fluid uses changes in the opposite direction by between 3 and 4 percent. (2) The relatively high cost of marketing (particularly transportation) which must be deducted to translate prices in fluid outlets at the city market into prices received by farmers located at any point in the supply area for milk channeled into fluid uses. In figure 8, if the city plant price is at the level of line RS, and if marketing costs are assumed as given in any period, prices in the supply area related to distance from the market can be represented by the line ABC. Raising or lowering the price at the city plant (line RS), with marketing costs fixed, would raise or lower the price structure at the country plant level (line ABC). (3) The perfectly elastic demand for milk in manufacturing uses for this supply

area at a price determined on the national market, as represented by the line DBIE. (4) The total supply of milk available, which is assumed to be fixed in any given period for reasons explained earlier. For any given density of production of milk, any point on the distance axis shown at the left side of figure 8 can also represent a quantity of milk produced within a given distance from the market, and these points have corresponding points on the quantity axis in the right-hand part of figure 8. For example, the quantity within the distance OF corresponds to the quantity UT.

The quantity of milk channeled into fluid outlets is not known until equilibrium is established between the local fluid milk market and the national market for milk for manufacturing. The quantity of milk channeled into fluid outlets from any point in the supply area depends on the relation between prices in fluid and manufacturing outlets, with milk channeled to the higher priced outlet. For example, in the diagram, producers who are located nearer than the point F from the market gain by selling to fluid outlets, while producers who are located beyond point F gain by selling to manufacturing plants.

At equilibrium, the price at the market (line RS) must be at a level such that the price in the supply area (line ABC) is just sufficiently above the manufacturing price (line DBIE) to siphon from the supply area (that is, the area within a distance OF of the market) to the city market the quantity of milk corresponding to the quantity (UT) that will clear the market at the going price (line RS). Any other set of prices, quantities, and distances are inconsistent with equilibrium for the given demand conditions, supply densities, marketing costs, and manufacturing prices.

Obviously, if more than one fluid milk market or more than two outlets had been included, the analysis would become much more complex. However, the same logic holds for the more complex case.

Effect of Seasonal Variation on Pricing

Historically, much of the inherent instability in month-to-month prices of fluid milk, and many of the pricing problems, stem from differences in the seasonal patterns of production and consumption of milk. Blum and Herrmann (*12*), in a study of sales data in 22 Federal order markets, found that the maximum range in sales of whole milk between the highest and lowest month was 11 index points (table 29). On the other hand, daily receipts for those markets showed a range of 21 to 60 index points between the lowest and highest month (table 28). To further aggravate the situation, consumption of milk was at a minimum during June, July, and August when supplies were in a relatively surplus position, whereas production of milk tends to be the least in November and December, when sales in most markets are above their annual average.

Differences in the seasonal patterns of production and consumption affect the balance between market supplies and market demand. Suppose that the equilibrium position discussed in the previous section occurred during the flush season. (See fig. 8.) Suppose also the same competitive conditions to prevail. As we move from the flush to the short season, the density of milk production declines and market supplies of milk from existing plants and producers become

TABLE 28.—*Daily average receipts of milk from producers: Index numbers of seasonal variation, selected markets under Federal milk marketing orders, 1947–51* [1]

Market	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.	Range [2]
Boston, Mass.	81	83	98	113	128	137	115	101	96	90	79	79	58
Chicago, Ill.[3]	98	103	109	115	123	123	104	91	83	81	81	89	42
Cincinnati, Ohio	80	86	95	108	132	130	119	110	100	88	77	75	57
Cleveland, Ohio	86	90	98	107	126	126	110	100	98	93	83	83	43
Columbus, Ohio	87	92	97	104	125	122	110	103	98	93	85	84	41
Dayton-Springfield, Ohio	86	91	98	105	124	122	112	104	99	93	84	82	42
Dubuque, Iowa	90	97	105	113	132	120	114	97	87	79	75	82	57
Fall River, Mass.	91	91	96	109	115	124	107	98	94	95	91	89	35
Fort Wayne, Ind.	89	96	104	114	130	121	108	98	92	84	81	83	49
Kansas City, Mo.-Kans.	89	92	95	104	119	118	115	107	98	91	86	86	33
Louisville, Ky.	88	94	100	111	125	115	108	104	100	90	82	83	43
Lowell-Lawrence, Mass.	91	93	101	115	125	120	104	94	96	87	86	88	39
Minneapolis-St. Paul, Minn.	107	115	121	123	128	120	95	76	68	72	80	95	60
Omaha-Council Bluffs, Nebr.-Kans.	93	101	105	110	124	121	111	101	89	81	79	85	45
Philadelphia, Pa.	89	94	101	108	120	116	104	105	100	92	86	85	35
Quad Cities, Ill.-Iowa [4]	93	100	108	108	119	119	110	100	90	86	81	86	38
St. Louis, Mo.	91	97	101	110	125	117	109	103	95	86	81	85	44
Sioux City, Iowa	95	103	108	113	124	124	111	97	84	79	78	84	46
South Bend-La Porte, Ind.	90	96	101	107	123	121	110	104	95	88	81	84	42
Toledo, Ohio	94	99	104	110	120	119	104	95	92	88	86	89	34
Tri State, Ky.-Ohio-W. Va.	83	87	94	104	127	126	118	113	103	89	78	78	49
Wichita, Kans.	98	102	105	106	111	104	104	99	91	90	94	96	21
22 markets	92	97	104	112	124	123	108	97	90	85	82	86	42

[1] Adapted from Blum and Herrmann (*12*, pp. 15, 18). Average ratio to 12-month moving average, adjusted to add to 1200.
[2] Amplitude of index variation from lowest to highest figure.
[3] Includes suburban Chicago.
[4] Includes Clinton, Iowa.

TABLE 29.—*Daily average sales of fluid whole milk: Index numbers of seasonal variation, selected markets under Federal milk marketing orders, 1947–51* [1]

Market	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Range [2]
Boston, Mass	101	101	103	102	102	100	95	95	100	101	101	99	8
Chicago, Ill.[3]	100	100	101	100	99	100	97	100	102	101	100	100	5
Cincinnati, Ohio	101	102	103	100	98	98	95	96	103	102	102	100	8
Cleveland, Ohio	99	100	100	100	100	101	99	100	101	101	100	99	2
Columbus, Ohio	101	101	102	102	100	98	95	96	100	103	102	100	8
Dayton-Springfield, Ohio	101	100	102	101	99	99	96	97	102	102	101	100	6
Dubuque, Iowa	101	102	102	101	99	95	95	97	102	104	102	100	9
Fall River, Mass	96	97	99	99	100	101	102	104	104	101	99	98	8
Fort Wayne, Ind	102	102	103	102	100	99	93	93	100	102	102	102	10
Kansas City, Mo.-Kans	102	102	103	103	98	96	93	95	101	103	102	102	10
Louisville, Ky	102	103	104	101	97	95	93	95	102	104	103	101	11
Lowell-Lawrence, Mass	99	99	100	101	101	100	99	100	101	102	100	98	4
Minneapolis-St. Paul, Minn	101	102	103	101	99	97	95	98	101	102	101	100	8
Omaha-Council Bluffs, Nebr.-Iowa	101	102	102	101	98	98	96	95	101	102	102	102	7
Philadelphia, Pa	100	101	103	101	102	100	93	94	102	103	101	100	10
Quad Cities, Ill.-Iowa [4]	100	101	103	102	99	98	95	96	101	101	102	102	8
St. Louis, Mo	100	102	102	102	99	99	95	97	101	102	101	100	7
Sioux City, Iowa	101	101	104	100	97	96	96	96	102	102	102	103	8
South Bend-La Porte, Ind	100	101	103	102	100	97	97	98	101	101	101	99	6
Toledo, Ohio	99	100	101	101	101	100	99	100	101	101	98	99	3
Tri State, Ky.-Ohio-W. Va	100	102	106	104	100	96	95	95	100	102	100	99	11
Wichita, Kans	101	102	102	102	98	97	94	97	102	103	101	100	9
22 markets	100	101	102	101	100	97	96	98	102	102	101	100	6

For footnotes, see table 28.

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inadequate to meet fluid milk requirements. Hence, the quantity of milk supplied from the area within a distance OF from the market now is less than UT because of a reduction in production density. Since producers cannot increase milk production greatly in the short run, city milk dealers will add new producers by increasing their buying prices (this is, by raising line RS to the higher position indicated by the dotted line). Higher prices at city plants raise prices in the supply area to a level shown by line HIJ and induce some plants which manufacture dairy products to ship milk to the city market. This causes an expansion of the milkshed until a maximum number of producers are reached in the month of shortest supply. The price will rise and the market supply area expand until the quantity in the supply area (within the distance OK from the market) is equivalent to the quantity UV which will clear the market at the price represented by line WX at the city market. Therefore, equilibrium is reestablished. The same logic holds for the adjustment from the short to the flush season. Therefore, seasonally, the extent of the milkshed would pulsate between distances OF and OK. Producers and plants located within the distance OF would be permanent participants in the fluid market. On the other hand, plants or producers who are located within the distance FK would ship milk only in the fall season and hence be "part time" participants in the fluid market. In the season of flush production, these producers ship to plants that manufacture dairy products. The above seasonal adjustments are those to be expected under competitive conditions. They would not occur under classified pricing and pooling discussed on page 134.

The discussion so far has assumed no lags in adjustment from the summer equilibrium position to the fall equilibrium position, or vice versa. But suppose there are lags in adjustment. What then is the effect of seasonal variation in the production of milk on the price and quantity relationships in the local fluid milk market in relation to prices for milk for manufacture?

Suppose that in figure 9 the line DE represents the price for milk in manufacturing outlets. Suppose also that the line MN represents the demand for fluid milk in the local market priced on an f. o. b. country plant basis. This line is essentially the same as that in figure 8 obtained by subtracting transportation and country plant receiving costs from the curve MN. This is shown in figure 8 as the curve ABC.

Suppose that in the first period, equilibrium has been reached in the supply area during the fall season such that the quantity OX of milk is supplied to the city market at the price OD (fig. 9). Suppose that the number of producers needed to supply the quantity OX in the fall produce the quantity OZ in the following late spring and early summer. As mentioned before, if complete mobility prevailed between outlets, the most distant producers and plants would shift to manufacturing outlets until the remaining producers and plants are just sufficient in number to supply the city market with the quantity OX. But suppose there are lags in shifting between outlets. For example, lack of readily available manufacturing facilities may tend to slow down the shift from fluid outlets to manufacturing during the late spring and early summer months. This would tend

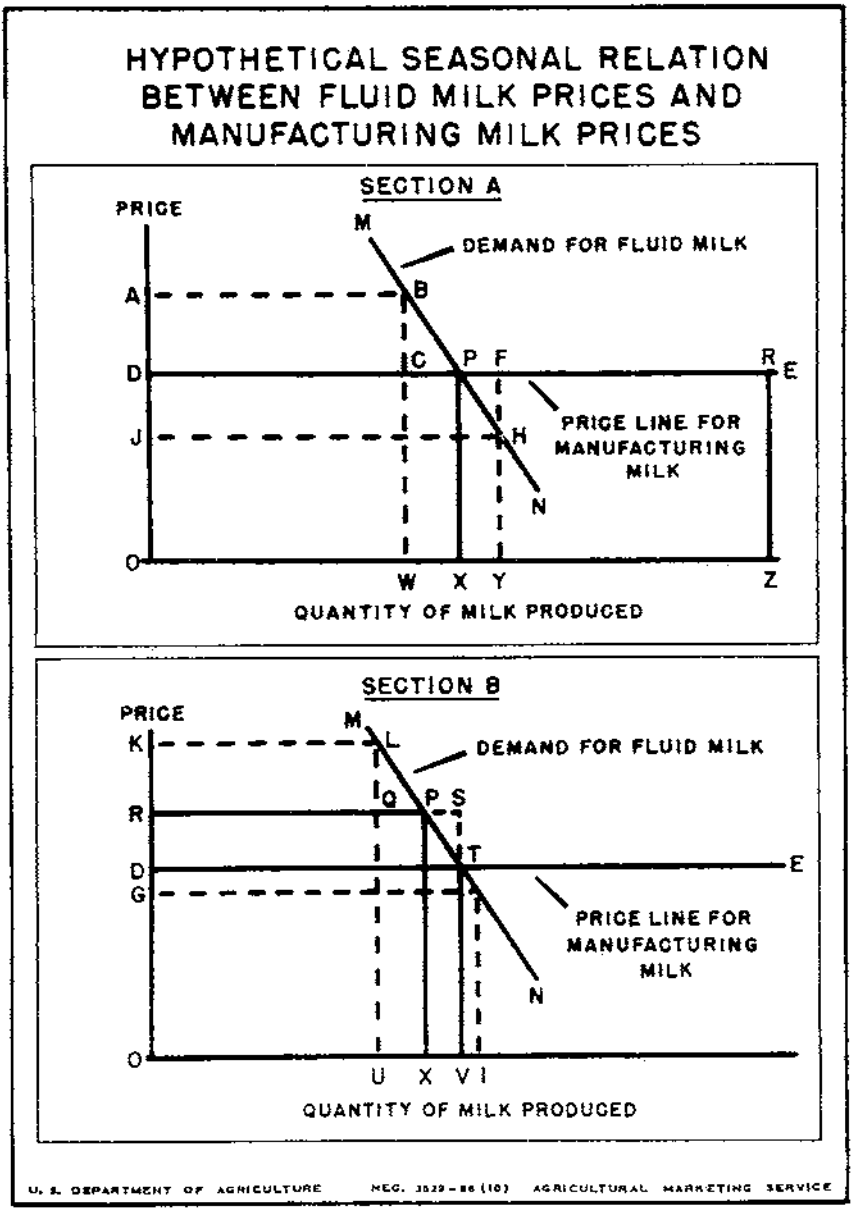

FIGURE 9.—Hypothetically, prices of milk for fluid use may be lower seasonally relative to the longer-run, normal relation between fluid and manufacturing milk prices in spring months of high production while they may be higher relative to the normal relationships during the fall months of low production. The amount of seasonal variation in prices depends on the case of shifting milk seasonally between manufacturing and fluid outlets and the seasonal variation in prices of milk in manufacturing outlets.

to depress the price for fluid milk below the manufacturing price because of an oversupply in fluid channels. On the other hand, once plants are equipped to produce manufactured dairy products, they may require a premium to participate in the fluid market on a part-time basis, since they would have idle manufacturing equipment whose depreciation costs must be covered. Under these circumstances, the price for milk channeled into fluid outlets in the fall would have to rise above the equilibrium level to induce the shift to fluid milk.

It can be shown that for given demands in fluid and manufacturing outlets, a given seasonal pattern of supplies, and given rates of shifts between outlets that are functions of their relative prices, a particular disequilibrium position of unique prices and quantities in the fall and spring seasons will exist. This is illustrated in section A of figure 9. Here the spring equilibrium for fluid outlets might tend to be established at the quantity OY and price OJ, while the fall equilibrium might tend to be established at the quantity OW and the price OA. The particular values of prices A and J and quantities W and Y would depend on the level of the several given factors.

In the example shown in section A of figure 9 it is assumed that manufacturing prices do not vary seasonally. However, normal seasonal variation can be expected. If prices for milk in manufacturing outlets had been permitted to vary seasonally, fluid milk prices would tend to fluctuate around the seasonally varying manufacturing price. As prices tend to be low in the late spring and early summer months and high in the fall and early winter months, the magnitude of the absolute fluctuations in fluid prices would be greater than that shown.

It also was assumed that the costs of producing milk in the two outlets are the same. Normally, however, producers and plants supplying the fluid market need to meet specific sanitation requirements which tend to raise their costs above the costs of producing milk for manufacturing purposes. Suppose this amount equals DR as shown in section B of figure 9. Suppose further that for the initial equilibrium position in the fall, a sufficient number of producers supplied the quantity OX at the price OR to the fluid market. Even if there were no lags for shifts in outlets, as the flush season approached the same number of producers would continue to ship to the fluid market until the price fell to the price of manufacturing milk as represented by the line DE. At that price, any production in the flush season greater than the quantity OV would tend to be shifted to manufacturing outlets. If equilibrium is reached in the flush season at the quantity OV, as the short season approached, theoretically no producers or plants would shift from the manufacturing outlet until the price of milk covered the additional costs of meeting sanitary requirements. If the long-run average costs are OR for producing milk for fluid outlets and OD for manufacturing milk, and since milk usually is shipped to one or the other outlet the year round on a given farm, it is more profitable to produce and sell manufacturing milk the year round at the price OD than to produce for fluid outlets and sell fluid milk at the price OR in some months and as manufacturing milk during the rest of the year. Thus, theoretically, some premium above the price OR could be expected by those who ship to

fluid outlets only in periods of shortest supply. Also, as noted above, as long as some of the milk produced under higher-cost sanitation requirements is used in manufacturing outlets, as would be the case in the flush season, the price of fluid milk in the short run could not exceed the price of manufacturing milk in the marginal supply area. Under these conditions, theoretically no quality differential could exist between fluid and manufacturing milk in the flush season.

If lags to shifting between outlets are present, the price would tend to be lower than OD in the late spring and early summer and higher than OR in the fall. As shown in section B of figure 9, prices might range between OG in the flush season and OK in the short season, with the extent of the downward pressure on fluid milk prices during the flush season depending to a great extent on the elasticity of demand for manufacturing milk in the milkshed. In most instances, it is not perfectly elastic as assumed in figure 9. Availability of unused manufacturing capacity in the supply area would tend to increase the elasticity of demand for surplus milk. Currently, some of the major milksheds appear to have ample manufacturing facilities. Improved transportation, refrigeration, and communication facilities also would tend to reduce the downward pressure on fluid milk prices in the flush season. In fact, in areas with strong producer cooperatives who own manufacturing facilities, the price of manufacturing milk, in a true sense, acts as a base price or floor below which fluid prices do not fall.

Likewise, the extent to which the price for milk in fluid uses tends to rise above the manufacturing level in the fall depends on the ease of shifting from manufacturing to fluid outlets. Here, sanitation requirements in each outlet are a major consideration. If requirements in fluid outlets are so rigid that the costs of producing milk in the two outlets are substantially different, a substantial premium may be required to get producers to shift. But, because of the frequent difficulties encountered in obtaining approval, many producers tend to maintain eligibility to avoid reprocessing. This tends to minimize the rise in prices in the fall months. Likewise, as sanitation requirements become more nearly alike for both manufacturing and fluid outlets, this cost differential becomes smaller. Furthermore, in many instances, seasonal shifting is more a shifting of plants than of producers. Producers supplying these plants may have regular health approval, although this is not necessary in all cases, as "emergency permits" are issued freely when milk is seasonally short. Thus, shifting depends on plant considerations such as covering depreciation costs of idle manufacturing equipment, utilization of plant labor force, etc. The inherent seasonal instability in the price of milk for fluid uses in local markets is probably less important now than formerly. A stable manufacturing price level also tends to reduce the tendency to instability in fluid milk prices.

Some of the principles discussed in this section apply also to cyclical variations in production and consumption, but relative magnitudes and timing tend to differ.

Development of Organized Milksheds

The need for controls with respect to quality in the production and marketing of milk has long been recognized. This is so because milk is perishable, it is a good medium for the growth of bacteria and it

actually may carry bacteria dangerous to human beings. Control has been exercised at several different levels of Government.[22] Milk and dairy products entering interstate commerce are subject to the Federal Food, Drug, and Cosmetic Act and regulations issued thereunder. Most States also have pure food laws and regulations applicable to milk, cream, and manufactured dairy products. On the other hand, sanitary requirements for fluid milk marketed for local consumption as fluid milk are governed by health ordinances established by local and State health authorities. In general, these require that milk sold in fluid form in a given locality must come from sources approved by the local health agency.

Quality control of fluid milk by local health authorities may have influenced the development of the institutional elements responsible for organized marketing of fluid milk on a market-by-market basis. Behavior of individual markets similar to those of isolated islands was encouraged, and, in some instances, reinforced by lack of reciprocity in sanitary regulations among markets. Ordinarily, milk inspection for quality control is applied to the area covered by the maximum seasonal fluid milk and cream supply area. If the approved supply area for a local city market is defined in this manner, it must include, in the flush production season, an area from which a considerable volume of milk must be utilized in the form of manufactured milk products.

Soon after the turn of the century, at the time that many city health departments were promulgating and enforcing sanitary regulations, the more successful milk distributors in large cities achieved considerable size and volume of sales. As evidence of this growth Froker, Colebank, and Hoffman (*54*, p. 31) reported that three dairy companies handled nearly 16 percent of the fluid milk and cream consumed in all cities and villages for the year 1934. Evidence of size becomes more pronounced when data for individual cities are analyzed. Based on data for the mid-1930's, Gaumnitz and Reed (*57*, p. 41) reported that for the total Class 1 or fluid milk sales in each market, the three largest distributors handled 63 percent in Boston, 84 percent in Phoenix, 63 percent in San Diego, and 90 percent in Richmond. Freemyer (*52*, p. 122) reports that, on the average, the four largest milk handlers accounted for more than 70 percent of the total Class I sales in the St. Louis market from 1936 to 1948. Swantz (*131*, pp. 170, 171) shows that the four largest distributors handled 64 percent of the pasteurized milk sales in Minneapolis in 1950 compared with about 50 percent in the early 1930's. Although the fluid milk business is local in nature, the same national companies frequently handle fluid milk in a score of widely separated cities. Froker, Colebank and Hoffman (*54*, p. 35) suggest that this development was encouraged because "the organization of local fluid milk companies into national corporations whose capital stock is traded in on the leading stock

[22] Dahlberg and Adams (*35* and *36*) show a comprehensive compilation of State and municipal statutes concerned with sanitary regulations, including an analysis of the relation between those regulations and actual quality of milk. Recent contributions that deal with the economic consequences of sanitary regulations, as well as with other regulatory agencies in the dairy industry, include Marketing Research Report No. 98 (*145*), the National Grange study (*135*), and a study by Hillman et al (*67*).

exchanges, no doubt increased tremendously, at least for a time, the total market value of these local companies."

The advent of large dairy firms also resulted in a marketing system for fluid milk that is highly integrated as to marketing functions. Milk sold for fluid consumption frequently is handled by the same company at all stages of the marketing chain from the point of first sale by farmers to the final delivery to retail stores or consumers. The main exceptions to this integration are large fluid milk cooperatives who have facilities to handle milk at country shipping points and who sell to city milk dealers. Vertical integrations, as well as other institutional elements such as classified pricing and pooling, have eliminated the type of pricing which was described for the manufacturing segment of the dairy industry for each level of the marketing chain, particularly pricing at central markets. Though generated in a different manner, the dealers' buying prices for milk for fluid use f. o. b. city plant as published by the Agricultural Marketing Service approximate the idea of a central market price.

As early as the 1880's individual dairy farmers, recognizing their weakness in bargaining as individuals, organized into dairy cooperatives in order to offset the bargaining advantages presumably held by the comparatively few large milk handlers. However, before World War I, the growth of the cooperative movement in fluid milk marketing was slow. Fetrow (*41*) reported that a rapid increase in the number of cooperative milk marketing associations began during World War I and continued until about 1925. He also reported that fluid milk marketing associations in 1934 handled about two-fifths of the fluid milk sold in the United States. Based on information available for 34 Federal order markets, 31 percent of the producers supplying these markets were members of operating cooperatives and 46 percent were members of bargaining associations in 1952. Classification as to bargaining and operating cooperatives is difficult since some cooperatives perform both functions. Metzger (*88*) suggests that some of the early cooperatives were formed for the purpose of distributing and retailing milk because they felt that milk handlers were getting more than their fair share of the consumer's dollar. Because entry into the distribution trade in large cities required substantial capital, producers more commonly formed bargaining associations for the purpose of determining the terms of sale to dealers as a group in the market. To strengthen their bargaining position, particularly during the flush season, bargaining associations often found it necessary to establish facilities for handling and processing surpluses above fluid milk requirements. In some instances, associations which started as bargaining associations eventually became completely integrated as to marketing functions, as, for example, the Dairymen's League Cooperative Association of New York. However, the majority of the present associations are still primarily bargaining associations.

The prime objective of many milk cooperatives is to obtain for their members the highest possible price for their milk—both temporarily and over a longer period. In regard to their effectiveness to achieve this objective (prior to Federal and State regulation of milk marketing), Stitts and Welden (*120*, p. 7) have this to say: "In this complex economic picture, bargaining associations, by extending their control over many of the marketing functions, have been able in some in-

stances to change or modify the effect of a few separate price-making forces. On the whole, however, their influence has been limited to getting prices as favorable to producers as possible under existing conditions."

Because of the inherent instability of fluid milk prices arising from the seasonal problem, and because of the relative prices for milk in fluid and manufacturing outlets, it is not surprising that producers as individuals and as association members had a strong desire to stabilize prices and, equally important, to share in the fluid milk market the year around. On the other hand, dealers were willing to pay fluid milk prices only on that portion of the milk actually used for direct consumption as milk or cream. It is therefore understandable why negotiation between producers and dealers resulted in the adoption of a classified system of pricing. However, because producers were unwilling to shift outlets seasonally, some method of sharing Class I sales was needed to implement classified pricing. Toward this end, pooling was developed in the early negotiated arrangements between producers and dealers. In the absence of any practical alternative, classified pricing and pooling were incorporated in the Federal order program and in a number of State-regulated markets. Both classified pricing and pooling have as long a history as the cooperative movement. For example, according to Stitts and Gaumnitz (*128*, p. 4), "Historically, there have been producers' milk cooperatives, class prices, and milk pools in Boston continuously since 1917, and before that for interrupted periods as far back as 1885."

Though no attempt is made here to trace out the development of the well organized market of today, some of the characteristics of the larger present-day milk markets are discussed. Producers are well organized in practically all large markets, and their associations ably represent farmers' interests in public hearings provided by law or through direct bargaining with dealers. This is true whether markets have Federal or State milk marketing orders or are in the so-called unregulated category. The Washington and Baltimore markets are notable examples of large markets in which collective bargaining is still practiced outside of a governmental regulatory framework. All organized milksheds have some system of classified pricing and operate under either a dealer or market-wide equalization pool. Recent developments, such as outer-market distribution of packaged milk, for example—see Cook (*30*)—and the probable development of a feasible marketable sterile milk requiring no refrigeration, tend to extend fluid milk markets to a regional, if not a national, basis. This is in contrast to the present market structure which functions chiefly on an individual market basis. Because the policies and strong bargaining positions of fluid milk cooperatives are tied closely to the local market, the development of a national market for fluid milk might transform their structure materially.

Classified Pricing and Pooling Systems

The classification system of pricing milk and the pooling system are two institutional elements which implement each other in determining what the dealer pays and what the farmer receives for milk. Factors leading to their adoption were discussed above. Detailed

descriptions of classified pricing and pooling methods are given in several studies, notably Gaumnitz and Reed (*57*) and Stitts and Gaumnitz (*128*).

Under classified pricing, a separate minimum price is determined, either administratively or by formula, for each use-class of milk. This is the cost of milk to the dealer. If such pricing is used, the cost of milk f. o. b. plant in the same use category is the same for all dealers participating in the market regardless of the source of supply, because the dealers' paying prices are adjusted for locational differentials. Ideally, prices for the several end uses are set at levels such that net returns to milk handlers are not affected by their utilization of the milk. In most organized fluid milk markets, two basically different sets of prices are used: (1) A price for milk used for direct consumption as fluid milk, and sometimes as fluid cream, which is set administratively or established by formula for some period in advance, commonly referred to as the Class I price, and (2) one or more prices for milk used in the manufacture of specified dairy products which usually are established by a formula which allows for frequent variations in the price of the end products. These prices must be set at a level such that all milk not needed for direct consumption at the established Class I price is processed into dairy products. They commonly are designated as Class II, Class III, and so on, prices with the lower numbers carrying a higher price. For example, in the Chicago market, the following classes are used: Class I—fluid milk and fluid skim items; Class II—fluid cream, ice cream, etc.; Class III—evaporated and condensed milk, etc.; and Class IV—manufactured dairy products not specified in other Class uses. In most markets, milk is classified into two classes: Class I—milk utilized in fluid milk products; and Class II—milk in other uses or products.

Under a combination of classified pricing and a market-wide pool, each dairy farmer who supplies milk receives for each marketing period (usually a calendar month) what is termed a "blended" or "uniform" price. This price is announced by the pool. It is determined by weighting the different class prices by the total quantity of milk falling into each class, for the market as a whole, even though there may be wide variations in use among handlers. All producers who are members of the market-wide pool receive the same price for their milk, after adjustment for location of their farms and the butterfat content of their milk. For markets employing individual handler or dealer pool arrangements, on the other hand, the uniform price to individual farmers is computed on the basis of the use made of the milk by the handler to whom it was shipped. In this instance, average prices of producers similarly located may differ owing to interdealer differences in product utilization.

A decided tendency exists for the dealer type of pool to be replaced by market-wide equalization pools. These are a natural extension of the organization-wide pools operated by bargaining cooperatives. The Boston pool shows this historical process—the pool of the dominant cooperative was extended and applied to all producers selling to the market. On April 1, 1956, 15 of the Federal order markets employed individual handler pools, 50 used market-wide pools.

The normal pooling area in a market is based on an area large enough to supply all Class I plus small reserve requirements for the

market during the fall months. As market receipts increase in the summer months, utilization in nonfluid forms rises and a lower blended price results. A perennial question asked is: Does a system of classified pricing in conjunction with pooling raise the farm price above the price that would have occurred under competitive results? Because of the many factors involved, and because each farm price structure is generated under a different set of marketing conditions, no clearcut answer is possible. As discussed on page 128, theoretically, under competitive conditions, there would exist a pulsating milk supply area seasonally, with some producers selling to the fluid market only part of the year. Producers sell to either the fluid market or to manufacturing outlets, depending on the relative prices of fluid and manufacturing milk. In essence, a varying price structure results; it pulsates between the kinked line ABI in the spring, and the line HI in the fall. (See fig. 8, p. 124.) On the other hand, under pooling, although handlers pay in terms of Class prices, the equating or equilibrium price between handlers and producers that determines the flow of milk into the fluid market is the blend price, while the equating price between manufacturers and producers is the value of milk for manufacturing outlets. Thus, under pooling, the relation between blend prices and prices for manufacturing milk determines the size of the milkshed, as did the relation between prices of fluid milk and manufacturing milk under competition.

If no cost differential exists between the milk produced for fluid uses and manufacturing, pooling should theoretically raise the farm price structure, providing the same locational differential is used to distribute the pool's receipts as for determining Class I prices, which is the case in most of the pools. Thus, if all producers and plants which are needed to meet fluid requirements in the fall are to participate in the pool the year round—as, for example, the producers located between OK in figure 8—blend prices must be as high in the flush season as for the short season, as represented by the line HI in figure 8. However, as discussed previously (see fig. 9, p. 129), actual seasonal fluctuations in prices of a greater magnitude than the hypothetical seasonal prices shown in figure 8 can be expected under competitive conditions when considerations of bulk and perishability of milk and dairy products, seasonal characteristics of supply and demand, fixed costs of seasonally idle equipment, costs of meeting sanitation requirements and mobility of milk to the most remunerative outlet are taken into account. Classified pricing and pooling, on the other hand, tend to result in more stable prices in the short run. Over the long pull, under conditions of short-run price stability, producers response to production in the long run may lead to higher production at given prices than would occur in absence of pooling.

Pooling in all circumstances tends to raise prices to producers in the outer limits of the milkshed because they share in Class I sales the year round, whereas they participate only in the fall months under competitive conditions. The additional money they receive need not, in all instances, come from higher aggregate payments by consumers; it may come from near-in producers who, in the perfectly competitive model, get the full Class I price the year round. These near-in producers often are willing to share some of the market to assure stability in marketing conditions. If (1) the fixed costs of meeting sanitation

requirements are high, (2) the seasonal variation in milk production is relatively low, and (3) Class prices are paid within the milkshed in such a way that transportation costs are minimized, aggregate payments by consumers may be less under pooling than under competitive conditions. This holds if true equilibrium prices prevail in all seasons so that the cost differential between producing for fluid and manufacturing milk can be maintained during the flush season in the short run. As shown on page 131, actual prices for fluid milk at the outer limits of the milkshed in the flush season cannot exceed prices for manufacturing milk as long as some of the milk produced for fluid outlets is used in manufacturing outlets.

In a given local supply area, producers face an inelastic demand for fluid use, and highly elastic demand for milk used in manufacturing. Therefore, restriction of the quantity of milk used for fluid purposes, by raising the Class I price to a point where marginal returns in fluid outlets equal marginal returns (price) in manufacturing outlets, always increases aggregate returns to producers within the pooled areas.[23] If this is done, classified pricing and pooling will raise the farm price structure for milk.

Other factors also may tend to raise the farm price structure. For example, techniques used and standards prescribed in carrying out quality control may be effective in controlling or limiting the supply. Sometimes the pooling area is limited by other means, such as exclusive buying practices and collective bargaining contracts, either written or understood. Also classified plans as such may act as exclusionary devices, particularly when a milkshed has dealer pools. In addition, rules sometimes are contained in Federal orders and State regulatory legislation which may tend to discourage movement of supplies within milksheds and free entry and exit from the market by producers. Restriction of movement of supplies between milksheds has in the past frequently resulted in price structures that are out of line with equilibrium levels. For example, Bredo and Rojko (*18*, p. 77), in their study of price and supply relationships among Northeast markets, found intermarket and interproduct price differences during 1947–48 that substantially exceeded price differences based on costs of marketing. A recent AMS study (*145*, p. 102) on regulations affecting movement of milk estimated that modification of economic and sanitary regulations restricting the movement of milk probably would result in a reduction of 48 cents per hundredweight for about 11.8 of the 46.7 billion pounds of milk consumed by nonfarm population in 1954 in the affected markets.

Closely associated with classified pricing and pooling are various kinds of "base and excess" plans used in paying producers for their milk.[24] These plans were introduced as part of an effort to even out production during the year. Bases usually are established in accordance with each individual producer's marketing of milk in the normally short production season; payments are made in accordance with these

[23] See Cassels (*24*), Gaumnitz and Reed (*57*) and Harris (*61*) for a detailed discussion of these effects. Here the market for fluid use and the market for manufacturing milk are considered as two distinct markets.

[24] For a detailed explanation and discussion of the effects of the various plans see Gaumnitz and Reed (*57*), Stitts and Gaumnitz (*128*), Welden and Herrmann (*188*), Herrmann and Welden (*66*), and Quackenbush and Homme (*107*).

bases in a following period, which sometimes is limited to the subsequent spring flush season. When bases are in use, a higher blend price is applied to the base quantity of deliveries, and a lower price is paid for deliveries in excess of base. Frequently, under a base-surplus plan, producers make strenuous efforts to increase their bases each year so that the final result is that the base price itself is lowered by the inclusion of substantial amounts of milk priced at a level below Class I.

In recent years, several markets have adopted what is often called a take-out and pay-back plan.[25] Under this plan, a certain amount is deducted from the producer's milk check during the flush season. This amount is pooled and paid back at some designated rate for a selected period, usually the short production months. Since this introduces contra-seasonal pricing, it tends to provide an incentive to even out production.

PRICE STRUCTURE AS AFFECTED BY GOVERNMENT ACTIVITIES

Since the early 1930's, activities of Federal and State governments have affected pricing, marketing and consumption of dairy products from time to time. This section does not evaluate these activities, but it discusses them insofar as they have affected prices and consumption. Historically, these activities may be grouped into three main categories. The first two affect prices directly, and the third affects them indirectly.

1.—The first group includes Government activities in the marketing of fluid milk as, for example, the Federal milk marketing order program. Although the main emphasis in the order program during the early 1930's was on raising prices, marketing orders basically are designed to maintain and improve stability of prices and bring about orderliness in the marketing process.

2.—The second group includes price programs designed to raise prices of manufactured dairy products or prevent them from falling below a specified level. These programs also have affected prices of fluid milk indirectly. Purchases by the Federal Surplus Commodities Corporation prior to World War II were carried out in order to raise prices of butter and cheese when they were believed to be unduly low. Purchases of the Commodity Credit Corporation under the current price support program are carried out to prevent prices from falling below a predetermined level.

3.—The third group of activities includes food distribution programs of a broader nature, such as the early low-cost milk programs and the current school lunch and special milk programs. Some of these programs may have originated as a result of an attempt to give price assistance to farmers and to provide outlets for agricultural products acquired under price support programs, but their goal also is to improve national health and nutrition, and to expand the consumption of milk and dairy products.

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[25] See Roberts (*110*), Pritchard (*103*), Roberts and Grayson (*111*), and Foelsch (*43*).

ROLE OF GOVERNMENTS IN PRICING FLUID MILK[26]

Development of Federal and State Regulation

As mentioned on page 134, the development of well-organized milksheds and of a system of classified pricing and pooling had their origin in the inherent instability of fluid milk prices. However, the ability of classified pricing and pooling plans to maintain stability in fluid milk prices before public regulation often depended on the extent to which the dominant cooperative controlled the total supply of milk in the market.[27] Lack of total or near-total control of supply frequently tended to break down the effectiveness of the classified pricing and pooling plans when the market was in a surplus supply position because both handlers and producers in the short run found it profitable to transact business at a price reflecting the blend price plus a nominal premium, but still lower than the Class I price for fluid milk. Under these circumstances, Government intervention in the marketing and pricing of milk frequently appeared desirable to producers; the economically depressed conditions in the 1930's gave impetus to this feeling.

Both Federal and State Governments intervened in the price-determining process in order to stabilize markets for milk. Under authority of the Agricultural Adjustment Act passed in 1933, the Congress of the United States delegated to the Secretary of Agriculture certain powers by which he could make it possible for producers and distributors to cooperate in the establishment of orderly milk marketing procedures. As a result, the Secretary of Agriculture, in 1933 and early 1934, issued marketing agreements and licenses, or licenses without marketing agreements, which regulated the marketing of milk in about 50 urban areas. The original agreements and licenses, which terminated during the first half of 1934, required dealers to pay minimum prices to farmers for milk deliveries up to a certain percentage of each producer's base, and provided schedules of resale prices and of fair trade practices. Reissued licenses in most of these markets

[26] This topic is discussed in more detail, particularly with respect to the role of State governments, in the September–October 1956 issue of *The Dairy Situation* (*154*). Recent contributions to an understanding of regulatory pricing of fluid milk with emphasis on economic implications include reports of the United States Agricultural Marketing Service (*145, 148*), hearings before the Subcommittee on Dairy Products of the House Committee on Agriculture (*162*), a National Grange study (*135*), studies by Warner (*186*), Spencer and Christensen (*125* and *126*), and a report of the Federal Milk Order Study Committee (*40*). The emphasis here is on the effect of regulation on the factors that affect the process of price-determination rather than on a description of the nature of Government participation.

[27] The Washington, D. C., market is one where the dominant cooperative appears to control a sufficient share of the total supply of milk in the market to maintain price stability through the mechanism of classified pricing and pooling, while operating outside the framework of the Agricultural Marketing Agreement Act. Gaumnitz and Reed (*57*) demonstrated that, even with complete mobility of supplies, this cooperative had a bargaining advantage associated directly with a high degree of control of supply within the contiguous area surrounding the market. This reflected the geographic isolation of the market from other areas of heavy milk production and the high transportation costs of fluid milk. In addition, producers who are approved for surrounding markets almost always must make additional investments and change their methods to meet District of Columbia health inspection. Recently, the Maryland-Virginia Milk Producers Association requested a Federal order for the Washington market.

dropped the provision for a schedule of resale prices and only required dealers to pay minimum prices for milk subject to the license. An amendment to the Agricultural Adjustment Act in 1935, and the subsequent Agricultural Marketing Agreement Act of 1937, specified more clearly the Secretary's authority. Lack of specification was an important weakness of the early legislation. In addition to including a provision for mandatory public hearings, the act specifically approved certain existing marketing arrangements, such as classified pricing and pooling, as necessary for maintaining minimum prices to producers. The legislation was tested in the courts and was placed on a firm legal basis in 1939.[28]

Although the legislation of 1935 and 1937 provides for the use of marketing agreements, the marketing of milk usually is regulated by marketing orders.[29] A milk marketing order applies to a specified

TABLE 30.—*Federal licenses and marketing orders regulating the handling of milk, 1934–56*

Year	Licenses [1]	Orders [2]	Year	Licenses [1]	Orders [2]
	Number	*Number*		*Number*	*Number*
1934	15	0	1946	1	29
1935	46	0	1947	1	30
1936	32	6	1948	0	30
1937	18	7	1949	0	35
1938	15	10	1950	0	39
1939	14	14	1951	0	46
1940	12	19	1952	0	50
1941	7	20	1953	0	[3] 49
1942	5	22	1954	0	53
1943	5	22	1955	0	63
1944	4	24	1956	0	68
1945	1	27			

[1] First license effective August 1, 1933; most licenses in 1935 effective January 1 or February 1; other years, licenses in effect on January 1. Some licenses were suspended and later terminated; licenses under suspension are not included in the table.

[2] Orders in effect all or a portion of the year; first order effective February 1, 1936.

[3] The net loss of one market is the result of a consolidation of the Clinton and Quad Cities orders; a consolidation of the Muskogee order with Tulsa; and the addition of Muskegon, Mich., as a new order.

[28] United States v. Rock Royal, 307 U. S. 533 (1939); H. P. Hood and Sons v. United States, 307 U. S. 588 (1939); United States v. Wright Dairy Co., 315 U. S. 110 (1943).

[29] The Secretary of Agriculture presents a marketing agreement to milk handlers in the marketing area concerned simultaneously with the issuance of the final decision concerning an order on fluid milk. A milk marketing agreement is a voluntary contract in which individual handlers signing the document agree to observe certain minimum prices and terms of sale with respect to the milk purchased from milk producers in the proposed marketing area. If handlers do not approve the marketing agreement, which usually is the case, the Secretary may issue an order to carry out the purposes of the Act if the order is approved by two-thirds (in some cases three-fourths) of the producers delivering milk to the market. The act also authorized use of marketing agreements for processed dairy products on a nationwide basis. No such agreement is now in effect, but in times past marketing agreements have been in effect for evaporated milk and nonfat dry milk solids.

local area and requires all milk handlers to pay minimum prices for the different use classifications and to observe certain terms of sale with respect to milk purchased from milk producers.

Table 30 shows the number of milk licenses and orders in effect on January 1 of each year from 1934 through 1956. After an initial rise, the number of orders in effect remained stable in the low 20's through World War II. The number increased substantially after 1945 to 68 in 1956. The geographic location of the orders as of September 1956 is shown in figure 10.

Currently, some 16 States regulate the marketing of milk either themselves or jointly with the Federal Government (figure 10). The number of States, as well as the nature of their statutes concerning pricing of fluid milk, has varied considerably over time. Unlike Federal regulation, many of the States regulate resale prices as well as minimum prices to producers.

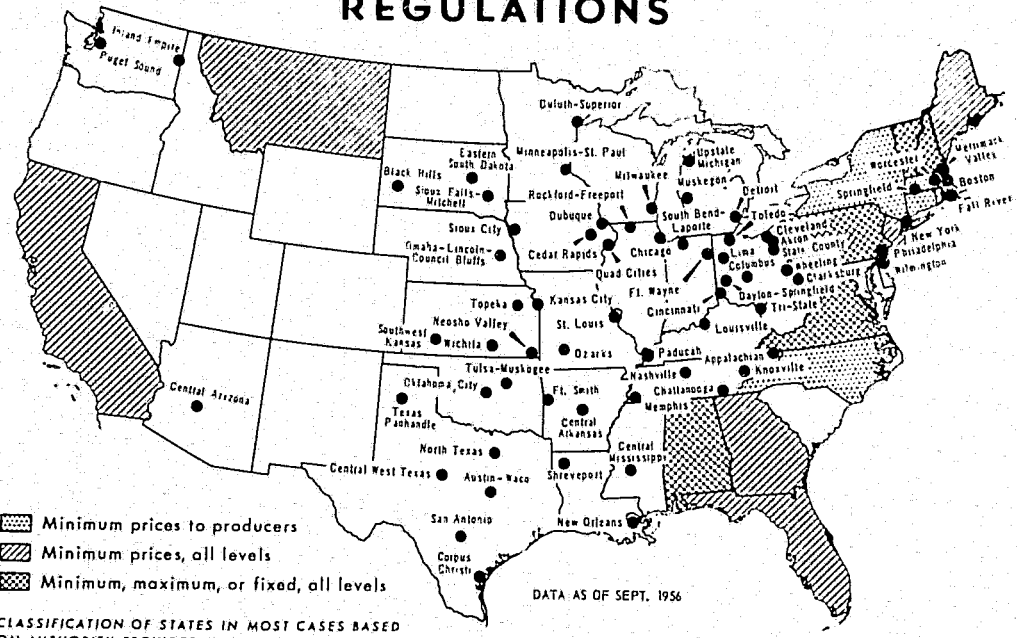
Objectives and Scope of Government Participation

A general objective of the Agricultural Marketing Agreement Act of 1937 as amended and as expressed by Congress was "to establish and maintain such orderly marketing conditions for agricultural commodities in interstate commerce as will establish" parity prices for these commodities. In the case of milk specifically, however, the Secretary of Agriculture is directed by the Act to establish minimum prices different from the parity price if the parity price does not appear reasonable in view of the price of feeds, the available supplies of feeds, and other economic conditions which affect market supply and demand for milk and its products in the marketing area to which the contemplated order relates. The actual minimum price established shall "reflect such factors, insure a sufficient quantity of pure and wholesome milk, and be in the public interest." In short, the principal objective of milk marketing orders is to establish a system for determining prices and conditions for orderly marketing.

Marketing orders are developed to function within the institutional framework prevalent in the market at the time the order is established. Elements of this framework may include (1) city ordinances, many of which relate to milk inspection standards designed to protect the health of the people of the community, (2) the custom and practices of the community as to the fat content of milk desired, and (3) any organizations of producers, cooperative or otherwise, which discharge functions such as bargaining with milk handlers over terms of sale, or physically handling milk in certain stages of the marketing process. Under a Federal marketing order, all interested parties have an opportunity to present publicly their views on all aspects of the order.

Directly or indirectly, the activities of Federal and State agencies in the pricing of milk affect almost all milk consumed off farms as fluid milk and cream in the United States. During 1955, minimum producer prices were established on roughly 29 billion pounds of milk, 18 billion pounds of which were sold for consumption in fluid form in city markets covered by Federal orders. Some of the State laws apply only to certain cities within the States. Making allowance for this, it appears that State milk control laws affected directly another 14 billion pounds of milk, 10 billion pounds of which were consumed

GEOGRAPHY OF FLUID MILK PRICE REGULATIONS



in fluid form in 1955. Prices for fluid milk in many markets not covered by Federal or State control measures are affected indirectly by pricing provisions established in these areas. As a result, the total influence of Federal and State milk pricing activities is much greater than indicated by the fact that somewhat over half of the total milk and cream is consumed in areas to which control measures apply directly.

Relation of Prices in Order Markets to Prices for the Country as a Whole

The Marketing Agreement Act requires the Secretary of Agriculture to employ the "classified use" basis when establishing minimum prices paid to producers. Pricing according to use usually is accompanied by some pooling arrangement because this is a necessary device for paying "blended" or "uniform" prices to farmers. Effective classified pricing and pooling arrangements imply that returns to handlers are not affected significantly by changes in quantities of milk channeled into different uses. This condition is important in the determination of class prices (see p. 147).

Milk used for fluid purposes in a regulated marketing area usually is placed in a Class I category. Minimum prices for other uses generally are set at lower levels, which permit milk handlers to compete effectively on the national market in the sale of dairy products manufactured from surplus milk. As prices received for products made from surplus milk are established in the National market, determination of the surplus class price affects the margin which the handler obtains for processing such milk and merchandising the products.

Determination of prices for milk in the Class I category is influenced considerably by local factors. Its purpose is to generate a price which will assure an adequate supply of milk to meet fluid requirements plus a necessary operating reserve. The degree of association between changes in Class I prices and changes in prices of manufacturing milk used for dairy products depends on the method used in establishing Class I prices. But regardless of method, the price of Class I milk usually is set at a higher level than that for milk used in manufacturing. In contrast to surplus milk, the margin received by distributors for handling fluid milk is determined through the interaction of the competitive forces in the local market.

In the early years of Federal order regulation, Class I milk prices were established at a fixed minimum, based on testimony received at public hearings in each market, and these fixed minimums remained effective until modified by amendment to the order. The Agricultural Marketing Agreement Act of 1937, however, established detailed regulations for the promulgation and amendment of Federal orders. These

FIGURE 10.—In 1956, Federal and State regulations together directly affected prices on about three-fifths of total nonfarm consumption of fluid milk in the the United States. In that year, 16 States had regulatory bodies to fix milk prices, whereas prices in 68 urban markets were regulated by Federal orders. In other areas, prices of fluid milk are determined by negotiations between representatives of producers and dealers, but Federal and State regulations indirectly affect the level at which some of these prices are set.

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procedures require a considerable period of time. In order to avoid delay in changing Class I prices as required by changing economic conditions, formulas for determining Class I prices have been utilized. These formulas make Class I prices respond "automatically" to changes in the market situation. All 68 Federal orders provide for some kind of formula pricing for Class I milk.

Formulas in use are of two general types:

1. "Basic price" formulas, which reflect movements in prices of manufactured dairy products or prices paid farmers for milk used in such products.
2. "Economic type" formulas, which relate fluid milk prices to selected factors.

Fifty-nine markets use basic price formulas in determining Class I prices. Orders in these markets usually provide for the derivation of several "basic prices" from prices paid for manufacturing milk or computed values of milk used to produce manufactured dairy products based on product prices in national markets. To the highest of the alternative basic prices, a differential is added to obtain the actual Class I price. An illustration of the computation of the Class I price when the basic type formula is used is shown below. When this type of formula is used, fluctuations in prices of manufactured dairy products are translated directly into fluctuations in Class I prices in the local fluid milk market.

The following shows the computation of the Class I price of milk in Detroit for March 1956:

Item	Price per hundredweight
Alternative basic formula price:	
Average price paid by—	*Dollars*
9 local condenseries	3. 05
15 Midwest condenseries	3. 05
Butter-powder formula:	
Price per pound of 92-score butter, Chicago, $0.57375, minus 0.03, times 1.2, times 3.5	2. 28375
Price per pound of spray and roller nonfat dry milk powder, United States, $0.14205, minus 0.055, times 8.2	. 71381
Total, rounded	2. 998
Derivation of Class I price:	
Highest of 3 basic formula prices	3. 05
Class I differential	1. 430
Total	4. 48
Supply-demand adjustment	—. 15
Final price	4. 33

Nine markets use the economic type formula. Indicators used in the economic type formula frequently include index numbers of wholesale prices, consumer demand, and costs involved in milk production.

This type of formula was established first for the Greater Boston Market, effective April 1, 1948. The computations shown below are illustrative of the steps needed to determine the Class I price in the Boston Market. The formula is designed to establish prices which reflect the supply-demand position in the local market. It assumes that short-run fluctuations in prices for milk in fluid form need not be directly related to short-run fluctuations in prices for manufacturing milk. Proponents of the economic type formula felt that in certain markets it was desirable to have formulas which gave more emphasis to certain local factors, and at the same time, allowed for price changes that would tend to be related to changes in manufacturing milk values.

The following shows the computation of the Class I price of milk for Boston in April 1956:

General economic factors:

Item	Index numbers, 1951=100
Bureau of Labor Statistics wholesale price index, 1947–49=100, for February 112.3, divided by 1.143 to convert to 1951 base	98. 25
New England consumer income index: United States per capita disposable income, 4th quarter 1955, $1,662, times 1.0673 to make it apply to New England, divided by 15.27 to convert to 1951 base	116. 18
New England grain-labor index:	
Average price per ton of dairy ration, for current month, $78.20, divided by 0.884 to convert to 1951 base times 0.6	53. 076
Regional farm wage rate per month on January 1st, $178.14, divided by 1.458 to convert to 1951 base times 0.4	48. 872
Total, rounded	101. 95
Average economic index	105. 46

Supply-demand adjustment:

Year and month	4 markets				
	Class 1 sales		Supply from producers		
	Actual	Normal percentage of supply	Normal (Column 1 divided by column 2)	Current	
				Actual	As a percentage of normal
	1,000 pounds	*Percent*	*1,000 pounds*	*1,000 pounds*	*Percent*
1956:					
January	107, 732	76. 9	140, 094	169, 829	121. 2
February	102, 170	73. 9	138, 254	163, 344	118. 1
Average					119. 7

Supply-demand adjustment factor when average percentage of normal supply rounds to 112 and over	.88
Seasonal adjustment factor for April	.92
Final derivation of Class I price:	
Class I price index equals economic index, 105.46, times 0.88, times 0.92	85.38
Unbracketed Class I average price per hundredweight:	*Dollars*
1951	5.61
Current month, $5.61 times 0.8538	4.790

Class I price per hundredweight schedule:

Unbracketed	Boston market, 201–210 mile zone	All markets, city plants
Dollars	*Dollars*	*Dollars*
4.440–4.659	4.55	5.07
4.660–4.879	[1] 4.77	[1] 5.29
4.880–5.099	4.99	5.51

[1] Price for April.

Because attention is given in each order to the local situation, the factors used in the formulas and their relative weights differ among the orders. The following tabulation shows for the 66 markets in effect as of July 1, 1956, the number of markets using each factor or combination of factors in deriving a formula price:

Factors used	Number of markets
Economic indicators	9
Prices of butter and nonfat dry milk powder	2
Prices at nearby manufacturing plants	3
One of two alternatives:	
Prices of butter and nonfat dry milk powder or—	
Prices at 13 Midwest condensaries	20
Prices at nearby manufacturing plants	2
One of three alternatives:	
Prices of butter and nonfat dry milk powder or—	
Prices of 13 Midwest condensaries or—	
Prices at nearby manufacturing plants	16
Prices of butter and cheese	8
Prices at nearby manufacturing plants or prices of butter and cheese	1
One of four alternatives: Prices of butter and nonfat dry milk powder, prices at 13 Midwest condensaries, prices at nearby manufacturing plants or prices of butter and cheese	5
Supply-demand indicators	42

An important new development in Class I formula pricing is the so-called "supply-demand adjuster." This device increases the Class I price when supplies of milk relative to Class I sales are less than normal, and decreases Class I prices when supplies are larger than normal. This device was designed primarily to correct prices for maladjustments of supply and demand in the local market. Such maladjust-

ments may arise from poorly established differentials between prices of milk in fluid and manufacturing uses, as well as secular changes in supply and demand conditions. If producers and plants can shift with ease from manufacturing outlets to become suppliers for the fluid market the supply-demand adjuster tends to keep prices in the local market in line with prices of dairy products for the country as a whole. On the other hand, if mobility is limited, this device more slowly increases the closeness of the relationship between the local and national markets.

It should be noted that the relation between the price of milk received by farmers in milksheds and average prices received by farmers for manufacturing milk depends not only on the relation of individual class-use prices to the United States average but also on the proportion of milk used in each category.

Problems of Administration

As mentioned previously, certain marketing arrangements such as classified pricing and pooling are considered necessary for maintaining orderly marketing under a milk order program. Some problems of administration stem directly from carrying out the specific provisions of these arrangements or from the nature of the pricing and pooling arrangements themselves.

More complete information is generally available in regulated markets than in nonregulated areas concerning marketing and price condition. Orderly procedures are provided, through public hearings, for bringing available information together and for resolving differences of opinion or conflicts of interest. Nevertheless, determination of the *right* prices for milk in fluid markets is a difficult matter.

Class I prices need to be set at a level such that supplies are adequate to meet requirements for fluid consumption during the period of shortest supply, but must not be so high as to result in a burdensome surplus. As prices received for products made from surplus milk are established in the national market, the determination of the surplus class prices affects the margin which handlers obtain for processing this milk and merchandising the products. Therefore, pressures from handlers to lower surplus class prices are great. But too low a surplus price reduces the incentive to promote fluid sales and lessens total returns to farmers. A low surplus price also may attract unneeded milk to the pool. However, the surplus price must be low enough to make handlers willing to accept all surplus milk.

Another price problem is the dilemma of providing stable market conditions while leaving desired flexibility in prices. The objective of market orders is to "generate" a price that gives equilibrium in the long run for the fluid milk market. It is difficult to ascertain the extent of changes in technological or economic conditions that affect milk production, fluid consumption, and methods of marketing, and whether such changes are temporary, of intermediate duration, or permanent; and in addition, how much allowance for them should be provided in the order. Formula pricing, including automatic supply-and-demand adjustment devices, was introduced to maintain prices continuously in line with economic conditions, and to bring about automatic price adjustments to changing economic and technological conditions. The

public hearing provides the mechanism for obtaining facts which indicate necessary revisions in the formula factors themselves, in order to keep the level of the base price and changes in that price consistent with the long-run equilibrium.

Pooling plans are a corollary of the classified pricing of milk. Pooling raises the problem of determining the conditions under which milk producers are eligible to share in returns from Class I sales. Theoretically, these benefits should accrue to the minimum number of producers needed to assure an adequate supply to meet fluid milk requirements plus an operating reserve throughout the year.

As has been noted, a milk marketing order applies to a specified marketing area, and it regulates handlers who operate plants from which milk is distributed in the marketing area or receiving stations for such plants. In the early days of the order program these handlers were required to pay minimum prices to any dairy farmer holding a local health department permit to sell milk in the marketing area. As health departments of given regulated markets began to inspect milk plants and dairy farms, which in fact were principally engaged in supplying unregulated markets or other regulated markets having individual handler pools, these simplified order definitions became inadequate for designating pool members in markets with marketwide pools, but were still adequate for those with handler pools.

An important aspect of this development was that plant operators in many instances were given the key decision to shift outlets between markets. Thus, they could bring about changes in market supplies which need not be related to changes that would have occurred if market supplies were the direct result of producers' reactions to the prices they received. With the result, to administer a marketwide pool pricing system, it was necessary to prescribe marketing conditions for all the milk sold in the marketing area with respect to plants as well as producers.[30]

Specifically, a further requirement was added—to be a pool producer, a farmer must also deliver his milk to a pool plant, that is, a plant that meets certain performance requirements. These requirements generally state that the plant is a pool plant if it (1) sells any milk for bottling or distributing on the market and (2) sells a specified percentage of its milk in the market.

The purpose of these pool-plant provisions are: (1) To eliminate manufacturers whose sole purpose is to get into a market pool for the purpose of collecting equalization payments and thereby raise their payments to producers, but who serve the fluid market as little as possible, and (2) to exclude from regulation shippers who occasionally send fluid milk to the regulated market and are primarily engaged in supplying short-season requirements of dealer pools of other regulated markets or other unregulated markets.

Terms also must be specified for marketing conditions of intermittent suppliers of milk, who do not qualify as pool shippers. Some of these conditions may actually, in effect, become part of the pricing provisions of the order, such as assignment of classification and compensatory payments. These are essentially adjuncts to pool plant

[30] For details concerning the specification of marketing conditions for pool and nonpool shippers, see Harris (*61*), Luke (*81*) and reports of the Agricultural Marketing Service (*146*) and the Federal Milk Order Study Committee (*40*).

provisions. Assignment of classification means that milk obtained from nonpool or unregulated sources is assigned to available uses according to a specified plan. Where assigned to the lowest use classification, it simply means that all milk from regular pooled sources must be used first in the higher priced outlets. Compensatory payments are the sums of money that dealers pay into the pool from milk obtained in unregulated sources that is used in the higher class uses. The rate of payment usually is such that the cost to handlers for other source milk used in the same outlets is not lower than the cost of milk priced under the order.

Two aspects of a marketing order program may lead to a somewhat different production response to price by farmers as compared with a system of unregulated prices: (1) The institution of the order itself tends to reduce market instability and price uncertainty; (2) the element of forward pricing present also tends to reduce price uncertainty. Removal of price uncertainty permits producers to make production plans and commitments with greater confidence than under conditions that often prevail in the absence of price regulation. The added degree of certainty may well lead to a higher production at given prices than would be likely under a system of unregulated prices. It is difficult to allow for these effects in arriving at the initial price when establishing an order.

Several developments of recent occurrence or on the horizon may profoundly affect the marketing order program. The order program regulates the sale of fluid milk in defined marketing areas which normally are confined to built-up concentrations of populations. This market-by-market approach is consistent with the historical fact that fluid milk markets were local markets. The recent development of outer-market distribution and the location of processing plants in surplus areas which package milk and ship packaged milk from a central shipping point to an ever-widening sales area tends to wipe out the distinctions between markets. In the North Central Region, outer-market shipments of milk in paper containers have become commonplace, according to a recent study (*96*). Conditions that promote this type of development are rising costs of labor and increasing use of expensive equipment. These conditions appear to place increased emphasis on large volume operations. In addition, continued improvements in highways, trucks and refrigeration facilities make possible a widening area of sales. Over time, the net effect may be to destroy the local nature of fluid milk markets. Likewise, the development of a sterile milk, requiring no refrigeration, might put this product in the same marketing framework as evaporated milk. If these types of developments continue, and if regulation is to be maintained, the present concept of local marketing areas may need to be greatly modified.

PRICE PROGRAMS FOR MANUFACTURING MILK AND BUTTERFAT

Price Programs Prior to World War II

Upon recommendation of a national Dairy Advisory Committee, the Federal Farm Board, on January 9, 1934, granted a loan to Land O'Lakes Creameries, Inc., to enable the cooperative to withhold

temporarily some of its own butter and, if necessary, to purchase additional butter on the open market in order to stabilize prices.[31] The cooperative offered to buy at market quotations whenever prices of butter were 35 cents per pound or lower, but no butter was offered to it. By March 15, 1934, it had accumulated about 5 million pounds of butter from its own production which was sold back to the trade by May of that year (the start of the heavy production season). Thus ended the first price stabilization experiment in the marketing of manufactured dairy products.

The Agricultural Adjustment Act of 1933, as amended, approved by the President May 12, 1933, essentially provided three ways for improving prices and income to dairy farmers.[32]

1.—Section (11) of the Act designated milk and its products as one of the seven basic commodities. Thus these products were entitled to the same price-support and production-adjustment operations as storable commodities. However, as stated in a report of the Administrator of the Agricultural Adjustment Administration (*140*, p. 5), "A dairy-adjustment program was presented to producers, but the support it received from the dairy industry was not deemed sufficient to warrant its adoption."

2.—Section (8) of the Act authorized marketing agreements, licenses, and Secretary's orders. The role of these was greatly strengthened in the Act of 1937; the extent to which they apply to the marketing of fluid milk was discussed in the preceding section (see p. 139).

3.—Section 12 (b) of the Act authorized the Secretary of Agriculture to use funds available to him for the expansion of markets and disposal of surplus agricultural products. In this section we discuss purchases of dairy products under this legislation and similar later legislation that permitted the support of prices for milk and butterfat from mid-1933 until early in World War II. The Department of Agriculture did not announce specific price-support levels or specific purchase prices in these early purchase programs. Purchases generally were made on the basis of competitive bids and the quantities purchased usually did not exceed those that could be used for school lunch, institutional, and welfare purposes. A staff report to the Senate Committee on Agriculture and Forestry (*165*, p. 5) cites the following

[31] For details of the operation of the butter program, see First Annual Report of the Federal Farm Board (*169*, pp. 42–43). The Federal Farm Board was formally constituted on July 15, 1929, under provisions of the Agricultural Marketing Act of 1929 (H. R. 1, Public Law 10, sec. 2) approved by the President on July 15, 1929. The objectives of the Board as stated by Congress (sec. 1 (a)) were ". . . to promote the effective merchandising of agricultural commodities in interstate and foreign commerce, so that the industry of agriculture will be placed on a basis of economic equality with other industries, and to that end to protect, control, and stabilize the currents of interstate and foreign commerce in the marketing of agricultural commodities and their products . . ." The Board gave loans from a revolving fund to cooperatives and stabilization corporations so that they might carry out these objectives. The losses resulting from stabilization activities were borne by the revolving fund with no recourse upon member cooperatives. In May 1933, the powers of the Board were consolidated with those of other credit agencies to form the Farm Credit Administration. For details of the operations of the Board, see annual reports of the Federal Farm Board (*169*) and the First Annual Report of the Farm Credit Administration (*168*).

[32] For details of Government programs of this type in the 1930's, see Black (*7*), Lininger (*77*), and reports of the administration and activities of the Agricultural Adjustment Administration (*139*, *140*, *141*, *142*, and *143*).

three factors as important determinants of the quantity and kind of product purchased under these early programs:

"(1) Effectiveness with which groups of producers organized and pressed their request for governmental assistance.

"(2) Suitability of the product for meeting the food requirements of the people on the relief rolls.

"(3) The ability of the purchase program (in the amount permitted with available funds) to make an observable improvement in the market-price situation."

With few exceptions, the early purchase programs were carried out with wide discretionary powers from the Administrators of the Agricultural Adjustment and the Federal Emergency Relief Administrations. Table 31 summarizes the quantities of dairy products that have been purchased mainly for price-support operations since 1933.

In the summer of 1933, the Secretary of Agriculture authorized Land O'Lakes Creameries, Inc., to purchase surplus butter for resale to the Administration. Between August 17 and October 25, the cooperative bought 11 million pounds. This butter, in turn, was donated by the Agricultural Adjustment Administration to the Federal Surplus Relief Corporation for relief purposes with the understanding that the Relief Administration would also expend some of its own funds for the purchase of butter and cheese.[33] In October 1933, the Dairy Marketing Corporation was formed to handle purchases of surplus dairy products.[34] From October until December 16, when its agreement with the Department of Agriculture terminated, the Corporation purchased 32 million pounds of butter. As in the previous instance, the butter was turned over to the Federal Surplus Relief Corporation. In December 1933, the Federal Surplus Relief Corporation began to purchase butter and cheese through bids. Direct market purchases in December 1933 and early 1934 included 46 million pounds of butter and 6 million pounds of cheese. The Federal Surplus Relief Corporation financed all of these purchases from Treasury advances of $11 million in anticipation of processing taxes on dairy products.

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[33] The Federal Surplus Relief Corporation was chartered under the laws of the State of Delaware in October 1933 for the purpose of purchasing and processing commodities for relief distribution. In November 1935, the charter was amended to call it the Federal Surplus Commodities Corporation and to change the membership so that the direction of the corporation was transferred from the Federal Emergency Relief Administration to the Department of Agriculture. At the first meeting of the board, the Administrator of the Federal Emergency Relief Administration resigned and the Administrator of the Agricultural Adjustment Administration became president of the corporation. This transfer resulted in a shift in emphasis from relief aspects to that of helping in the removal of agricultural surpluses and encouragement of domestic consumption. Dairy products distributed were obtained by (1) direct purchases with the corporation's own funds, (2) donations from the Agricultural Adjustment Administration, and (3) donations from the several State Emergency Relief Administrations. For details of its operations from 1933 to 1945, see annual reports of Federal Surplus Commodities Corporation (*170*).

[34] The stockholders of the Dairy Marketing Corporation were the National Cooperative Milk Producers' Federation, the American Association of Creamery Butter Manufacturers, the International Milk Dealers' Association, and the National Cheese Institute. Purchases were to be made only upon instruction of the Secretary of Agriculture. The Department agreed to take over all products acquired.

TABLE 31.—*Dairy products: Purchases by the United States Department of Agriculture, mainly for price support, 1933–41 and 1947–56*

Year	Butter [1]	Cheese [2]	Evaporated milk	Whole milk equivalent, all purchases		Nonfat dry milk		
				Quantity purchased	Purchases as a percentage of production of milk on farms	Quantity purchased	Purchases as a percentage of—	
							Production of nonfat dry milk for human use	Total solids-not-fat produced on farms
	1,000 pounds	*1,000 pounds*	*1,000 pounds*	*Million pounds*	*Percent*	*1,000 pounds*	*Percent*	*Percent*
1933	[3] 43,234			869	0.8			
1934	[4] 24,624	[5] 17,936	[5] 400	675	.7			
1935	7,055	192	47,027	244	.2	15,840	8.4	0.2
1936	2,951	932	6,160	82	.1	3,594	1.6	([7])
1937	[8] 3,049	[9] 138	19,636	104	.1	23,188	9.5	.3
1938	141,979	3,463	[10] 19,470	2,916	2.8	[11] 31,260	10.8	.3
1939	25,398		3,209	515	.5	5,035	1.9	.1
1940	10,604	4,354	65,903	397	.4	[12] 7,317	2.3	.1
1941	11,454		4,350	238	.2	[12] 2,742	.7	([7])
1947						211,311	31.2	2.0
1948								
1949	114,273	25,526		2,541	2.2	325,493	34.8	3.1
1950	127,905	108,944		3,666	3.1	351,641	39.9	3.3
1951	221	828		13	([7])	53,612	7.6	.5
1952	16,065	2,789		348	.3	51,494	6.0	.5

1953	358, 909	291, 043	----------	9, 981	8. 3	587, 431	48. 4	5. 4
1954	[13] 319, 668	[12] 275, 065	----------	9, 144	7. 5	650, 565	46. 4	5. 9
1955	162, 351	149, 962	----------	4, 747	3. 8	555, 742	39. 4	5. 0
1956 [14]	164, 710	187, 905	----------	5, 173	4. 1	754, 066	50. 3	6. 6

[1] Includes 132,006,000 pounds purchased by Dairy Products Marketing Association during 1938–41.
[2] American cheese unless otherwise specified.
[3] Includes 11,051,046 pounds purchased by Land O'Lakes prior to mid-October 1933.
[4] Includes 5,908,020 pounds purchased with Federal Surplus Commodities Corporation funds in 1934.
[5] Includes Swiss cheese purchased in August.
[6] Purchased by F. S. C. C. during 1934.
[7] Less than 0.05 percent.
[8] Includes 36,525 pounds purchased by F. S. C. C. under State programs for flood relief.
[9] Purchased by F. S. C. C. with State funds.
[10] Includes 435,000 pounds purchased with State funds by F. S. C. C. in September and October and 19,035,000 pounds acquired by F. S. C. C. in November and December in exchange for fluid milk under the New York milk diversion program.
[11] Includes 1,001,000 pounds acquired by F. S. C. C. in November in exchange for fluid milk under the New York milk diversion program.
[12] Includes 2,336,000 pounds in 1940 and 2,742,000 pounds in 1941 acquired for relief distribution by the Surplus Marketing Administration from D. P. M. A.
[13] Excludes 5 million pounds of butter and 87 million pounds of cheese sold in March 1954 under conditions to be bought back after April 1, 1954.
[14] Preliminary.

Compiled from records of operating agencies.

In 1934, funds for the purchase of surplus dairy products were made available under Sections (2) and (6) of the Jones-Connolly Act, approved April 7, 1934. Section 37 of the Agricultural Act of August 24, 1935, provided additional funds that could be used to purchase surplus dairy products. From 1934 to 1938, the Government spent $22 million from funds provided under these Acts, and from Federal and State Emergency Relief funds, in direct market purchases and for relief distribution of the following dairy products:

	Million pounds
Butter	35
Cheese	13
Milk:	
Evaporated	88
Condensed	1
Nonfat dry milk	59

Section 32 of the Agricultural Act of August 24, 1935, authorized the Secretary of Agriculture to use an amount equal to 30 percent of the annual custom receipts to encourage (1) exports of agricultural commodities, and (2) domestic consumption of commodities by diverting them from normal channels of trade or by increasing their use among persons in low-income groups. Beginning in 1937 for butter and evaporated milk, and in 1938 for cheese and nonfat dry milk, direct market purchases of dairy products to provide price assistance to dairy farmers by removing surplus dairy commodities from normal trade channels were financed chiefly from these funds. These products were disposed of through relief distribution channels. In the period 1937–41, $57 million of section 32 funds was spent in purchases for surplus removal of the following dairy products:

	Million pounds
Butter	176
Cheese	8
Evaporated milk	78
Nonfat dry milk	28

All the quantities purchased by Federal Surplus Commodities Corporation were obtained directly in the market place, except for some nonfat dry milk since 1938, and 118 million pounds of butter which were obtained from the Dairy Products Marketing Association.[35] Un-

[35] The Dairy Products Marketing Association, a nonprofit organization with a membership of eight regional butter marketing cooperatives, was set up in 1938 to help operate the Government stabilization program for butter. Loans were made to the Dairy Products Marketing Association by the Commodity Credit Corporation to buy butter at prices specified by CCC. Support was permissive. All butter, cheese, and nonfat dry milk bought by the Dairy Products Marketing Association under the Government stabilization program was held in storage for possible resale through commercial channels at prices representing a seasonal increase, and at least sufficient to cover the purchase price plus handling and carrying charges. Dairy products not resold to the trade could be sold to the Surplus Marketing Administration for relief distribution. For details see Foote (*44*, pp. 8–13). The Dairy Products Marketing Association, acting as an agent for the Department of Agriculture, also purchased dairy products during World War II for Lend-Lease and Government use. The last purchases of the Dairy Products Marketing Association occurred in the spring and summer of 1947 when it purchased about 10 million pounds of nonfat dry milk for price support. It was turned over to Commodity Credit Corporation. The last sale to CCC occurred early in 1948.

der the Government price stabilization program, the Dairy Products Marketing Association bought 132 million pounds of butter during 1938–41, 114 million pounds in 1938 alone.

Government purchases of dairy products for price support during 1933–41 had relatively little effect on the overall price structure for dairy products in most of the years. But as the products were bought during periods of abnormally low prices, even relatively small purchases could substantially affect the market price of a dairy product bought at any given time. For example, Lininger (*77*, p. 61) states that when Land O'Lakes Creameries, Inc. bought 11 million pounds of butter on the Chicago and New York markets between August 17 and October 25, 1933, the price of butter, which had dropped to 18 cents a pound on August 16, increased to 23 cents in Chicago, and approximately 24 cents in New York, within a few days. Total pre-World War II purchases in milk equivalents were less than 1 percent of total production of milk except in 1938 when they were close to 3 percent (see table 31). Based on the coefficients obtained for the aggregate demand for farm milk (see p. 64), the average price received by farmers for milk might have been about 6 percent lower in 1938 if no purchases had been made, assuming that quantities distributed for relief had no material effect on prices. Based on the "error tolerance" associated with price estimates obtained from the above regression analysis (see discussion on p. 163), we would expect that in 2 out of 3 times the actual price would fall within 4 percent of the estimated price and in 19 out of 20 times within 8 percent.

Although Government purchases of dairy products were largest in 1938, quantities distributed for relief were 2 billion pounds, milk equivalent, in 1939 compared with 1 billion pounds in 1938. Most of the purchases of butter in 1938 by the Dairy Products Marketing Association were not turned over to the Federal Surplus Commodities Corporation until 1939. Even though there may have been some substitution for regular market purchases, Government purchases for price support, which were distributed later for relief, undoubtedly tended to increase total consumption of dairy products, and Government expenditures probably were chiefly a net addition to the income of dairy farmers. The remaining smaller supplies in commercial channels normally would sell for more total dollars than the larger supply because of the relatively inelastic demand for milk and most manufactured dairy products.

The operation of three other Government programs also affected consumption, and, probably to a lesser extent, the overall price structure of the dairy industry. These were the Food Stamp Plan for butter, the Low-Cost Milk Program beginning in 1939, and the Penny School Milk Program in 1940. These programs are discussed on page 172.

Price Programs During World War II [36]

During World War II, emphasis shifted from the use of price programs to remove surpluses and raise prices paid to dairy farmers to the provision of incentives for increasing production of milk for mili-

[36] For more detailed discussions of price programs, supply programs, and consumer subsidy programs during World War II, see Foelsch (*42*), Henderson (*64*) and reports of the United States War Food Administration (*181*, *182*, *183*).

tary, Lend-Lease and other wartime uses. This was accomplished by announcing minimum price guaranties to encourage the production desired as, for example, on April 1, 1941, when the Department of Agriculture announced that it would support prices of dairy products through June 30, 1943, by open market purchases of butter at Chicago for 31 cents per pound.

Under the Steagall amendment of the Act approved July 1, 1941, (Public Law 147, 77th Congress), price supports at not less than 85 percent of parity became mandatory for all nonbasic commodities for which the Secretary of Agriculture requested by public announcement an increase in production to meet wartime needs. In October 1942 this legislation was revised to require supports at not less than 90 percent of parity. The new amendment also provided that supports at that level be maintained for two years beyond the year that hostilities ceased. For the first time, price supports became mandatory for manufactured dairy products on August 29, 1941, when support prices were announced for evaporated milk, nonfat dry milk and cheese, and butterfat on November 28, 1942. These items were supported under the Steagall amendment until December 31, 1948.

When price supports became mandatory under the Steagall amendment, the Commodity Credit Corporation assumed the responsibility of carrying out the program to maintain prices and to purchase and distribute commodities through noncompetitive domestic and foreign outlets.[37] Wartime demands, however, kept market prices from falling below price ceiling levels and no price support purchases were necessary during the war. Large quantities of dairy products were purchased by the Armed Forces and the Department of Agriculture under the Supply Program during and immediately after World War II. All of these purchases were for military, lend-lease, and postwar foreign assistance programs rather than for price-support purposes.

During World War II, subsidy programs also were in operation to maintain a high level of production of milk and dairy products while permitting consumer prices to remain at price ceiling levels. From October 1, 1943, to June 30, 1946, CCC made payments to producers of milk and butterfat amounting to $1.2 billion to compensate for increased costs of feed and farm labor and to help maintain ceiling prices for dairy products. CCC also made payments to manufacturers of Cheddar cheese amounting to 3¾ cents per pound, with appropriate adjustment for moisture content, beginning January 1943 and ending in January 1946. From April 1943 to June 1946, $38 million were paid to milk handlers in areas having a milk shortage in compensation for increased prices paid producers and to maintain price ceilings at wholesale and retail. The Defense Supplies Corporation

[37] The Commodity Credit Corporation was organized October 17, 1933, pursuant to Executive Order No. 6340. It currently operates as an agency of the United States under a permanent Federal Charter under the Commodity Credit Corporation Charter Act approved June 29, 1948, and amended June 7, 1949. Management of CCC is vested in a board of directors, subject to the general supervision and direction of the Secretary of Agriculture, who is ex officio director and is chairman of the board.

made payments to creameries amounting to 5 cents per pound of butter from June 1943 to October 1945 to enable creameries to absorb a price rollback of like amount ordered by the Office of Price Administration.

Price Programs After World War II [38]

In contrast to permissive price supports prior to World War II, the objective of postwar programs has been to provide mandatory support of prices of milk and butterfat within ranges of parity specified by law. Two aspects of the support program are considered in this study in analyzing their effect on the overall price structure and consumption of dairy products.

1.—The purchase program of the Commodity Credit Corporation and the extent to which these purchases were needed to prevent the decline of prices of milk and butterfat below specified levels during periods when supplies of dairy products exceeded demand at the prevailing support level. Naturally, the larger the purchases relative to total supply, the greater the effect on consumption and prices in relation to what would have prevailed had no purchases been made.

2.—The disposal program of the CCC. Here we are concerned with the distribution of dairy products in ways that have little effect on amounts bought normally in commercial channels or other outlets at prevailing prices.

Purchase program for price support.—As noted previously, mandatory price supports for dairy products at not less than 90 percent of parity [39] were provided under the Steagall amendment until December 31, 1948. The only purchases made for price support under the Steagall amendment were 211 million pounds of nonfat dry milk in 1947. The Agricultural Act of 1948 extended mandatory price supports at 90 percent of parity through 1949. The Agricultural Act of 1949, passed the following year, continued mandatory supports for milk and butterfat but gave the Secretary of Agriculture discretion to determine the level between 75 and 90 percent of parity so as to assure an adequate supply of milk. The 1949 Act as amended provides the basic legislation for the price support program in operation from January 1, 1950, to date.

Prior to each marketing year beginning April 1, the Secretary of Agriculture announces the specific support levels effective for the coming marketing year. The announced support levels from early 1949 through March 1957 ranged from 75 to 90 percent of the parity

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[38] See Henderson (*64*) for an overall study of all price programs of the United States Department of Agriculture, the staff report of the United States Senate (*165*) for price supports for perishable products, and the study made by the United States Department of Agriculture (*161*) for the United States Congress on alternative methods of supporting prices for milk and butterfat.

[39] Parity prices give farm commodities the same buying or purchasing power that they had in a selected base period when prices received and prices paid by farmers were considered in good balance. For a discussion of parity and its method of computation, see *Parity Handbook* (*166*).

TABLE 32.—*Manufacturing milk and butterfat in farm-separated cream: Comparison of announced support prices and United States average market prices paid to producers, 1949–58*

Product and support period	Support level		Market price	
	Percentage of parity [1]	Support price	Actual	Amount above or below support
Manufacturing milk, per 100 pounds:	*Percent*	*Dollars*	*Dollars*	*Dollars*
Jan.–Dec. 1949	90	3.14	3.14	0.00
Jan. 1950–Mar. 1951	79	3.07	3.40	.33
Apr. 1951–Mar. 1952	87	3.60	3.97	.37
Apr. 1952–Mar. 1953	90	3.85	4.00	.15
Apr. 1953–Mar. 1954	90	3.74	3.46	−.28
Apr. 1954–Mar. 1955	75	3.15	3.15	.00
Apr. 1955–Mar. 1956	80	3.15	3.19	.04
Apr. 1956–Mar. 1957	84	3.25	3.30	.05
Apr. 1957–Mar. 1958	83	3.25		
Butterfat, per pound:		*Cents*	*Cents*	*Cents*
Jan.–Dec. 1949	90	58.5	62.1	3.6
Jan. 1950–Mar. 1951	86	60.0	64.2	4.2
Apr. 1951–Mar. 1952	90	67.6	74.1	6.5
Apr. 1952–Mar. 1953	90	69.2	71.6	2.4
Apr. 1953–Mar. 1954	90	67.3	65.7	−1.6
Apr. 1954–Mar. 1955	75	56.2	57.1	.9
Apr. 1955–Mar. 1956	76	56.2	56.9	.7
Apr. 1956–Mar. 1957	81	58.6	58.8	.2
Apr. 1957–Mar. 1958	80	58.6		

[1] Percentage of the parity equivalent price of manufacturing milk and the parity price of butterfat.

equivalent price of manufacturing milk and the parity price of butterfat in farm-separated cream.[40] (Table 32).

Section 201 of the Agricultural Act of 1949, as amended, provides that support prices will be maintained through loans on, or purchases of, milk and the products of milk and butterfat. Support prices have been maintained almost exclusively through purchase programs of

[40] Official parity prices are published only for milk and butterfat. While the 1949 Act did not specifically direct that individual components of the milk supply be supported separately, the Secretary of Agriculture found it necessary to institute by administrative action a system for separately supporting manufacturing milk. The parity equivalent for manufacturing milk bears the same relationship to the parity price of milk as the average relationship between (1) the average price paid f. o. b. plant by processors for all milk sold by farmers for use in production of American cheese, evaporated milk, and butter and byproducts in a base period and (2) the average price received by farmers for all milk sold at wholesale to plants and dealers during the same period. From February 1949 to March 1954 the base period used was July 1946 through December 1948. The resultant factor was 88.5 percent. Beginning in April 1954, the base period was July 1946 through the December preceding the date of computation. Data for each year were added until 10 full calendar years were included in the comparison and thereafter only the 10 latest years were to be used. The factor in 1956 was 83.3 percent.

the Commodity Credit Corporation, except a limited number of nonrecourse loans made to manufacturers of whey products for animal feed in 1954 on the equivalent of 71 million pounds of dry whey. These loans were offered to offset possible losses on the animal feed market for commercial suppliers of whey and dried buttermilk that might result from CCC sales of nonfat dry milk for use in animal and poultry mixed feeds. Practically all of these products were taken over by CCC and sold for export.

Under the purchase program, the Secretary, prior to each marketing year, announces that the Commodity Credit Corporation will stand ready to buy at specified prices any butter, Cheddar cheese, and nonfat dry milk of specified grades offered to it in carlots. The purchase prices apply to processed dairy products, but the announced price support objectives are stated in terms of prices received by farmers. Based on recent trends in marketing margins or relationships between wholesale product prices and prices paid producers for manufacturing milk and butterfat, purchase prices are set at levels such that the average United States price received by farmers for manufacturing milk and butterfat will equal the support prices for these items. Implicit in the purchase program is the assumption that competition is equally effective in keeping farm prices of milk and butterfat in line with wholesale market prices of processed dairy products when price support purchases are made and when price support programs are not in operation.

Table 33 shows the announced purchase prices and their equivalent market prices since 1949. In 1949 and since late 1952 in periods in which substantial price support purchases were made, wholesale market prices for butter and cheese have been close to the announced purchase prices. The market price for nonfat dry milk has been at the support level during most of the period since 1949, reflecting almost continuous purchases of nonfat dry milk. The United States average prices to producers for manufacturing milk and butterfat have equaled or exceeded the announced support levels during most of the period since early 1949. (See table 32.) Prices to producers for both milk and butterfat averaged below support level during the 1953–54 marketing year, reflecting increased marketing costs and a surplus amounting to 10 percent of the total production of milk.

Effect of CCC purchases on prices and consumption.—All milk and butterfat in excess of the quantities that can be marketed as milk and its products at prevailing prices when prices of butter, cheese, and nonfat dry milk are at the support level tend to be used in the production of processed dairy products that are purchased by the Commodity Credit Corporation. Thus, although only butter, cheese and nonfat dry milk are purchased under the price support program, prices of other processed dairy products also are supported in effect because of the close relationship among prices of all processed dairy products. Prices in regulated and unregulated fluid milk markets also are affected by changes in support level because many price formulas for Class I milk, and practically all price formulas for lower-use classifications, are based on prices of manufactured dairy products or manufacturing milk (see p. 143).

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TABLE 33.—*Dairy products: Actual wholesale and United States Department of Agriculture purchase price under price-support programs, per pound, 1949–57* [1]

Period	Butter, Grade A or higher [2]		Cheddar cheese, Grade A or higher		Nonfat dry milk, extra grade			
					Spray		Roller	
	Purchase price	Actual price [3]	Purchase price	Actual price [4]	Purchase price	Actual price [5]	Purchase price	Actual price [6]
	Cents	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
Feb. 8, 1949–July 27, 1949	59. 00	59. 8	None	[7] 30. 5				
Apr. 14, 1949–Aug. 31, 1949					12. 25	12. 2	11. 00	[8] 10. 8
July 28, 1949–Dec. 31, 1949	62. 00	62. 0	31. 75	[9] 31. 9				
Sept. 1, 1949–Dec. 31, 1949					12. 75	12. 6	11. 50	11. 2
Jan. 1, 1950–Mar. 31, 1951	60. 00	63. 0	31. 00	33. 8	12. 50	12. 6	10. 50	10. 9
Apr. 1, 1951–Mar. 31, 1952	66. 00	71. 8	36. 00	38. 6	15. 00	15. 2	13. 00	14. 0
Apr. 1, 1952–Mar. 31, 1953	67. 75	69. 3	38. 25	39. 8	17. 00	16. 7	15. 00	15. 1
Apr. 1, 1953–Mar. 31, 1954	[10] 65. 75	65. 5	37. 00	36. 8	16. 00	15. 5	14. 00	12. 9
Apr. 1, 1954–Mar. 31, 1955	[11] 57. 50	57. 8						
Apr. 1, 1954–July 11, 1954			32. 25	32. 2	15. 00	[12] 14. 8	13. 25	[12] 12. 6
July 12, 1954–Mar. 31, 1955			33. 25	33. 4	16. 00	[13] 15. 6	14. 25	[13] 14. 1
Apr. 1, 1955–Mar. 31, 1956	[11] 57. 50	57. 4	33. 25	33. 2	16. 00	15. 6	14. 25	13. 9
Apr. 1, 1956–Mar. 31, 1957	[14] 59. 50	59. 7	[14] 35. 00	34. 7	16. 00	15. 5	14. 25	13. 5
Apr. 1, 1957–Mar. 31, 1958	[15] 59. 75		[14] 35. 00		16. 00		14. 00	

[1] For the period 1/1/50–3/31/51, a purchase price for evaporated milk of $3.95 per case was in effect.
[2] The purchase price for Grade B butter is 2 cents lower than the price of Grade A.
[3] Average wholesale price for 92-score butter at Chicago, Agricultural Marketing Service.
[4] Average wholesale price of American Cheddars, f. o. b., Wisconsin assembly points, Agricultural Marketing Service.
[5] Manufacturers' average selling price of nonfat dry milk solids (spray process), Agricultural Marketing Service.
[6] Manufacturers' average selling price of nonfat dry milk solids (roller process), Agricultural Marketing Service.

[7] Average for March–July 1949.
[8] Average for May-August 1949.
[9] Average for August-December 1949.
[10] Price at Chicago. Prices of 66.50 cents at New York and 66.75 cents at San Francisco and Seattle.
[11] Price at Chicago, San Francisco and Seattle. Price of 58.25 cents at New York.
[12] Average for April-June 1954.
[13] Average for August 1954–March 1955.
[14] Prior to the 1956–57 marketing year, the Secretary announced that the same purchase prices would remain in effect as in the previous marketing year except that the price of Cheddar cheese would be raised to 34 cents. On April 18, the Commodity Credit Corporation's buying prices were increased 2 cents per pound on butter and 1 cent per pound on cheese for products produced on or after April 1, 1956.
[15] Price at San Francisco and Seattle. Price of 60.50 cents at New York.

Table 34 shows the estimated percentage decreases below the prevailing market price that would have occurred in farm and retail prices of milk and dairy products during each marketing year since 1949 if the Commodity Credit Corporation had made no purchases. The basic assumptions underlying these estimates are as follows: (1) All milk used in making those products that were sold to the Commodity Credit Corporation otherwise would be used in making products that enter into normal commercial channels for domestic consumption. (2) Implicit in the first assumption is that the levels of ending commercial stocks, exports, and imports would be about the same as they were under the price support program. (3) It is also assumed that disposals by the Commodity Credit Corporation do not significantly replace consumption in outlets that normally would have taken place under prevailing prices when they are at support level. (4) In making the analysis, the effect on next year's production of milk of lower prices received by farmers during the current marketing year is not included; thus, each year is considered a separate entity. (5) The CCC purchase data used in the analysis were adjusted for sales back to domestic commercial channels and are therefore net purchases.

Making use of the assumptions given in the preceding paragraph, two approaches were used to estimate price decreases for all milk at wholesale: (1) The first approach assumes constant elasticity of demand with respect to price at the farm level. These estimates

TABLE 34.—*Milk and dairy products: Estimated percentage decreases in price below prevailing market levels had no price-support programs been in effect, marketing years, 1949-55* [1]

Item	Year beginning April 1						
	1949	1950	1951	1952	1953	1954	1955
Price received by farmers:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Milk:							
Manufacturing	8	2	----	12	32	16	16
All at wholesale:							
Analysis I [2]	6	2	----	9	25	12	12
Analysis II [3]	7	2	----	10	26	13	13
Butterfat	7	2	----	12	33	16	16
Retail prices:							
All dairy products	3	1	----	4	12	5	5
Milk:							
Fluid	3	1	----	4	10	5	5
Evaporated	3	1	----	5	14	7	7
Butter	5	1	----	8	22	10	10
American cheese	5	1	----	7	19	9	9
Ice cream	2	1	----	3	7	4	4

[1] Unless noted otherwise, price decreases computed assuming constant demand elasticities with respect to price at the retail level and constant absolute marketing margins. For details, see text.

[2] Price decreases based on demand coefficient in the demand equation at the farm level for total milk obtained on page 64.

[3] Price decreases based on assumptions stated in footnote 1.

were obtained from coefficients in the demand equation for total milk at the farm level discussed on page 64. (2) The second approach assumes, for each product, (a) constant elasticities of demand with respect to price at the retail level and (b) absolute constant marketing margins that are not affected by the size of the surplus in any year under consideration. The estimates obtained from using the second approach also are consistent with the structural models discussed on page 75 for which prices at retail and quantities of the individual dairy products consumed were assumed to be simultaneously determined. The latter approach also was used for the estimates relating to prices received by farmers for manufacturing milk and butterfat and for retail prices of specified dairy products. Results of the two approaches for all milk at wholesale, as shown in table 34, are remarkably similar.

In the second approach, the assumption of constant elasticities of demand with respect to price implies that logarithmic relations prevail at the consumer level in contrast to the linear relations assumed when estimates of elasticities were obtained earlier from the simultaneous-equations approach. Linear relations result in lower price elasticities as the volume of dairy products marketed increases. The assumption of absolute constant marketing margins implies that any price decrease necessary to sell an increment of product at the final consumer level is passed on in full to the farmer. In some periods of substantial decreases in prices, such as the early 1930's, prices received by farmers, in equivalent dollars, decreased more than did retail prices of the several dairy products as is shown on page 181. Thus the estimated decreases in prices probably are too small rather than too large.

The price elasticities of demand at retail which were used in this price analysis are presented in the following tabulation:

Product	*Retail price elasticity*
Fluid—	
Milk	−0.3
Cream	−.7
Butter	−.7
Cheese:	
American	−.8
Other	−.7
Evaporated milk	−.5
Ice cream	−1.2
Other dairy products	−1.0

These elasticities were derived in part from results obtained in the analyses for the period between World Wars I and II and that following World War II, respectively. The precise way in which these elasticities were used in obtaining the results shown in table 34 consistent with the assumptions underlying the estimates of price decreases is discussed in detail in the appendix, page 234.

Before discussing the estimated price decreases in table 34, we caution the reader that these decreases are estimates that are subject to some probability distribution as to their error. Since these estimates are based on relations which were synthesized from results of several statistical analyses, no error of estimate can be computed for each estimate of price decrease. However, some indication as to the magnitude of the errors involved in making such price estimates is obtained from inspection of errors of estimate for the regression analysis of farm demand for milk (p. 64) and the retail price regression

analyses for the several dairy products (p. 198). "Error tolerances" for these price estimating equations are shown in the following tabulation:

Price equation	"Error tolerance"
	Percentage points
All milk at wholesale	8
Fluid milk	5
Butter	7
American cheese	6
Evaporated milk	6

The "error tolerance" equals two standard errors of estimate from the above discussed analyses based on data for 1925–41. The "error tolerance" has the following approximate significance: If the economic structure represented by these regression analyses and the probability distribution of disturbances or residual errors still apply, we might expect the actual price to be within the range of 2 standard errors of forecast from the estimated price obtained from the regression equation in 19 out of 20 times, provided the values of the explanatory variables (for example, changes in total milk production) fall within the range of changes that occurred during the years included in the analysis. As the standard error of estimate is always smaller than the standard error of forecast, the "error tolerance" cited above is somewhat too small.

During the 1953–54 marketing year, the largest percentage decrease in price, amounting to 32 percent, would have occurred for manufacturing milk, in the absence of price support purchases, and the smallest percentage decrease, amounting to 7 percent, would have occurred for ice cream. The assumption of a constant marketing margin used in the analysis results in smaller percentage decreases in retail prices than in the corresponding price decreases at the farm level. Differences in the percentage decreases among retail prices reflect differences in the size of the marketing margin. Thus, the impact on retail prices, in percentage terms, of price decreases at the farm level is larger for products like butter, whose marketing margin is relatively small, than for products such as fluid milk, whose marketing margin is relatively large.

Of interest also is the determination of the effect of the purchase program on utilization of milk. The first column in table 35 shows the actual utilization of milk, fat-solids basis, during 1955. The next three columns reveal that since 1952 from two-thirds to three-fourths of the milk that could not be used in making products to be sold commercially at prevailing prices was used in making butter, and the remainder in making Cheddar cheese, both products being sold to the Commodity Credit Corporation. The last three columns indicate how the milk which is used in products that are sold to the CCC normally would have been used in different outlets had no support program been in effect. The estimates in these columns show

the percentage distribution among the products of an increment in the supply of total milk, fat-solids basis, that would occur under competitive conditions when the supply of milk increases by 5, 10, and 15 percent, respectively, above a given base quantity, while holding all other factors constant except prices of dairy products. These estimates, which would prevail under competitive conditions, also are consistent with all the assumptions used in estimating the price decreases in table 34. Thus, when the support program is in operation, all of the surplus goes into butter and cheese, while in the absence of the support program, this milk would have been distributed among all products as shown in the last three columns in table 35, depending on the size of the surplus.

The estimated distribution of the increment in supply under competitive conditions results from two effects: (1) The percentage distribution varies directly with the price elasticity of demand for the product; and (2) the percentage becomes smaller with each increase in size of the marketing margin. Thus, because butter has a relatively high elasticity of demand and a relatively low marketing margin, slightly over 45 percent of the increase in supply of milk

TABLE 35.— *Milk: Comparison of utilization of total production with utilization of surplus at prevailing support prices under assumed conditions*

Product	Percentage utilization of total milk production, 1955	Percentage utilization of surplus [1]					
		Commodity Credit Corporation purchases, year beginning April [2]			Sales in market at specified levels of surpluses [3]		
		1953	1954	1955	5 percent	10 percent	15 percent
		Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Fluid—							
Milk	40.8				14.2	13.8	13.3
Cream	6.4				5.1	4.9	4.7
Butter	24.9	67.2	76.7	69.6	45.9	46.6	47.3
Cheese:							
American	8.1	32.8	23.3	30.4	13.4	13.4	13.5
Other	2.8				4.0	3.9	3.8
Evaporated milk	4.5				3.8	3.7	3.6
Ice cream	6.7				6.8	6.6	6.4
Other dairy products	5.8				6.8	7.1	7.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Surplus is defined as that quantity of milk in excess of the quantities that would be sold in normal outlets at the prevailing market prices when prices of manufactured dairy products are at support levels.

[2] Commodity Credit Corporation purchases adjusted for sales back to domestic commercial channels.

[3] Percentage distribution of an increment of supply of total milk in excess of the quantities demanded at the prevailing support level that would occur under competitive conditions in the absence of the price support program. These estimates are consistent with the assumptions used in estimating price decreases in table 34. For details see text.

would normally be channeled into butter even though only about 25 percent of the total production of milk were used in making butter in 1955. In contrast, only about 14 percent of the increment in supply would be used for fluid milk, compared to 41 percent of the total production of milk used in fluid form in 1955.

If we had used constant percentage markups in the analysis instead of constant absolute marketing margins, the distribution of an addition to supply of milk would be a function only of the price elasticities.

Utilization of CCC stocks.—The development of outlets for dairy products acquired under the price support programs has been an integral part of the overall program. Although CCC has stored dairy products well into the second year without any serious loss of quality, their relatively short storable life precludes the operation of an ever-normal granary type of storage program. Thus, CCC purchases must be disposed of within a reasonable length of time of purchase, and in such a way that their disposals do not unduly affect market prices of dairy products and thereby impair the price support program.

Beginning with 1952, table 36 shows the major breakdown of CCC disposals between domestic and foreign outlets, indicating that each form is a substantial outlet. Table 37 shows, in more detail, the number of outlets available. Following is a discussion of the nature and source of these outlets.

Section 407 of the Agricultural Act of 1949, as amended, authorizes CCC to sell commodities owned by it at any price not prohibited by the Section. The Secretary rules administratively that dairy products are not storable commodities within the meaning of Sections 407 and 408 and therefore not subject to any restrictions in sales. But to maintain the objectives of the support program and to encourage commercial storage, CCC offers dairy products for sale to domestic markets at prices moderately above the current support price. In a year when the surplus is relatively small, some of the supplies acquired in months of high seasonal production may be sold back to the trade during the same marketing year, in months of low seasonal production. But such sales normally are limited unless there is a substantial shift in the supply-demand situation as, for example, when substantial quantities of butter were sold back to the trade in late 1950. In addition, limited sales may occur in specialized and restricted uses such as the butter sold under a program for use as an extender of high-priced imported cocoa butter in the manufacture of chocolate products. Special circumstances occasionally may provide substantial outlets for CCC stocks. This occurred in 1954 when CCC sold nearly a year's purchase—581 million pounds—of nonfat dry milk for use in animal and poultry mixed feeds because soybean meal was in short supply and relatively high in price.

As in the case of domestic commercial sales, export sales by the CCC also have been limited. Beginning in 1954, CCC offered butter, Cheddar cheese, and nonfat dry milk at prices comparable to world prices, but sales were small. Title I of the Agricultural Trade Development and Assistance Act of 1954, which permitted export sales

TABLE 36.—*Dairy price-support program: Purchases, utilization and stocks, year beginning April 1, 1952–55*

BUTTER

Year beginning April 1	Purchases by Commodity Credit Corporation	Utilization			Uncommitted supplies, end of period
		Domestic	Foreign	Total	
	Million pounds	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*
1952	143.3	20.9	----------	20.9	122.5
1953	[1] 375.0	93.3	45.8	139.1	[1] 359.0
1954	210.5	164.2	170.5	334.7	236.6
1955	177.6	150.4	263.7	414.1	0.0

AMERICAN CHEESE

1952	75.2	1.1	----------	1.1	74.2
1953	[1] 369.4	31.7	22.6	54.3	[1] 390.9
1954	153.4	123.1	90.8	213.9	328.6
1955	157.4	92.5	165.3	257.8	228.2

NONFAT DRY MILK SOLIDS

1952	210.4	20.5	47.4	67.9	169.3
1953	665.9	11.8	227.6	239.4	598.8
1954	523.2	659.6	374.2	1,033.8	86.3
1955	623.7	106.2	558.1	664.3	46.4

[1] Excludes quantities of butter and cheese sold to Commodity Credit Corporation in March 1954 but contracted for repurchase by private firms in April 1954. Quantities excluded: Butter, 5.1 million pounds; cheese, 86.6 million pounds.

for foreign currency, also provided a limited outlet for butter and cheese. Disposition also occurred under Title II of the same act by transfers to the International Cooperation Administration for foreign famine relief programs. Negotiated sales with other countries also have provided a significant outlet.

Transfers of dairy products to military agencies and the Veterans Administration were stepped up under the Agricultural Act of 1954, which amended Section 201 (c) of the Agricultural Act of 1949. The Act directs CCC to make available to those agencies, without charge except for packaging costs, milk and dairy products acquired under the price support program for use by them in addition to their normal market purchases.

The school lunch program has been an important domestic outlet for CCC stocks of dairy products. These dispositions were made with funds authorized under Section 32 of the 1935 Act and Section 6

TABLE 37.—*Dairy products: Utilization of price-support purchases, years beginning April 1, 1952–55*

Item [1]	Butter, creamery				Cheddar cheese				Nonfat dry milk			
	1952	1953	1954	1955	1952	1953	1954	1955	1952	1953	1954	1955
	Mil. lb.	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*
Commercial sales:												
Domestic:												
Unrestricted and restricted use, flood and fire damage	------	4.3	[2] 16.8	2.8	1.1	7.4	[2] 35.9	4.5	4.8	0.1	4.4	1.7
Animal feed	------	------	------	------	------	------	------	------	5.2	2.1	581.4	18.4
Export:												
Unrestricted and restricted use	------	------	2.6	18.7	------	------	.6	4.9	------	------	5.0	35.3
Animal and poultry feed	------	------	------	------	------	------	------	------	------	------	------	75.0
Title I (Foreign currency)	------	------	------	7.1	------	------	------	2.5	------	------	------	------
Barter	------	------	------	------	------	------	------	------	------	------	------	1.0
Non-commercial export sales	------	------	[3] 18.9	19.0	------	------	------	6.8	42.4	131.2	99.2	59.8
Transfers to—												
International Cooperation Administration	------	------	9.1	5.8	------	.5	4.1	16.0	------	------	11.6	15.5
Section 32	20.9	68.8	17.5	37.1	------	24.3	12.8	29.4	10.5	9.5	1.2	29.0
United States Army:												
Sales:												
Domestic	------	20.2	14.7	------	------	------	.8	.3	------	------	------	.1
Overseas	------	------	5.6	6.5	------	------	(4)	(4)	5.0	5.6	------	.1
Donations	------	------	18.8	26.0	------	------	1.1	1.5	------	------	.1	.1
Veterans Administration:												
Sales	------	(4)	(4)	------	------	------	------	------	------	------	------	------
Donations	------	------	1.5	2.8	------	------	------	------	------	------	------	------

Donations:												
Section 416:												
Domestic	------	------	94.9	81.6	------	------	72.5	56.8	------	------	72.5	56.8
Export:												
Bulk and packaged	------	45.8	82.8	108.3	------	22.1	86.1	135.1	------	90.8	258.4	371.3
Processed into butter oil	------	------	51.5	98.3	------	------	------	------	------	------	------	------
Foreign Agricultural Service	------	------	------	.1	------	------	------	------	------	------	------	.1
Research	------	------	------	------	------	------	------	------	------	.1	------	.1
Total utilization:												
Domestic	20.9	93.3	164.2	150.4	1.1	31.7	123.1	92.5	20.5	11.8	659.6	106.2
Foreign	------	45.8	170.5	263.7	------	22.6	90.8	165.3	47.4	227.6	374.2	558.1
Grand total	20.9	139.1	334.7	414.1	1.1	54.3	213.9	257.8	67.9	239.4	1,033.8	664.3

[1] For description of these programs, see text.
[2] Excludes quantities of butter and cheese sold to Commodity Credit Corporation in March 1954 but contracted for repurchase by private firms after Apr. 1, 1954. Quantities excluded: Butter 5.1 million pounds; cheese, 86.6 million pounds.
[3] Processed into butter oil.
[4] Less than 50,000 pounds.

Data based on contracts.

of the National School Lunch Act of 1946 or as direct donations under Section 416 of the Agricultural Act of 1949.

In fact, a substantial part of CCC stocks of dairy products is donated by CCC under Section 416 into both domestic and foreign uses. These amounted to 70, 75, and 64 percent of the total CCC disposition of butter, Cheddar cheese, and nonfat dry milk, respectively during the 1955–56 marketing year. Section 416 of the Agricultural Act of 1949 authorizes the donation of certain food commodities acquired for price support to school lunch programs, charitable institutions, and needy persons in this country, and to United States private welfare agencies for foreign welfare uses. An amendment to the 1949 Act in the Agricultural Trade Development and Assistance Act of 1954, in authorizing CCC to bear repackaging and certain transportation costs, stepped up the usage in these outlets. The same 1954 Act also revised Section 416 of the 1949 Act to permit donations of price support commodities to intergovernmental groups, as well as to United States private welfare agencies, for the relief of needy persons outside the United States.

Utilization of CCC stocks, both domestic and foreign, reached sizable proportions by 1955, amounting close to 11 billion pounds, milk equivalent, fat-solid basis, during the 1955–56 marketing year. This included 414 million pounds of butter, 258 million pounds of cheese, and 664 million pounds of nonfat dry milk. Dispositions in 1955 for butter exceeded, and those for nonfat dry milk almost equaled, purchases of these products in any marketing year. (See table 36.) Utilization of Cheddar cheese, although sizable, has been at a slower rate. The net effect of these substantial dispositions has been that, although record stocks were held by CCC in 1954, by the end of the 1955–56 marketing year uncommitted supplies were practically nil for butter, very low for nonfat dry milk, and still substantial for Cheddar cheese. (See table 36.)

The data in tables 38 and 39 show the contributions made to domestic consumption by supplies from CCC stocks and purchases with Government funds since 1947. In the case of manufactured dairy products, these contributions have tended to vary with the size of CCC purchases and stocks.

These contributions have been substantial since 1953 amounting to 8, 9, and 9 percent of the domestic civilian consumption of butter, Cheddar cheese, and nonfat dry milk, respectively, during 1955. While some of these quantities may have replaced some consumption that would have occurred normally under prevailing prices, total consumption was substantially higher than it would have been in the absence of these Government programs if the same prices were maintained. In addition, one long-run effect of these programs may be a higher level of consumption than it otherwise would have been. Sufficient data are not available to measure the precise effect that these contributions may have had on consumption. It should be noted that the price decreases estimated in table 34 did not take into account the replacement of domestic consumption by such Government programs.

TABLE 38.—*Domestic disappearance of dairy products (military and civilian): Commercial and non-commercial channels, 1947–56*

BUTTER

Year	Military		Civilian				
			Total		Per capita		
	Commercial channels	Commodity Credit Corporation [1]	Commercial channels	From CCC supplies or bought wholly or partly with Government funds	Commercial channels	From CCC supplies or bought wholly or partly with Government funds	Total [2]
	Mil. lb.	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Lb.*	*Lb.*	*Lb.*
1947	28		1,289		8.9		11.1
1948	36		1,156		7.9		9.9
1949	32		1,268	5	8.5	(3)	10.4
1950	34		1,301	51	8.5	0.3	10.6
1951	52		1,205		7.9		9.4
1952	38		1,102		7.1		8.5
1953	28	15	1,079	55	6.8	.3	8.4
1954	35	28	1,141	93	7.1	.6	8.8
1955	35	40	1,184	115	7.2	.7	8.9
1956 [4]	41	30	1,179	115	7.0	.7	8.6

AMERICAN CHEESE

1947	4		741	2	5.1	(3)	5.1
1948	14		739	12	5.0	.1	5.1
1949	9		769	17	5.1	.1	5.3
1950	11		798	25	5.2	.2	5.4
1951	21		756	17	4.9	.1	5.0
1952	21		806	14	5.2	.1	5.3
1953	18		770	23	4.9	.1	5.0
1954	14	1	816	62	5.0	.4	5.4
1955	13	2	777	90	4.7	.5	5.3
1956 [4]	12	2	806	108	4.8	.6	5.5

NONFAT DRY MILK SOLIDS

1947	6		414	3	2.9	(3)	2.9
1948	7		474	11	3.2	.1	3.3
1949	2		470	11	3.1	.1	3.2
1950	3		517	32	3.4	.2	3.6
1951	9		621	16	4.1	.1	4.2
1952	11		690	21	4.5	.1	4.6
1953	4	1	630	17	4.0	.1	4.1
1954	3		767	50	4.8	.3	5.1
1955	4		817	90	5.0	.5	5.5
1956 [4]	3		736	101	4.4	.6	5.0

See footnotes at end of table.

TABLE 38.—*Domestic disappearance of dairy products (military and civilian): Commercial and non-commercial channels, 1947–56—Con.*

FLUID MILK AND CREAM

Year	Military, commercial channels, paid for—		Civilian						
			Total			Per capita			
	With military funds	Partly with CCC funds	Commercial channels	School programs		Commercial channels	School program		Total
				Regular lunch	Special milk		Regular lunch	Special milk	
	Mil. lb.	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
1947	400	------	52, 165	435	------	365. 8	3. 1	------	368. 9
1948	400	------	51, 125	475	------	352. 1	3. 3	------	355. 4
1949	400	------	51, 330	570	------	347. 8	3. 8	------	351. 6
1950	500	------	51, 758	642	------	344. 6	4. 3	------	348. 9
1951	900	------	52, 502	698	------	347. 5	4. 6	------	352. 1
1952	900	------	53, 224	776	------	347. 0	5. 0	------	352. 0
1953	900	------	53, 380	820	------	342. 2	5. 2	------	347. 4
1954	900	(5)	54, 358	893	49	341. 7	5. 6	. 3	347. 6
1955	900	200	55, 678	933	489	343. 1	5. 7	3. 0	351. 8
1956 [4]	800	300	56, 833	927	840	343. 8	5. 6	5. 1	354. 5

[1] Includes donations and quantities purchased at world market prices.
[2] For butter, includes farm production. Estimates computed from total disappearance.
[3] Less than 0.05 pound.
[4] Preliminary.
[5] Less than 50 million pounds.

FOOD DISTRIBUTION PROGRAMS [41]

Some of the food distribution programs discussed in this section had their origin in attempts to improve prices and income received by farmers during periods when agricultural commodities were in surplus supply. In fact, the immediate objective of these programs frequently is to supplement price support operations by providing outlets for surpluses acquired under the support program, and by increasing consumption through their own purchase programs. Some programs, such as the special school milk program, were designed to supplement price support programs for manufacturing milk and butterfat by increasing consumption in fluid outlets and thereby reduce the quantity of milk available for the production of surplus manufactured dairy products bought by CCC. Although the imme-

[41] For a discussion of early food distribution programs, see annual reports of the Federal Surplus Commodities Corporation (*170*), report of the Surplus Marketing Administration (*180*), Agricultural Marketing Administration (*144*), and War Food Administration (*181*), Foote (*44*), Gold, Hoffman and Waugh (*59*), Stiebeling Adelson and Blake (*127*) and Sullivan (*130*). For a discussion of recent programs, see literature cited in footnote 38.

diate objectives of most of these programs are to give price assistance to dairy farmers and to provide outlets for dairy products acquired under price support programs, their long-run objectives are to bring about consumption levels that will improve the health and well-being of the nation and to expand consumption of agricultural commodities and other food. The price effect of these programs depends on the scale of operation which, in any given year, may be affected by the size of the surplus supply.

Direct Distribution

Direct distribution refers to programs whereby the Federal Government purchases food for distribution to, or donates food to, school-lunch programs, charitable institutions and welfare groups to help needy people. These programs have been discussed in conjunction with the Federal Surplus Commodities Corporation purchases prior to World War II and with price support operations after World War II. Quantity distributed varies each year, depending on the price situation and surplus supply position of the commodity. Distributions under these programs have been made possible by purchases with funds from Section 32 of the Agricultural Act of 1935 and by dispositions of CCC stocks under Section 416 of the Agricultural Act of 1949.[42] Table 40 shows the volume and expenditures on dairy products under Section 32 for direct distribution since 1936. Donations under Section 416 were shown in table 37.

Low-Cost Milk Program

In October 1937 an experimental milk distribution program for needy people was begun in Boston. In this program, which continued until August 7, 1939, the Federal Surplus Commodities Corporation purchased raw milk, paid processing costs of about 2 cents per quart, and distributed the milk free to people on direct relief and other eligibles for 2 cents per quart. Between 1939 and 1942, a relief milk program was in operation in six cities—Boston, Chicago, New Orleans, New York City, St. Louis, and Washington, D. C. The essential elements of the program included (1) farmers receiving a price for milk above surplus milk price but below Class I price; (2) the recipients paying about 5 cents per quart (4 to 6 cents); and (3) the Surplus Marketing Administration paying for the remaining cost of the milk amounting to about 2 cents. Stiebeling, Adelson, and Blake (*127*) in a study of the Washington market and Sullivan (*130*) in a study of the six markets having relief-milk programs found that significant increases in the consumption of fluid milk had occurred among the participants of the program, although the increase included some replacement of evaporated milk. Sullivan (*130*, p. 9) reported increases in consumption as a result of the reduction in price from the going level to the 5-cent-per-quart range varied among cities from 11 to 164 percent, with an average of all markets of 52 percent. In the year beginning July 1, 1941, 140 million pounds of milk were distributed at the cost of 2.4 million dollars under the relief milk program.

[42] For the relation of Section 32 programs with price support programs and food distribution programs, see Section 32 Handbook (*178*).

TABLE 39.—*Civilian disappearance of dairy products: Commercial and non-commercial channels, 1947–56*

(Milk equivalent)

Item and year	Butter			American cheese			Fluid milk and cream			Total dairy products [1]		
	Commercial channels [2]	From CCC supplies or bought with Government funds	Total	Commercial channels	From CCC supplies or bought with Government funds	Total	Commercial channels [2]	School programs [3]	Total	Commercial channels [2]	From CCC supplies or bought with Government funds	Total
Total:	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*
1947	31, 954	----	31, 954	7, 424	20	7, 444	52, 165	435	52, 600	109, 142	455	109, 597
1948	28, 937	----	28, 937	7, 407	120	7, 527	51, 125	475	51, 600	104, 465	595	105, 060
1949	30, 867	100	30, 967	7, 714	170	7, 884	51, 330	570	51, 900	107, 486	840	108, 326
1950	31, 247	1, 020	32, 267	8, 002	250	8, 252	51, 758	642	52, 400	109, 422	1, 912	111, 334
1951	28, 886	----	28, 886	7, 583	170	7, 753	52, 502	698	53, 200	107, 212	868	108, 080
1952	26, 081	----	26, 081	8, 120	140	8, 260	53, 224	776	54, 000	106, 510	916	107, 426
1953	25, 216	1, 100	26, 316	7, 719	230	7, 949	53, 380	820	54, 200	105, 795	2, 150	107, 945
1954	26, 136	1, 860	27, 996	8, 185	620	8, 805	54, 358	942	55, 300	108, 035	3, 422	111, 457
1955	26, 777	2, 300	29, 077	7, 788	900	8, 688	55, 678	1, 422	57, 100	110, 118	4, 622	114, 740
1956 [4]	26, 355	2, 300	28, 655	8, 061	1, 080	9, 141	56, 833	1, 767	58, 600	111, 883	5, 147	117, 030

Per capita:	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
1947	221	--------	221	51	(5)	51	366	3	369	755	3	758
1948	197	--------	197	50	1	51	352	3	355	710	4	714
1949	206	1	207	52	1	53	348	4	352	718	6	724
1950	205	7	212	52	2	54	345	4	349	718	13	731
1951	189	--------	189	50	1	51	347	5	352	700	5	705
1952	168	--------	168	52	1	53	347	5	352	685	6	691
1953	159	7	166	49	1	50	342	5	347	668	14	682
1954	162	12	174	51	4	55	342	6	348	670	21	691
1955	163	14	177	47	6	53	343	9	352	670	28	698
1956 [4]	157	14	171	48	7	55	344	11	355	668	31	699

[1] Includes milk equivalent of all dairy products shown in table 6.
[2] Includes consumption on farms where produced.
[3] See table 38 for breakdown between milk distributed under regular School Lunch and Special School Milk Programs.
[4] Preliminary.
[5] Less than 0.5 pound.

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TABLE 40.—*Dairy products: Volume and expenditures on products handled under Section 32, years beginning July, 1937–55* [1]

Year beginning July	Butter								Direct distribution						Fluid milk						Total	
	Food stamp plan		Direct distribution		Exports		Total		Cheese		Evaporated milk [2]		Nonfat dry milk [3]		Direct distribution		Diversion		Total		Quantity (milk equivalent) [3]	Value [4]
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value		
	1,000 lb.	*1,000 dol.*	*1,000 lb.*	*1,000 dol.*	*1,000 lb.*	*1,000 dol.*	*1,000 lb.*	*1,000 dol.*	*1,000 lb.*	*1,000 dol.*	*1,000 lb.*	*1,000 dol.*	*1,000 lb.*	*1,000 dol.*	*1,000 lb.*	*1,000 dol.*	*1,000 lb.*	*1,000 dol.*	*1,000 lb.*	*1,000 dol.*	*Mil. lb.*	*1,000 dol.*
1936	------	------	357	122	------	------	357	122	------	------	4,350	246	------	------	------	------	------	------	------	------	16	368
1937	------	------	15,030	4,129	------	------	15,030	4,129	3,463	499	------	------	6,471	367	26,870	881	------	------	26,870	881	362	5,876
1938	143	39	122,287	34,704	802	24	123,232	34,768	------	------	3,202	172	13,997	707	131,722	3,349	------	------	131,722	3,349	2,603	38,996
1939	9,588	3,010	31,687	9,408	239	9	41,514	12,427	4,234	642	[2] 67,814	[2] 3,628	[2] 5,006	[2] 347	4,680	146	80,247	693	84,927	841	1,104	17,885
1940	29,154	10,272	6,619	2,075	------	------	35,773	12,347	------	------	4,350	375	2,120	23	------	------	174,935	2,111	174,935	2,111	900	14,856
1941	25,105	10,323	9,041	3,221	------	------	34,146	13,544	5,000	1,250	119,494	9,622	7,300	1,095	------	------	192,085	3,869	192,085	3,869	1,182	29,380
1942	5,872	2,544	1,366	520	------	------	7,238	3,064	1,999	611	(5)	(5)	985	134	------	------	224,586	6,573	224,586	6,573	389	10,383
1943	------	------	------	------	------	------	------	------	------	------	32,340	3,611	------	------	------	------	------	------	------	------	70	3,611
1944	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
1945	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
1946	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
1947	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
1948	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
1949	------	------	19,128	12,751	------	------	19,128	12,751	------	------	------	------	13,747	1,823	------	------	------	------	------	------	------	1,823
1950	------	------	------	------	------	------	------	------	------	------	------	------	12,069	2,792	------	------	------	------	------	------	383	15,543
1951	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
1952	------	------	23,292	16,673	------	------	23,292	16,673	1,808	716	------	------	20,764	4,175	------	------	------	------	------	------	------	4,175
1953	------	------	84,136	58,289	------	------	84,136	58,289	54,486	21,891	------	------	20,959	4,387	------	------	------	------	------	------	484	21,776
1954	------	------	[6] 170	[6] 170	------	------	[6] 170	[6] 170	------	[6] 154	------	------	35,732	6,941	------	------	------	------	------	------	2,228	87,121
1955 [7]	------	------	75,588	45,416	------	------	75,588	45,416	57,270	22,214	------	------	56,432	10,849	------	------	------	------	------	------	2,084	[6] 423 78,479

[1] Section 32 of the Agricultural Act of August 24, 1935, as later amended, authorized the Secretary of Agriculture to use an amount equal to 30 percent of the annual custom receipts to encourage the exportations of agricultural commodities and the products thereof and to encourage domestic consumption of such commodities by diverting them from normal channels of trade or increasing their use among persons in low-income groups.

[2] Includes the following exports in 1940: 1,911 thousand pounds of evaporated milk valued at 111 thousand dollars and 25 thousand pounds of nonfat dry milk valued at 2 thousand dollars.

[3] Fat-solids basis.

[4] Computed from unrounded figures.

[5] Value less than 500 dollars.

[6] Transportation costs on prior-year purchases.

[7] Preliminary.

Compiled from records of the operating agencies of the U. S. Department of Agriculture.

Table 40 shows the quantities and expenditures under Section 32 for the combined relief milk and penny school milk programs.

Penny School Milk Program

The school milk program was started on an experimental basis in May 1940 and was merged with the school lunch program in 1943. In the year beginning July 1, 1941, about 52 million pounds of milk were distributed under this program at the cost of 1.5 million dollars from Section 32 funds. The expenditures in 1943 amounted to 4.5 million dollars. In the operation of this program, the local agency (school) made agreements with the local dairy and the Agricultural Marketing Administration. AMS reimbursed the local agency in an amount equal to cost of Class I unprocessed milk. The local agency assumed handling costs and distributed the milk at a cost to school children of not more than a penny a half pint.

Food Stamp Plan

The food stamp plan,[43] which was started in May 1939 and discontinued in February 1943, was a Federal subsidy that provided additional foods to low-income families. These families were given free blue stamps to be used for the purchase of specified surplus foods on condition that they buy a certain quantity of orange-colored stamps that could be used for the purchase of any food. Butter was the only dairy product listed as a surplus food eligible for the program and was designated as such in 35 of the 46 months of the operation of the program. The program operated under Section 32 of the 1935 Act with specific authorization made each year by Congress in its appropriation acts (See table 40).

National School Lunch Program

The national school lunch program, which was authorized under the National School Lunch Act of 1946, is a grant-in-aid type of program that is administered by the State departments of education. Individual schools are reimbursed through State agencies by the Federal Government for a part of the cost of food used in the service of meals that meet nutritional standards established by the Department of Agriculture. The local agency plans the meal, but each meal must include whole milk if a suitable supply is available.

From its first year of operation through 1955, the quantity of milk consumed under the regular school lunch program has increased yearly. (See tables 38 and 39.) In 1955, milk consumption under this program amounted to about 6 pounds per person or 2 percent of total fluid milk consumption. Milk used for school lunches is purchased from local dairies. These purchases, as well as other cash food purchases including dairy products by the local agency, may be looked upon as a relatively stable component of the aggregate demand for milk. Thus, from the standpoint of price analysis, they should be considered as a regular continuing demand created by the school lunch program and treated as any other institutional purchase.

[43] For a detailed economic analysis of the Food Stamp Plan see Gold, Hoffman, and Waugh (59).

On the other hand, local agencies may receive substantial quantities of dairy products that may vary each year, depending on the size of surplus supply. These include quantities received under Sections 32 and 416, mentioned earlier. In addition, Section 6 of the National School Lunch Act provides that some of the annual appropriation may be used by the Department of Agriculture to purchase food for distribution to participating schools. Because donations of dairy products represent, in effect, a cash value to the schools, receipt of these dairy products may affect the pattern of normal purchases. For example, donations of cheese may replace purchases of some meat and donations of butter may replace other fats. These donations also may replace purchases of the same commodity that local agencies would normally have bought in local markets; to that extent they would not be considered a net increase to the regular demand created by the school lunch program (discussed in the preceding paragraph). Program regulations provide that schools will not reduce total food expenditures as a result of donations. Although there may be some substitution of the nature discussed above, the receipt of donated food has made it possible for schools to serve better meals without increasing the price of the meal to the child.

Special (School) Milk Program

The Agricultural Act of 1954 provides that the Commodity Credit Corporation use some of its own funds to increase consumption of milk in schools. Under this Act, the Department of Agriculture in September 1954 established a special school milk program which is designed to increase consumption of milk in schools. The Agricultural Act of 1956 extended the program for 2 more years through the 1957–58 school year, and increased the authorization 50 percent to 75 million dollars. In addition, the eligibility was broadened to include nonprofit child-care institutions such as settlement houses, summer camps, child-care centers, and similar institutions. Currently, the amount of reimbursement provided by the Federal Government depends upon the cost of milk to the school or child-care institution, the proposed selling price to children, and the cost of handling milk within the school or institution. The Department of Agriculture has also established the maximum amounts that may be paid. Schools serving type A or B meals under the national school milk program may receive up to 4 cents reimbursement for each half pint served in excess of the first half pint in a type A or B lunch. All other schools and all child-care institutions may receive up to 3 cents reimbursement for each half pint of milk they serve to children under the program. Under this program, consumption in schools increased from 3 pounds per person in 1955 to about 5 pounds in 1956, or about 1 and 2 percent of the total fluid consumption, respectively. (See tables 38 and 39.)

Other Fluid Milk Programs

The Agricultural Act of 1954 amended Section 201 (e) of the Agricultural Act of 1949 so that the Commodity Credit Corporation could make available to military agencies and Veterans Administration, without charge except for packaging costs, milk and dairy products

acquired under the price support program for use by them in addition to their normal market purchases. Under this legislation, the Commodity Credit Corporation reimburses these agencies for a substantial part of the cost of additional milk purchased and used by them. This program, as in the case of the special school milk program, is aimed at utilizing some of the milk that otherwise would go into dairy products and be sold to CCC under the price support program.

RELATIONS AMONG FARM, WHOLESALE, AND RETAIL PRICES

As previously noted (see p. 113), a demand schedule is matched by a supply schedule at each stage of the marketing chain at which milk or dairy products change ownership. Conceptually, behavior equations (both for supply and demand) could be constructed for each such transfer and estimates obtained for the coefficients of these relationships. Because a lack of data normally prevents a complete analysis, simplifying assumptions must be made to quantify the important relationships. This section states the hypotheses needed, and develops economic relations to convert results obtained from supply-demand analyses at one level of the marketing chain for application to another marketing level. A complete analysis of marketing margins is not included.[44]

Analysts have used two hypotheses in this connection:[45] (1) That farm and retail prices are related by either (a) certain fixed charges that represent costs of hauling, processing, and distribution of milk and dairy products or (b) certain percentage markups such as might occur at retail stores in the sale of dairy products; and (2) that, on an annual average basis, all marketing margins change directly with costs of marketing. Each of these hypotheses assigns a passive role to the marketing system—that of transmitting retail consumer demand to farmers in a simple way. These hypotheses also imply that demand relationships should be measured at the final consumption level—either wholesale or retail, as was done in this study for dairy products. The relation between farm and retail demand then can be measured by a simple regression equation.[46]

The hypothesis that wholesalers and distributors use percentage markups implies a downward sloping curve for these services as a fall in retail price associated with increased marketings would lead to a decrease in marketing charges. The second hypothesis implies a per-

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[44] A detailed analysis of the nature and composition of marketing margins for dairy products is given by Howe (*70*). Considerable interest exists in the spread between what the consumer pays and what the farmer receives for his milk as witnessed by the numerous investigatio.. and analyses conducted by the United States Congress, Federal Trade Commission, and Federal and State Governments in this area (*151*, *163*, *164*, *167*, *171*, *172*, *173*, *174*, *175*, *176*, *191*).

[45] See Fox (*50*, p. 18).

[46] Because farm and retail prices are determined simultaneously, the limited information method should be used to obtain coefficients that are statistically unbiased for market-price relationships, as for example relations (22), (23), and (24) on page 85. However, we feel that results from a least squares regression analysis provide an adequate measure of the relationship between prices at different marketing levels if only an understanding of the nature and degree of association is desired.

fectly horizontal supply curve for marketing services within the relevant range of quantities of dairy products marketed, since it assumes that the unit cost of these services essentially is determined by factors outside the dairy marketing sector. A third hypothesis also is possible; it assumes that retailers tend to maintain constant retail prices in the short run, even though procurement costs and costs of marketing may change. In an analysis of prices in Baltimore for 1949–50, McCallister (*86*, p. 6) found that retail prices for butter in Baltimore held steady for long periods of time, even though wholesale prices changed. A fourth hypothesis is that the marketing charge varies with the volume moving through the market. Under the latter, we normally expect marketing charges to be larger with larger marketings, as this results in a larger demand for marketing services, given a relatively fixed supply of these services. From a cost side, the higher charges might reflect overtime payments to labor, increased costs due to use of obsolete equipment, and similar items.

Alternatively, the farm demand for milk can be assumed to equal the sum of the individual retail demands for fluid milk and dairy products minus the charges for marketing services, with charges for these services depending on their supply curve for each product.

This section tests the application of the first two hypotheses to the dairy marketing system.

MARKETING MARGINS

Trends in Marketing Margins

Table 41 shows the margin for the aggregate and selected dairy products expressed in absolute terms and as a percentage of retail costs for the period between World Wars I and II and the post-World War II period, and for the years 1922–53, excluding 1930–33. On the average, around 50 percent of the total retail cost to consumers for all dairy products went toward payment of marketing charges in the interwar period. This percentage was reduced slightly in the early postwar period. Although marketing margins for individual dairy products exhibit somewhat similar trends over time, at any given time, considerable variations occur among the products. When each margin is expressed as a percentage of total retail cost, about a third of the retail cost of butter represents a marketing charge. For cheese, this proportion is two-fifths; for fluid milk, one-half; and for evaporated milk, somewhat larger than one-half. Smaller percentages are obtained if the years 1930–33 are omitted.

Constancy in the marketing margin when expressed as a percentage of retail cost, if it existed, would reflect, in part, (1) use of constant percentage markups or (2), after allowing for year-to-year variation and trends over time, a tendency on the part of dairy product prices and dairy marketing charges to change proportionately in the long run. It also would suggest that reasonably good relationships between retail and farm prices could be obtained if statistical relationships were fitted with each variable converted to logarithms.

If marketing margins are determined chiefly by costs outside the dairy marketing system, and if index numbers of wholesale prices of all commodities reflect these marketing costs then the marketing margin when deflated by index numbers of wholesale prices would

TABLE 41.—*Specified dairy products: Marketing margins expressed in absolute terms and as a percentage of retail costs, selected averages, 1922–53* [1]

ABSOLUTE MARGIN

Item	Unit	Average		
		1924–41	1946–53	1922–29 and 1934–53
Actual:				
Milk:				
Fluid per quart [2]	Cent	7.0	9.9	8.0
Evaporated per 14½-ounce can	do	5.1	6.6	5.5
Butter per pound	do	15.5	22.6	17.8
American cheese per pound	do	14.4	[3] 23.3	[3] 16.8
All dairy products [4] [5]	Dollar	36.2	81.2	50.2
Deflated, 1935–39 dollars: [6]				
Milk:				
Fluid per quart [2]	Cent	6.8	5.1	6.0
Evaporated per 14½-ounce can	do	4.9	3.4	4.2
Butter per pound	do	14.7	11.6	13.2
American cheese per pound	do	13.8	[3] 12.1	[3] 12.5
All dairy products [4] [5]	Dollar	34.8	35.6	41.5

ACTUAL MARGIN AS A PERCENTAGE OF RETAIL COST

Milk:				
Fluid	Percent	58.1	48.1	53.8
Evaporated	do	61.0	48.5	55.0
Butter	do	37.5	29.0	32.4
American cheese	do	49.3	[3] 40.0	[3] 43.2
All dairy products [5]	do	50.3	47.1	47.9

[1] Based on data from Been (*5*) and Marketing and Transportation Situation (*155*).
[2] Includes fluid milk marketed through wholesale channels only.
[3] The year 1953 is omitted.
[4] Average annual purchases by a family of 3 average consumers.
[5] All dairy products includes other items not listed.
[6] Actual margin divided by Bureau of Labor Statistics index number of wholesale prices of all commodities.

remain unchanged after allowing for changes in technology over time. Figure 11 shows marketing margins for fluid milk, butter, American cheese, and evaporated milk that have been deflated in this way.

The deflated marketing margin for fluid milk in the period following World War II does not differ significantly from that in the 1920's, but it is significantly lower than in the 1930's. The relatively high margin on a deflated basis in the 1930's reflects, in part, the slow downward adjustment in freight rates and distribution charges as

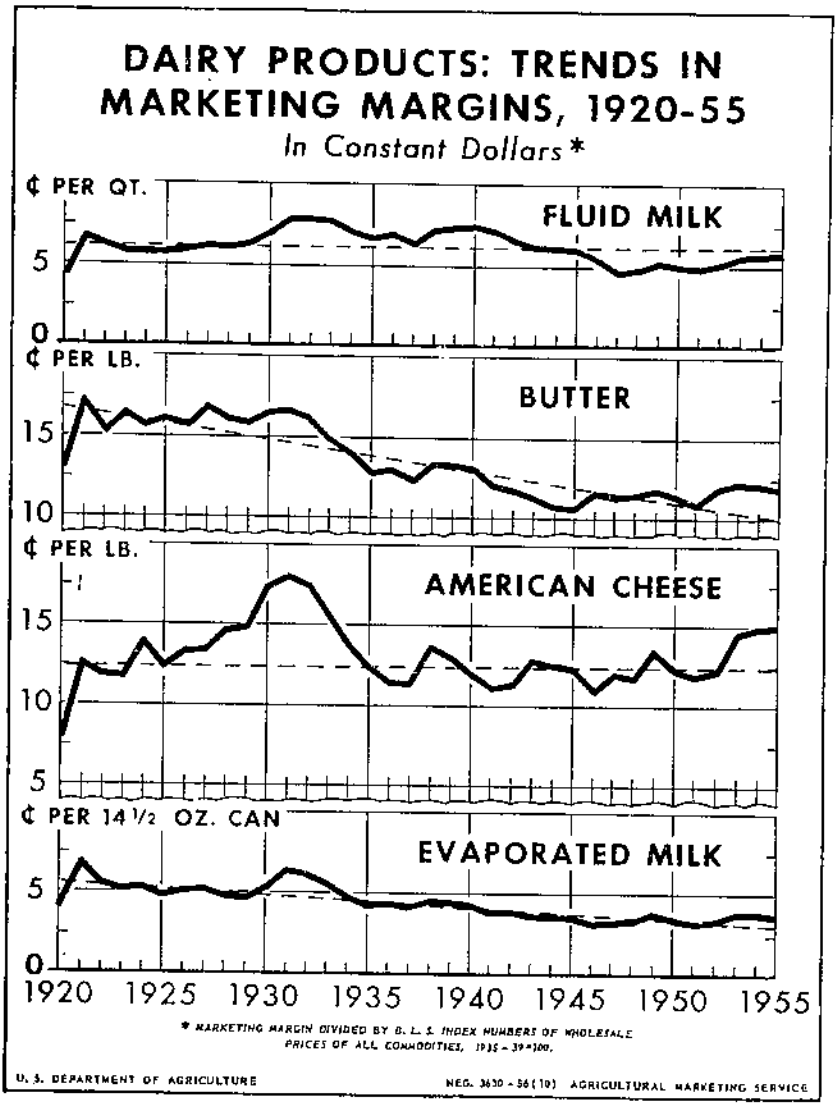


FIGURE 11.—Except during the early 1930's, marketing margins (in constant dollars) for dairy products show little year-to-year variation. American cheese has tended to fluctuate about a stable level, while margins for both butter and evaporated milk trended downward until the post-World War II period, following which they tended to rise somewhat. Decreases in marketing margins stem from increased size of manufacturing plants, vertical integration within the marketing system, savings in distribution costs through national chain stores and supermarkets, increased competition of substitutes such as margarine, and other cost-reducing changes in the marketing system. The relatively high margins in the early 1930's reflect the well-known tendency for changes in marketing margins to lag behind price adjustments, particularly in periods of falling prices.

compared with the sharp drop in prices of commodities.[47] The relatively low margin in the period following World War II also reflects, in part, changes in marketing services performed from that in the 1930's. According to a study by the Bureau of Labor Statistics (*159*) based on 56 cities, 30 percent of the milk for home consumption was sold through stores in 1935 as compared to 45 percent in 1948; this shift resulted in lower aggregate distribution costs. Improved roads and methods of hauling, such as the recent introduction of bulk tank pickup, have reduced costs of hauling milk from farm to plant. Increased competition between tank trucks and rail tanks used to ship milk and, in many instances, replacement of rail shipments by truck shipments have tended to reduce the cost of transportation.

Marketing margins (in deflated terms) for cheese and evaporated milk also were relatively high in the early 1930's. In contrast, the margin for butter adjusted more rapidly to the lower price. If the early 1930's are excluded, the margin for cheese has fluctuated about a uniform level. On the other hand, the margin for both butter and evaporated milk trended downward after 1921, apparently leveled off in the period immediately following World War II, and has tended to increase some in recent years. Reductions in margins (in constant dollars) for butter and evaporated milk probably stem from several causes: (1) An increase in the average size of manufacturing plants and creameries (see p. 115); (2) vertical integration within the marketing system whereby large chain stores and meat packing firms have taken over some of the functions performed formerly by independent wholesalers and distributors (see p. 117); (3) increased markets for nonfat dried milk powder, which have permitted the shift of some costs to dried milk, whereas butter carried the full cost in the earlier years; (4) increased competition from margarine, which has tended to reduce margins at retail; (5) the advent of chain stores and self-service supermarkets, with a resulting reduction in distribution costs; and, (6) for evaporated milk, the increasing importance of private brands of national chain stores and supermarkets, which has tended to lower margins in two ways—(a) the private brands always have sold for less and (b) their competitive position in relation to national brands has improved. Some of these factors probably tended to reduce margins for cheese also, but their effects on the margin apparently were offset by other factors; hence no reductions were observable.

The small increase in deflated marketing margins in the last few years may reflect in part that (1) there may have been lags in adjustment to falling farm prices and (2) the BLS index of wholesale prices of all commodities, which is used as the deflator, did not increase as much as some costs of food marketing, namely unit labor costs. Unit labor costs in marketing of food products increased to 26 percent above the 1947–49 average in 1955, while the BLS index of wholesale prices of all commodities increased only 11 percent. In

[47] For example, on the basis of data from Cassels (*24*, p. 252, table 24), Sonley (*128*, pp. 48–49, tables 1 and 2) and the Boston Milk Market Administrator (*15*, p. 5) the cost of shipping milk by rail tank car to Boston from the 201–210 mile zone was 26.7 cents per hundredweight from July 1, 1939, to March 31, 1942, as compared to 47.0 cents as late as August 31, 1932. In contrast, the low point in the index number of wholesale prices occurred in 1932.

addition, the deflated margin for fluid milk may have an upward bias because the retail prices used to compute the margin do not reflect changes in marketing practices that have occurred in recent years. (See Smith and Herrmann (*121*).) These prices refer mainly to sales of fluid milk in single-quart containers and do not cover sales in gallon jugs; whereas, discounts and sale of milk in multiple-quart containers and in gallon jugs at lower prices per quart have become increasingly important. Based on data from the Fluid Milk and Cream Report (*149*), over two-thirds of the markets reporting provided savings or discounts to consumers for milk delivered to homes and sold through stores in quantities exceeding a quart per delivery or sale in early 1956 compared with one-fifth for home-delivered milk and one-seventh for milk at stores in 1950. Based on 18 markets for a recent period, Olson (*98*, p. 14) reports that sales of milk in multiple-quart containers varied from 1 to 75 percent of all milk sold in these markets, although quart containers still were used for more than half of the milk in 11 of the 18 markets. In the case of cheese, the abrupt increase in the deflated margin in the 1950's probably also reflects a shift from a margin computed from price data for natural cheese to a margin based on price data for processed cheese.

Olson (*98*, pp. 14–16) studied the effect of quantity discounts on prices in 120 markets. Price differentials between home-delivered and milk at stores were allowed in 68 of the markets. In 50 of these 68 markets the price per quart to consumers who bought four or more quarts at a time averaged 1.5 cents lower for home-delivered milk and 1.3 cents lower for milk at stores than to consumers who bought a single quart per purchase.[18] However, the savings may not be as large as these comparisons suggest because the single-quart price averaged 0.8 cent higher for home-delivered milk and 0.4 cent higher for store milk in these markets than in the 18 markets which had no provision for quantity discounts. Higher prices on a single-quart basis are expected when a differential is allowed, as the prices with no differential reflect average costs for all volumes. Olson (*98*, p. 17) also found that in 21 markets for which prices of milk in gallon jugs were reported in November 1955, the gallon price (per quart) was 2.5 cents lower for home-delivered milk, and 2.3 cents lower for milk at stores, than milk sold in single-quart containers.

Variability in Marketing Margins

Choice of a suitable hypothesis in regard to the behavior of marketing margins for dairy products can be made from a study of variability in marketing margins. Data in table 42 provide the needed information for testing the alternative hypotheses.

Lack of variability in marketing margins when expressed in dollar values indicates that a simple regression equation can be used to relate farm and retail prices; the constant term in the equation reflects the margin. To test this hypothesis, coefficients of varia-

[18] The principle that milk delivered to homes should be priced inversely with the number of quarts delivered per stop is commonly referred to as the "Elwell Plan," first introduced by Elwell in the mid-1940's. For a discussion of quantity discount pricing of fluid milk, see Christensen and Moore (*27*), and Heimberger and Koller (*63*).

TABLE 42.—*Specified dairy products: Coefficients of variability and standard deviations for marketing margins expressed in specified terms, selected averages, 1922–53* [1]

Average and item	Coefficient of variability when margin is expressed in absolute terms [2]		Standard deviation when margin is expressed as a percentage of—	
	Actual	Deflated [3]	The previous year	Retail cost
1924–41:	*Percent*	*Percent*	*Percent*	*Percent*
Milk:				
Fluid [4]	5.9	10.7	4.3	3.0
Evaporated	14.0	14.1	4.8	5.4
Butter	20.8	11.4	6.4	4.0
American cheese	16.8	15.4	7.5	6.2
All dairy products [5]	9.2	7.5	4.4	2.8
1946–53:				
Milk:				
Fluid [4]	12.7	6.2	4.4	2.0
Evaporated	15.3	8.0	11.5	5.3
Butter	11.4	3.5	7.1	2.8
American cheese [5]	14.3	6.3	11.5	4.3
All dairy products [6]	13.5	5.5	5.5	3.1
1922–29 and 1934–53:				
Milk:				
Fluid [4]	17.6	27.7	3.8	5.0
Evaporated	20.9	[7] 6.5	8.0	7.9
Butter	24.2	[7] 6.4	7.6	5.3
American cheese [5]	27.7	7.1	9.4	5.5
All dairy products [5]	41.6	11.7	[8] 10.2	3.1

[1] Based on data from Been (*5*) and Marketing and Transportation Situation (*165*).

[2] Standard deviation divided by average value of the margin for the years included in the analysis.

[3] Marketing margin divided by Bureau of Labor Statistics index of wholesale prices.

[4] Marketed through wholesale channels only.

[5] Includes items not listed.

[6] The year 1953 is omitted.

[7] Standard deviation around trend line divided by average value of the margin for years included in the analysis.

[8] If the years 1946 and 1947 are omitted from the analysis, the coefficient of variability is reduced to 3.7 percent; coefficients of variability for individual products except fluid milk also are reduced.

bility—standard deviation divided by the average value of the margin for the years included in the analysis—were computed to measure variability in the margins.

When coefficients of variability were obtained for marketing margins which were expressed in current dollars, only fluid milk during the period between World Wars I and II substantiates this

hypothesis. The fluid milk margin varied less than 12 percent from the average value of the margin during this period in 19 out of 20 times.

On the other hand, when the marketing margin is deflated by index numbers of the wholesale price of all commodities, the coefficient of variability is reduced considerably for American cheese, butter, and evaporated milk in some analyses. If the years 1930–33 are excluded, and if the data for butter and evaporated milk are adjusted for trend, the coefficients of variability become 7 percent for the first named and 6 percent for the latter two commodities. This suggests that regression analyses relating farm and retail prices should include a variable reflecting marketing costs. The coefficients of variability are lower for the post-World War II period than for the prewar period because of the unusually large margin in the early 1930's. Thus, simple regressions relating farm and retail prices which are based on deflated data should give substantially better results for butter, American cheese, and evaporated milk than those obtained from analyses based on data in current dollars.

Lack of variability in deflated margins also indicates that prices of factors used in dairy marketing are determined outside the dairy marketing system, assuming index numbers of wholesale prices of all commodities reflect these marketing charges. Thus, when analyses relating farm and retail prices are based on data expressed in current dollars, the regression should include an index of marketing charges as an additional explanatory variable. This appears to be true for butter, American cheese, and evaporated milk in each of the three periods of analysis.

A reasonably good fit of the retail-farm price relationship can be obtained using regressions based on data in logarithms if marketing margins reflect (1) use of constant percentage markups and/or (2) costs of marketing that parallel dairy prices over time. To substantiate this hypothesis, marketing margins for dairy products were expressed as a percentage of total retail costs, and standard deviations were computed to measure variability of these percentages. It was found that deviations from the average percentage value during each of the three periods of analysis of less than 4 percentage points for fluid milk to less than 16 percentage points for evaporated milk would be expected in 19 out of 20 times.

Year-to-year variations are considerably smaller for fluid milk than for the other dairy products. For example, if direction of change is ignored, the fluid milk margin varied less than 9 percent from one year to the next in 19 out of 20 times in each of the three periods of analysis. Under these circumstances, a simple relationship in first differences of logarithms is adequate to measure the retail-farm price relationship.

STATISTICAL ANALYSES OF RELATIONSHIPS BETWEEN FARM, WHOLESALE, AND RETAIL PRICES

This section provides statistical analyses which can be used to transform prices that pertain to one level of the marketing chain into prices that apply at another level. By making use of these relations, for example, demand coefficients obtained from an analysis fitted

statistically at the retail level can be converted directly into coefficients which apply at the farm level. The analyses in this section relate prices between the following marketing levels: (1) retail and farm, (2) wholesale and retail, and (3) wholesale and farm.

Farm-Retail Price Equations

If a passive role can be assigned to the marketing system, the relationship between retail prices (P_r) and farm prices (P_f) may be expressed by the equation:

$$P_f = P_r - C_m \tag{64}$$

where C_m represents marketing costs or the gross difference between retail and farm prices. Such a relationship might seem to imply that supplies of dairy products are equated with demand at the retail level, and prices at the farm are the residual left after marketing costs are deducted from the equilibrium retail price. But, in fact, inference as to the direction of dependence cannot be drawn from such an equation because retail and farm prices are interrelated, even though at times the farm price may appear to behave as a residual.

If retailers and wholesalers consistently use constant absolute margins, coefficients can be obtained statistically for the retail-farm relation:

$$P_r = a + k\ b\ P_f \tag{65}$$

where the constant value "a" equals the marketing costs (C_m), the value "k" corrects for differences in (1) product densities of the finished processed dairy product and (2) raw milk used in making the product, and "b" equals 1. On the other hand, if retailers and wholesalers apply a constant percentage markup to the cost of their goods sold, the "a" value becomes zero and the coefficient "b" is greater than 1 depending on the percentage markup. For example, a value of 1.25 for "b" means that a markup of 25 percent is used.

Actual marketing charges may, in fact, be determined somewhere between a constant and a percentage markup. A fixed percentage markup tends to bring substantial profits to marketing firms when prices rise sharply relative to marketing costs, but the use of a markup of this type when prices rise sharply may be prevented by two factors: (1) Competition between existing dairy marketing firms and the potential and actual entry of new firms and (2) hesitancy on the part of retailers to raise prices considerably at any single time for fear of curtailing sales sharply. When prices decline sharply, a constant percentage markup reduces the revenue of marketing firms. For these reasons, a curvilinear relationship probably exists between farm and retail prices which can be expressed approximately by the equation:

$$P_r = b\ P_f^{\,c} \tag{66}$$

where the exponent "c" is less than 1. The logarithmic form of this relationship, which can be fitted by the least squares method, reads:

$$\text{Log } P_r = \log b + c \log P_f \tag{67}$$

If "c" equals 1, the relationship becomes the same as that mentioned under constant percentage markups; therefore, analyses based on logarithms also can be used if dairy marketing firms use constant percentage markups.

Table 43 shows certain statistical relationships between farm and retail prices for milk and dairy products obtained from analyses based on first differences of logarithms for the period between World Wars I and II and that following World War II. Farm prices for creamery milk reflect the value of milk used in making both butter and nonfat dry milk. Because prices available for nonfat dry milk are wholesale prices, the coefficients in the regression equation for creamery milk are derived by algebraic linkage of two regressions: (1) Farm price for creamery milk upon wholesale prices of butter and nonfat dry milk and (2) wholesale price of butter upon retail price of butter.[49] Coefficients of determination have been reduced and the standard errors increased to allow for residual errors in both equations.

Prices received by farmers for all milk, for milk for fluid use, for butterfat, and for milk used by plants making butter and nonfat dry milk solids are associated with 92 to 98 percent of the changes in the corresponding retail prices. However, only 79 percent of the variation in prices received by farmers for milk sold to condenseries and cheese factories is associated with variation in the corresponding retail prices of evaporated milk and cheese. For the postwar period, the degree of association remained the same for butterfat but was reduced as much as 10 percentage points for milk for fluid use. Some of the unex-

[49] Coefficients obtained by algebraic linkage of two regressions: (1) Farm price for creamery milk, X_0, upon wholesale price of butter, X_1, and nonfat dry milk, X_2 (average of prices for both human and animal use):

Based on data for 1927–41

$$X_0' = 0.0056 + \underset{(0.05)}{1.02}\, X_1 + \underset{(0.04)}{0.13}\, X_2$$

$R^2_{0.12} = 0.98 \qquad s_{0.12} = 0.01 \qquad b_{10.2} = 0.94$

Based on data for 1947–53

$$X_0' = -0.0039 + \underset{(0.19)}{0.80}\, X_1 + \underset{(0.10)}{0.40}\, X_2$$

$R^2_{0.12} = 0.94 \qquad s_{0.12} = 0.02 \qquad b_{10.2} = 1.02$

(2) Wholesale price of butter, X_0, upon retail price of butter, X_1:

Based on data for 1923–41

$$X_0' = 0.00007 + \underset{(0.04)}{1.17}\, X_1$$

$R^2_{0.12} = 0.98 \qquad s_{0.1} = 0.01 \qquad b_{10} = 0.84$

Based on data for 1947–53

$$X_0' = -0.0039 + \underset{(0.03)}{1.10}\, X_1$$

$R^2_{0.12} = 0.99 \qquad s_{0.1} = 0.003 \qquad b_{10} = 0.91$

NOTE.—Numbers in parentheses below the regression coefficients are their respective standard errors.

TABLE 43.—*Milk and butterfat: Relationships between year-to-year changes in price received by farmers and the corresponding retail price, 1923–41 and 1947–53*

Period and item	Coefficient of determination [1]	Constant or intercept value	Effect on price received by farmers of 1-percent change in—				Net effect on retail price of 1-percent change in farm price [4]
			Corresponding retail price [2]		Other factor		
			Net effect [3]	Standard error	Net effect [3]	Standard error	
			Percent	*Percent*	*Percent*	*Percent*	*Percent*
1923–41:							
Milk for—							
Fluid use [5]	0.92	−0.0005	1.61	0.12	------	------	0.57
Cheese [6]	.79	.0051	1.76	.22	------	------	.45
Condenseries [5]	.79	.0140	2.13	.27	------	------	.37
Creameries [6]	.96	.0057	[7] 1.19	.08	[7] 0.13	0.04	[7] .79
All at wholesale [5 8]	.97	−.0017	1.62	.08	------	------	.60
Butterfat [5]	.98	.0037	1.34	.05	------	------	.73
1947–53:							
Milk for—							
Fluid use [5]	.82	−.0095	1.35	.28	------	------	.61
Cheese [6]	.76	−.0276	1.63	.41	------	------	.47
Condenseries [5]	.73	−.0281	1.57	.43	------	------	.46
Creameries [6]	.93	−.0070	[7] .88	.38	[7] .40	.10	[7] .93
All at wholesale [5 8]	.87	−.0194	1.60	.27	------	------	.55
Butterfat [5]	.98	−.0079	1.32	.09	------	------	.74

[1] Percentage of total year-to-year variation in farm prices that was associated with the combined effect of the other variables.

[2] Index numbers of retail prices of all dairy products from Bureau of Labor Statistics. Retail prices for other items from Agricultural Marketing Service.

[3] Regression coefficient from analyses based on first differences of logarithms. Farm and retail prices are interrelated. Regression analysis is used to show association and not cause and effect.

[4] Regression coefficient from analyses with retail price dependent. (See note 3.)

[5] Agricultural Marketing Service. The analysis for all milk at wholesale based on 1925–41.

[6] Average price for Wisconsin from Agricultural Marketing Service and Wisconsin Crop and Livestock Reporting Service.

[7] Coefficients derived by algebraic linkage of two regressions. See text.

[8] All at wholesale includes other items not listed.

plained variations in these analyses may come from differences in the weighting and construction of the respective farm and retail price series. Another factor is the use of average retail prices for the entire country. The retail price includes average transportation costs which

may affect different areas differently from year to year; this has the effect of changing the marketing margin. Changes in stocks in both reported and unreported positions may be explanatory factors. For evaporated milk, the structure of the marketing system also may be involved. For American cheese, differences in retail prices may result because cheese is usually packaged in several ways, and because of degree of aging, since cheese increases in value with age; these factors at least partly explain the low correlation for cheese.

Prices received by farmers for milk and butterfat fluctuate more than do retail prices of the products marketed. Butter has the smallest percentage relationship between farm and retail price changes. This results because butter has the smallest marketing margin (table 41, p. 118) and, probably, because percentage markups are used in some segments of the butter marketing system. For example, the analysis based on first differences of logarithms for the period 1947–53 shows that a 1-percent change in the price of milk at Wisconsin creameries was associated with a 0.9-percent change in the retail price of butter after allowing for the effects of changes in the price of nonfat dry milk. Equal percentage changes in prices at both farm and retail levels of the marketing chain indicate that dairy marketing firms use percentage markups.

In contrast to the short-run relationships between prices indicated by the first difference analyses, the regression analyses based on actual data show the average long-run relationships between farm prices and retail prices (table 44). These regressions also test hypothesis 2, postulated on page 179, that a horizontal supply curve for marketing services exists within the range of quantities marketed. Specifically, this means that prices of factors used in marketing affect costs of marketing dairy products but the volume of dairy marketings does not appreciably affect the price paid by firms for factors used in dairy marketing. Therefore, the regression analyses shown in table 44 include the Bureau of Labor Statistics index numbers of wholesale prices of all commodities as a variable reflecting changes in dairy marketing costs. The results of these analyses appear to verify the assumed hypothesis in the case of butter, American cheese, and evaporated milk because (1) coefficients that differ from zero by a statistically significant amount were obtained for the net effect on farm prices of wholesale prices of all commodities and (2) a 1-cent change in the retail price was associated with approximately a 1-cent change in the farm price. As expected from figure 11, page 182, the regression analyses show that the average reduction in the margin over the entire period was close to 0.4 cent per year for butter and 0.1 cent per year for evaporated milk. The reduction for butter, however, is sharper than the 0.2 cent suggested by figure 11.

Retail-Wholesale Price Equations

Wholesale prices in central markets play a key role in equating supply and demand for each of the manufactured dairy products. Table 45 presents results obtained from regression analyses which relate year-to-year changes in retail prices with year-to-year variations in wholesale prices for butter, cheese, and evaporated milk based on data in first differences of logarithms. Variations in wholesale prices

TABLE 44.—*Milk used in specified way: Effect on price received per hundredweight by farmers of changes in corresponding retail prices and other factors, 1922–53 excluding 1930–33* [1]

Item	Unit	Milk for—			
		Fluid use [2]	Cheese [3]	Condenseries	Creameries
Coefficient of determination [4]		0.98	0.98	0.96	0.99
Constant or intercept value		−3.03	−.92	−1.89	−3.04
Effect on price received by farmers of a unit change in—					
Corresponding retail price: [5]					
Net effect	Cent	.78	.95	1.06	.99
Standard error	do	.13	.07	.10	.03
Coefficient of partial determination.		.39	.89	.81	.97
Wholesale price of all commodities: [6]					
Net effect	Cent	[7] −.02	−.21	−.08	−.27
Standard error	do	.06	.05	.02	.03
Coefficient of partial determination.		.04	.49	.56	.75
Time, 1922=1:					
Net effect	Cent	[7] −.02	[7] .07	.12	.36
Standard error	do	.06	.05	.02	.04
Coefficient of partial determination.		.02	.09	.71	.78
Net effect on corresponding retail price of a 1-cent change in price received by farmers.	Cent	.75	.93	.77	.98

[1] Analyses based on data from Been (*5*) and Marketing and Transportation Situation (*155*). Includes adjustment for Government payments to producers for 1943–46.

[2] Marketed through wholesale channels only.

[3] The year 1953 is omitted in this analysis.

[4] Percentage of total variation in farm prices that was associated with the combined effect of the other variables.

[5] Fluid milk per quart, American cheese per pound, evaporated milk per 14½-ounce can, and butter per pound, each in cents.

[6] Index numbers from Bureau of Labor Statistics. Used as an indicator of changes in marketing costs.

[7] Does not differ significantly from zero when tested at the 5-percent probability level.

are associated with 98 to 99 percent of the yearly variation in the retail price of butter, and 93 to 92 percent for the retail price of evaporated milk, but only 77 to 84 percent for the retail price of American cheese during the periods before and after World War II, respectively. As discussed earlier, retail prices of American cheese in any given period vary because cheese is usually packaged in several ways and may be in different stages of aging. These variations would reduce the correlation between retail and wholesale prices for American cheese. The analyses also show that, on the average, a 1-percent change in the wholesale price of the product concerned is followed by as little as a 0.5 percent change in the retail price in the case of cheese to as much as 0.9 percent in the case of butter. As explained on page

TABLE 45.—*Dairy products: Relationships between year-to-year changes in retail price and wholesale price, 1923–41 and 1947–53*

Period and commodity	Coefficient of determination	Constant or intercept value	Effect on retail price of 1-percent change in wholesale price [1]	
			Net effect [2]	Standard error
1923–41:			*Percent*	*Percent*
American cheese	0.77	−0.0018	0.51	0.07
Evaporated milk	.93	−.0041	.78	.05
Butter	.98	−.0001	.84	.03
1947–53:				
American cheese	.84	.0148	.53	.10
Evaporated milk	.92	.0055	.80	.10
Butter	.99	.0035	.91	.02

[1] Wholesale and retail prices from Agricultural Marketing Service. Specific wholesale prices used were: Creamery butter, Grade A (92-score), at Chicago; American cheese at Plymouth, Wisconsin; and United States average manufacturers' selling price for evaporated milk.

[2] Regression coefficients from analyses based on first differences of logarithms. Wholesale and retail prices are interrelated. Regression analysis is used to show association and not cause and effect.

190, had coefficients of 1 percent been obtained, we would have concluded that distributors and retailers use fixed percentage markups. Since these coefficients are less than 1 percent, it appears reasonable to assume that the other hypotheses, discussed on p. 179, regarding the behavior of distributors and retailers also influenced the relationship between retail and wholesale prices.

Farm-Wholesale Price Equations

At any time, the wholesale price of a processed dairy product to the owner of a manufacturing plant appears to be given, that is, determined by factors outside his control. This price minus transportation costs determines the price he receives for the dairy product at the plant; the price he is able to pay the farmer for the equivalent quantity of whole milk delivered to his plant is determined by subtracting costs of manufacture, including profit, from his price for the processed product. Although each plant owner acting individually has no perceptible effect on wholesale prices, their behavior in the aggregate does influence the level of prices. The supply of and demand for the processed dairy product determine wholesale prices, and competition among plant owners for the supply of milk in the area affects the price paid farmers for whole milk at plants in that area. Therefore, these two prices are interdependent. However, as in relating prices at the other marketing levels, simple regression analysis is used here to approximate the relationship between wholesale and farm prices.

Table 46 presents results obtained from regression analyses that relate yearly variations in the price received by Wisconsin farmers for

butterfat and for whole milk at creameries, and for whole milk at cheese factories and condenseries, with yearly variations in the wholesale price of the corresponding processed dairy product. These regressions are based on data expressed as first differences of actual values rather than first differences of logarithms, because plant owners are believed to translate changes in wholesale prices directly in terms of changes in the value of the equivalent quantity of milk used to manufacture the dairy product.

For example, the analyses show that, on a year-to-year basis, a 1-cent change in the price per pound of butter at Chicago is accompanied by an average change of 4.6 and 4.0 cents per hundredweight in the price received by farmers for whole milk at Wisconsin creameries during the periods before and after World War II, respectively, after allowing for changes in the wholesale price of nonfat dry milk. In

TABLE 46.—*Milk and butterfat: Relationship between year-to-year changes in price received by farmers and wholesale price of processed dairy products, 1923–41 and 1947–53*

Period and commodity	Coefficient of determination [1]	Constant or intercept value	Effect on price received by farmers of 1-cent change in—			
			Corresponding wholesale price [2]		Other factor	
			Net effect [3]	Standard error	Net effect [3]	Standard error
1923–41:			*Cents*	*Cents*	*Cents*	*Cents*
Milk for—						
Cheese [4]	0.98	0.736	10.15	0.32		
Condenseries [5]	.88	.022	.38	.03		
Creameries [4]	.98	1.424	4.60	.31	[6] 2.57	0.99
Butterfat [5]	.96	.197	1.03	.05		
1947–53:						
Milk for—						
Cheese [4]	.98	−3.084	10.65	.69		
Condenseries [5]	.94	−.162	.38	.04		
Creameries [4]	.94	−3.002	4.03	.96	[6] 11.05	2.60
Butterfat [5]	.97	−.493	1.25	.09		

[1] Percentage of total year-to-year variation in farm price associated with the combined effects of the other variables.

[2] Agricultural Marketing Service. United States average manufacturers' selling prices for evaporated milk, cents per 100 pounds; American cheese at Plymouth, Wisconsin, cents per pound; creamery butter, Grade A (92-score) at Chicago, cents per pound.

[3] Regression coefficients from analyses based on first differences of logarithms. Farm and wholesale prices are interrelated. Regression analysis is used to show association and not cause and effect.

[4] Average price for Wisconsin from Agricultural Marketing Service and Wisconsin Crop and Livestock Reporting Service.

[5] United States average price for condensery milk, cents per 100 pounds, and for butterfat, cents per pound, Agricultural Marketing Service.

[6] Wholesale price of nonfat dry milk (average of prices for both human and animal use), cents per pound. This analysis based on 1927–41 for the inter-war period.

the same analyses, the net effect of a 1-cent change in the wholesale price of nonfat dry milk solids on the price per hundredweight of milk at Wisconsin creameries increased from 2.6 cents in the prewar period to 11.0 cents in the postwar period. As expected, this increased effect coincided with the growth of the commercial market for nonfat dry milk solids resulting from efforts during World War II to increase the consumption of all solids in milk.[50] This was accompanied by a shift on the part of farmers from selling farm-separated cream to selling whole milk.

Wilcox, Krause and Brereton (*190*, p. 43) point out that Wisconsin farmers tended to ship whole milk to butter plants even before World War II; the milk was skimmed and the skim milk returned to the farmer or shipped to other manufacturing plants. Of the total milk and cream delivered to all Wisconsin plants, farmers sold less than 2 percent of their milk as farm-separated cream following World War II, compared with about one-fourth in the mid-1930's and two-fifths in the mid-1920's. Most of the sales of farm-separated cream are used in making butter. Based on the percentage utilization of milk, it is estimated that currently about 5 percent of the creamery butter in Wisconsin is made from farm-separated cream, compared with probably as high as three-fourths in the mid-1930's, and practically all in the mid-1920's.

Similar comparisons as to the average relationship between yearly changes in the wholesale price of the processed dairy product and the farm price for milk can be made for the other dairy products from the data shown in table 46. If we assume that plant operators consider the average yield of product from a given quantity of milk and that they pass on to the farmer all price changes at the wholesale level, assuming no change in manufacturing costs, the equivalent change in the farm price for milk or butterfat following a 1-cent change in the wholesale price is estimated in table 47.

These values are reasonably close to the coefficients in table 46 relating farm prices to wholesale prices. Therefore, operators of manufacturing plants appear to pass on to farmers practically all changes in the wholesale price. As this passive role played by plant operators is discussed here in the pricing of farm milk, it was discussed in the pricing of butter on page 115, and of cheese on page 116. Action of this sort is further substantiated by the fact that yearly changes in wholesale prices are associated with at least 94 percent of the variation in the farm price, except in the case of evaporated milk during the prewar period, when the percentage was 88.

The constant values in the regression analyses suggest that marketing margins decreased on the average during the prewar period but have been increasing in the post-World War II period. In terms of equivalent value per hundredweight of milk, the constant values suggest that the wholesale-farm marketing margin increased 21, 22, and 113 cents from 1946 to 1953 for butter, cheese, and evaporated milk, respectively, compared with an actual increase in these margins of 18 and 119 cents for butter and evaporated milk, respectively, for the same period, and 26 cents for cheese from 1950 to 1953. A comparable period cannot be used for cheese because price data for natural

[50] See footnote 7, p. 28.

TABLE 47.—*Milk and butterfat: Effect on price received by farmers of a 1-cent change in the wholesale price of specified dairy products if plant operators pass on to farmers all changes in the wholesale price* [1]

Product	Effect on price received by farmers for—	
	Milk, per hundredweight	Butterfat, per pound
Wholesale price per pound:	*Cents*	*Cents*
American cheese, Plymouth, Wisconsin	9.6	----------
Evaporated milk [2]	.47	----------
Butter, Grade A (92-score), Chicago	4.7	1.24
Nonfat dry milk [2]	8.5	----------

[1] These values represent the pounds of butter, nonfat dry milk solids, cheese, and evaporated milk that can be made from a hundredweight of milk, and the pounds of butter from a pound of butterfat. In so far as possible, they are based on yields applicable to the geographic area covered by the farm price. Values for butter and cheese are based on a simple average of the annual quantities of milk needed to manufacture each in Wisconsin during the period 1933–43 as reported by Gilbert (*68*, table 35, p. 57 and table 37, p. 58), and during 1949–50 for American cheese, as reported by Hintzman and Wilcox (*68*, table 2, p. 7). These averages were 21.5 and 10.4 pounds for butter and cheese, respectively. Hintzman and Wilcox (*68*, table 12, p. 22) also report that 1.242 and 1.235 pounds of butter were made from a pound of butterfat in Wisconsin in 1949 and 1950, respectively. The value for evaporated milk is based on the average quantity of milk used in its production as reported by the Agricultural Marketing Service (*158*). A yield of 8.5 pounds for nonfat dry milk is a composite of the following: 8.892 reported by Froker and Hardin (*55*, table 1, p. 4), 8.2 by March (*82*, p. 52), 8.488 by Pritchard (*104*, table 1, p. 7), and 8.28 by Walker and others (*184*, p. 25). All of these were for milk containing 4 percent butterfat except in the study by March, in which 3.5 percent was used. Milk delivered to Wisconsin creameries has averaged around 3.8 percent fat since 1933. [See Caparoon (*23*, table 9, p. 27) and Wilcox and Hintzman (*189*, table 1, p. 2).]

[2] United States average manufacturers' selling price. Nonfat dry milk includes both human and animal use.

cheese are available through 1952 only. Beginning with June 1949, price data for processed cheese are available.

RETAIL PRICES OF INDIVIDUAL DAIRY PRODUCTS

Relations Among Retail Prices

As explained on p. 69, individual dairy products at the same marketing level are equivalently priced. Measurable differences in retail prices of the several dairy products stem from a variety of sources, the principal ones being the following:

1.—Price differences may reflect differences in the marketing services performed for each commodity. For example, fluid milk and cream frequently are delivered to the homes of consumers, whereas most manufactured products are purchased chiefly in stores. On the other hand, manufacturers perform a marketing service, in a sense, by transforming milk into butter, cheese, ice cream, or other products,

whereas fluid milk, though processed (clarified, pasteurized, and homogenized), is sold in essentially the same form in which it is produced.

2.—Price differences may reflect differences in the densities of each dairy product, since prices are usually quoted on the basis of product weight. For example, 100 pounds of whole milk will make about 10 pounds of cheese, or 5 pounds of butter, or 8 pounds of nonfat dry milk powder. If there were no marketing or processing charges, and if milk were valued at $4 per 100 pounds, the corresponding price of cheese would be 40 cents a pound, assuming no market value for cheese whey. If the price of nonfat dry milk powder were 15 cents a pound, the corresponding price of butter would be 56 cents a pound. If differences in price were caused only by differences in densities, year-to-year changes in the prices of individual products would be proportional. Thus, if the price of whole milk were increased by 10 percent, prices of each of the individual dairy products would increase by 10 percent, assuming that yield factors remain constant over time, a condition that appears to be approximately true.

3.—Differences in prices may reflect differences in the quality of milk required for use in the product. For example, producers who ship milk for resale to consumers as fluid milk usually receive a higher price than farmers who produce milk to be used primarily for manufactured products; as milk for fluid use is subject to rigid sanitation requirements it usually costs more to produce.

Factors That Affect Retail Prices

Results from Statistical Analyses.—Price information is important in decisions made by firms and households. Such decisions in the short run, and particularly day-to-day decisions of dairy farmers and marketing firms, to a large extent are based on past, current, and future expectations of prices of products and costs of producing or handling them. In earlier sections, in conjunction with the structural analyses, estimates of coefficients were obtained for retail price-estimating equations assuming linear relationships in actual data (see pp. 84, 86, 102, 104). To facilitate comparisons among products, estimates of coefficients for retail-price regressions based on first differences of logarithms are shown in this section.

Results of three sets of regression analyses for each of the dairy products are given in table 48. Two sets of analyses show the effect on retail prices of year-to-year changes in disappearance of total milk and in disposable personal income for the periods 1925–41 and 1947–54. A third set of regressions for the period since World War II also includes the effect of the price of margarine, which takes into account the possible effect of the fats and oils economy on the dairy industry.

Although estimates in the analyses for the period following World War II are based on data for a relatively short period, observed differences in the estimates obtained for the prewar and postwar regressions give some insight as to changes which probably have occurred in the price structure. Comparison of coefficients in identical regressions for the two periods shows: (1) The percentage of variation in the price of butter that resulted from a one-percent change in income increased in the postwar period as compared to the prewar period after allowing for changes in supply; (2) the net effect of in-

come on prices of evaporated milk and cheese remained about the same in both periods; (3) the net effect of income on price of fluid milk was reduced to almost zero in the postwar period; and (4) after allowing for *both* the effect of the price of margarine and total disappearance of milk, the effect of income on prices in the postwar analysis becomes practically zero for all dairy products except butter.

The partial correlation coefficients in table 48 indicate that year-to-year changes in disposable personal income alone explain most of the variation in prices of individual dairy products during the interwar period. This reflects the large variation in consumer income that took place during these years and the relatively small year-to-year variations in total disappearance or consumption of dairy products. However, for years in which the change in disappearance is large relative to that for consumer income, the price-estimating equation which allows for both factors would be expected to give considerably better results than would one based on changes in income alone. The percentage variation in prices explained by changes in disappearance of milk increased during the postwar period while that explained by income was reduced considerably, reflecting the increased variability of supply and the reduced variability of income during this period.

Comparison of regressions for the postwar and prewar periods also reveals substantial differences in variation in price resulting from changes in supply or disappearance of total milk. The percentage variation in prices of fluid milk and evaporated milk resulting from a 1-percent variation in disappearance of total milk increased from less than 1 percent during the prewar period to more than 2 percent during the period following World War II. The increased use of formula pricing in fluid markets probably encourages quicker adjustments in prices to changes in supply (see p. 144). However, the percentage variation in the price of butter following a 1-percent change in supply was reduced in the postwar period. This reduction in price response may be due to the operation of the price support program.

As expected, the coefficients of multiple determination for the analyses following World War II increase substantially when the price of margarine is included as a variable in the regression equation to take into account the substitution effect between margarine and butter. In addition, the standard errors of the regression coefficients involving the price of margarine were relatively smaller than the standard errors associated with the income coefficients. A 1-percent change in the price of margarine resulted in changes of 0.2–0.3 percent in the price of butter, American cheese, and evaporated milk compared with a change of 0.1 percent in the price of fluid milk and cream. The price of margarine would be expected to influence prices of manufactured dairy products more than prices of fluid milk and cream.

Differences in Variation in Prices Resulting from Changes in the Supply of Total Milk.—Theoretically, the price flexibility in relation to the disappearance of total milk should be equal for all dairy products. Price flexibility is defined as the percentage variation in price associated with a 1-percent change in supply or disappearance. At the farm level, the price of milk should be equal in all outlets after adjusting for locational or quality differentials; thus, the price flexibility coefficients at this level should be equal in all outlets. A num-

TABLE 48.—*Selected dairy products: Factors affecting year-to-year changes in retail price, 1925–41 and 1947–54* [1]

ANALYSES SHOWING EFFECT OF SUPPLY AND INCOME ON PRICE

Item	Unit	Fluid milk and cream	Butter	American cheese	Evaporated milk
Analyses based on 1925–41:					
Coefficient of multiple determination		0.89	0.93	0.92	0.88
Standard error of estimate		.011	.016	.013	.012
Constant term or intercept value		−.0002	−.0072	−.0055	−.0085
Effect on price of a 1-percent change in—					
Disappearance of all milk [2]					
Net effect [3]	Percent	[4].72	−2.59	−2.02	[4]−.69
Standard error	do	.43	.60	.49	.45
Coefficient of partial determination		.17	.57	.55	.14
Disposable income [5]					
Net effect [3]	Percent	.55	.92	.69	.56
Standard error	do	.05	.08	.06	.06
Coefficient of partial determination		.87	.91	.90	.87
Analyses based on 1947–53:					
Coefficient of multiple determination		.79	.66	.65	.77
Standard error of estimate		.045	.092	.076	.067
Constant term or intercept value		.0026	−.0314	−.0047	−.0122
Effect on price of a 1-percent change in—					
Disappearance of all milk [2]					
Net effect [3]	Percent	−2.29	−1.73	−2.13	−2.79
Standard error	do	.75	1.52	1.26	1.12
Coefficient of partial determination		.65	.20	.36	.56
Disposable income [5]					
Net effect [3]	Percent	.02	1.31	.50	.40
Standard error	do	.53	1.08	.89	.79
Coefficient of partial determination		.00	.23	.06	.05

ANALYSES SHOWING EFFECT OF SUPPLY, INCOME AND PRICE OF MARGARINE ON PRICE

Analyses based on 1947—54:					
Coefficient of multiple determination		0. 90	0. 82	0. 94	0. 94
Standard error of estimate		. 013	. 026	. 013	. 013
Constant term or intercept value		. 0071	—. 0226	. 0048	—. 0042
Effect on price of a 1-percent change in—					
Disappearance of all milk [2]					
Net effect [3]	Percent	−2. 19	[4]−1. 53	−1. 92	−2. 61
Standard error	do	. 59	1. 33	. 59	. 63
Disposable income: [5]					
Net effect [3]	Percent	[4]−. 22	[4]. 83	[4]−. 01	[4]−. 03
Standard error	do	. 44	. 91	. 44	. 46
Retail price of margarine:					
Net effect [3]	Percent	[6]. 13	[4]. 25	. 27	. 23
Standard error	do	. 06	. 13	. 06	. 07

[1] Retail prices from Agricultural Marketing Service. Index numbers of prices for fluid milk and cream (both analyses) and for butter (pre-war analysis only) applicable to quantities consumed in farm households and by all nonfarm people, computed by Agricultural Marketing Service.

[2] Estimates of per capita consumption or disappearance from Agricultural Marketing Service.

[3] Regression coefficients from analyses based on first differences of logarithms.

[4] Coefficient does not differ significantly from zero at the 10-percent probability level.

[5] Per capita estimates of disposable personal income from Agricultural Marketing Service and Department of Commerce.

[6] Coefficient differs significantly from zero when tested at the 10-percent probability level but not at the 5-percent level.

ber of factors, outlined below, determine whether these price flexibilities also are equal at retail.

The analytical results shown in table 48 suggest substantial differences in the price flexibility coefficients at retail. For example, the coefficients in table 48 indicate that a 1-percent change in the disappearance of total milk, after allowing for changes in income, result in price variations in the opposite direction of 2.6 percent for butter, 2.0 percent for American cheese, and 0.7 percent for fluid milk and cream and evaporated milk during the interwar period.

Consistency between the price flexibility coefficients associated with total milk supply and those associated with their own consumption would not be expected. Price flexibilities of individual dairy products in relation to their own consumption are the inverse of their individual elasticities of demand with respect to price. These are known to differ among the several products.

If processors, wholesalers, and retailers use percentage markups as a basis for establishing charges for their marketing services from the time milk leaves the farm until it is consumed, then year-to-year variations in prices in percentage terms for selected dairy products in relation to a 1-percent change in the total supply of milk theoretically should be alike for all products, even at the retail level. On the other hand, if marketing costs tend to be stable in relation to dairy product prices, year-to-year variations in retail prices will tend to be associated with like variations in prices at the farm level in absolute terms. Under these circumstances, price flexibility coefficients will be smaller at the retail level than at the farm. Previous comparisons of variability in marketing margins for individual dairy products, and comparisons of coefficients obtained from analyses relating farm, wholesale, and retail prices, have indicated that some combination of constant and percentage markup probably was used for most of the dairy products (see p. 184 and tables 42–46). It was indicated from the analyses that percentage markups probably were used for butter.

Differences in the price flexibility coefficients between the farm and retail level also are affected by the size of the marketing margin, with larger margins resulting in lower price flexibility coefficients at retail. Marketing margins as a percentage of retail price are considerably larger for fluid milk and cream and for evaporated milk than for butter and cheese (see table 41, p. 181).

Differences in price flexibility coefficients also may result from varying degrees of responsiveness within the marketing structure to changes in basic supply and demand conditions. For example, price plans used in many fluid milk markets may result in slower adjustments to changed conditions than does the open market pricing of butter and cheese.

GEOGRAPHIC PRICE STRUCTURE

The analysis of geographic price relationships in this bulletin is limited to (1) a discussion of the nature of the relationships normally expected among regions and (2) a statistical description of the pre-

vailing geographic relationships that exist among prices of selected dairy products.[51]

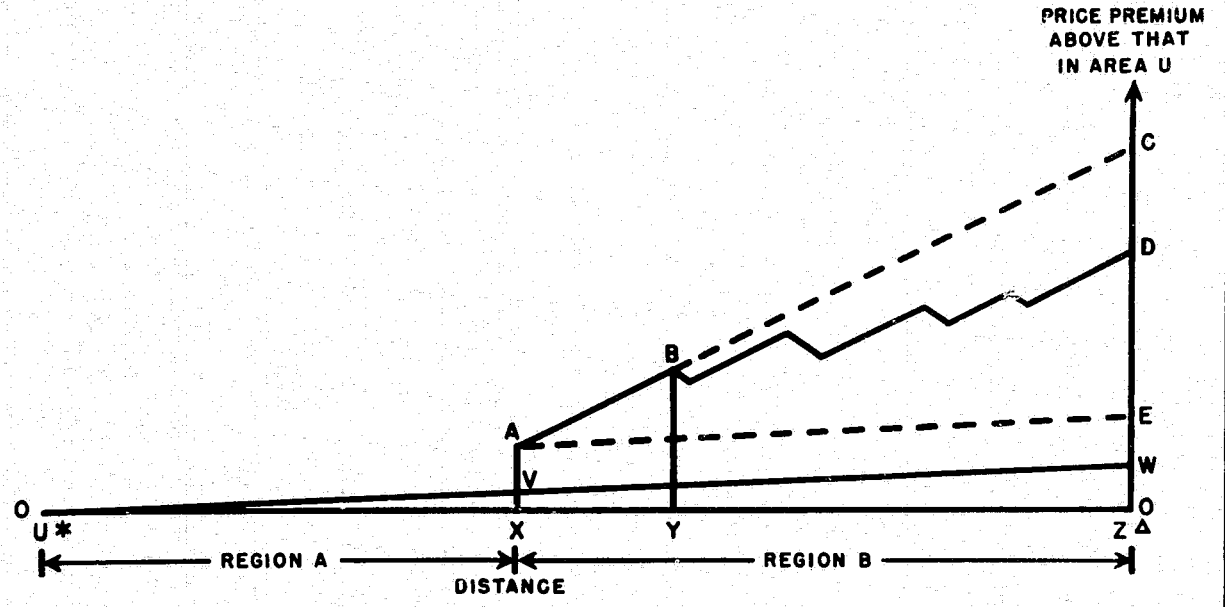
NATURE OF REGIONAL RELATIONSHIPS

Prices for fluid milk and processed dairy products in a single isolated consuming center surrounded by a single milk producing area are first examined to provide insight as to the nature of regional relationships that would normally be expected under competitive conditions. Prices of each product are determined by the relative supplies and demands for each product in the market. Because the quantity of milk used in making each product must come from the same milk supply or producing area, fluid milk and processed dairy products are equivalently priced under conditions of competitive equilibrium (see p. 69). Differences in product prices, discussed on p. 195, reflect only differences due to quality, marketing services performed, quantity of milk used in making the product, and costs of transporting milk in the different forms. Because of substantial differences in costs of transporting fluid milk and an equivalent quantity of processed dairy products made from milk, prices for milk used in fluid outlets fall more rapidly than do prices for milk used in processed dairy products as we move away from the consuming center into the producing area. As a result, concentrated dairy products can be shipped economically longer distances than fluid milk. Thus, specialized zones of production, such as those described by Cassels (*24*, p. 20), are created, with milk from the nearby area used primarily for fluid outlets and milk in the most distant areas for processed dairy products. Prices in the isolated market are at equilibrium when the total supply of milk in the surrounding producing area equals the demand in all milk outlets, including storage at the prevailing market prices.

When there are several consuming centers and several producing areas and dairy products move among markets, prices in the several markets tend to differ by the amount of transfer costs, the largest of which is the cost of transportation. Prices would be expected to increase with distance by the amount of costs of transportation from areas of surplus production toward large consuming centers or areas of deficits. When regional movement of products occurs, as in the case of manufactured dairy products, prices are said to be determined on a national market, and prices among markets are closely related. This tight relationship is illustrated in figure 12. The most distant producing area is assumed to be located at point U and the most distant con-

[51] For studies concerned with price differences due to location for milk and milk products, see Cassels (*24*), Gaumnitz and Reed (*57*), Hammerberg, Parker and Bressler (*60*), Bredo and Rojko (*18*), and Hassler (*62*) and a report by the Agricultural Marketing Service (*145*). These studies include an analysis of the effect of transportation costs upon area prices and geographical flow of products. In these studies, demands were assumed as given in each of a number of markets, and milk supplies were assumed as given in each of the supply areas. Transportation costs were known from points of production to points of consumption. Supply and demand were equated in each market and equilibrium prices were determined subject to the condition that they were high enough to attract sufficient supplies to meet the demand in each market. Fox (*49*) and Judge (*78*) applied similar assumptions to the spacial analysis of livestock products and eggs, respectively, but explicitly used linear programing techniques for treating the space factor.

MILK IN MANUFACTURING AND FLUID OUTLETS: PRICE PREMIUMS IN SPECIFIED AREAS



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suming center at point Z. The line UXYZ represents the location of many producing areas and consuming centers between the most distant producing area and consuming center. The price of milk used in making manufactured dairy products at consuming center Z tends to be higher than the price at producing area U by the amount WZ, which represents the cost of transporting dairy products from geographic point U to point Z. Likewise, the price premium over that in area U at any other geographic point between points U and Z in both supply and consuming centers can be depicted by the vertical elevation of the price line UVW. Thus, the price at point X tends to be above the price at point U by the amount VX.

On the other hand, prices of fluid milk are closely related among regions only when interregional movement of fluid milk products occurs, or can potentially occur. In many areas, no movement occurs. The determination of fluid milk prices in a single market, assuming a level of prices for manufacturing milk, was discussed on p. 123. When several consuming centers compete with one another for milk from several common producing areas, prices of milk for fluid use in each market may not be directly related to prices of milk for manufacturing outlets. Instead, prices are determined by the supply and demand for fluid milk in the local market and by prices of milk produced primarily for fluid use in competing or nearby markets. Thus, only prices in fluid milk markets located at the edge of large surplus milk producing areas are directly related to manufacturing milk prices. As a result whole regions, as for example the eastern part of the United States, produce milk primarily for fluid use, whereas large areas, such as those found in Wisconsin and Minnesota, produce milk primarily for manufactured dairy products.

The nature of the relationships between two such regions is shown in figure 12 where region A is assumed to produce milk primarily for manufacturing uses and region B for fluid uses. A farmer who is located on the boundary between these two areas at point X is indifferent as to whether he sells milk for the fluid milk market located at point X or in manufacturing outlets, since he receives the same equivalent price in each outlet. Here AV is assumed to be the premium needed to produce milk for fluid use over that for milk sold in manufacturing outlets. If a close relationship existed, the price of milk used in fluid outlets in region B would be represented by the line ABC, which equals the price of milk for fluid use in region A at point X plus the cost of shipping whole milk to any point in region B from point X. If the supply-demand situation in region B is such that interregional shipments are not needed, prices for fluid milk are somewhere below the price line ABC, as for example the jagged line ABD. Prices for milk in fluid outlets in region B cannot exceed prices represented by line ABC, the import point, for any considerable length of time because of inshipments from region A; they cannot go below the price line AE for

FIGURE 12.—In regions like A that produce milk primarily for use in manufactured dairy products, prices increase slowly as production takes place closer to consuming centers. In regions like B that produce milk chiefly for use in fluid milk outlets, prices tend to be above those at the point X, where a producer is indifferent as to the alternative outlet in which he sells, by an amount determined chiefly by local conditions but not exceeding the cost of shipping milk from region A, represented by line ABC.

any length of time because it would then be more profitable to produce milk for manufacturing purposes.

STATISTICAL ANALYSES OF REGIONAL DIFFERENCES

Prevailing regional price relationships are studied in two ways: (1) An analysis of actual price differences between regions or markets and (2) statistical analyses that show the way in which prices for each product are related among regions.

Actual Price Differences

Table 49 shows the amount by which dealers' buying prices of milk used for fluid outlets and manufacturers' selling prices of evaporated milk in specified regions exceed prices in the East North Central region. Similarly, table 50 shows the amount by which wholesale prices of butter and cheese in New York, Philadelphia, and San Francisco exceed prices in Chicago. In each instance, the base price is assumed to represent that in an area of relative surplus. The overall pattern

TABLE 49.—*Evaporated milk and milk for fluid use: Wholesale price differences between specified geographic regions and East North Central Region, 1921–54*

EVAPORATED MILK[1]

Region	Price above that in East North Central Region, specified averages						
	1921–24	1925–29	1930–34	1935–39	1940–44	1945–49	1950–54
	Dol.	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*
New England	0. 37	0. 34	0. 21	0. 11	0. 23	0. 25	0. 18
Middle Atlantic	. 34	. 23	. 16	. 05	. 14	. 14	. 18
South Atlantic	. 53	. 41	. 18	. 05	. 16	. 14	. 23
West North Central	. 16	. 09	. 02	−. 07	. 02	. 07	. 21
South Central	. 55	. 44	. 21	−. 02	. 09	. 11	. 32
North Western	. 16	. 14	. 18	. 02	. 28	. 23	. 51
South Western	. 39	. 23	. 14	−. 09	. 21	. 28	. 48

MILK FOR FLUID USE[2]

New England				0. 87	0. 84	1. 14	1. 40
Middle Atlantic				. 62	. 72	1. 03	1. 42
South Atlantic				. 58	. 69	1. 11	1. 78
West North Central				−. 12	−. 10	−. 03	. 10
East South Central				. 10	. 29	. 59	. 88
West South Central				−. 05	. 09	. 62	1. 41
Mountain				−. 20	−. 33	. 14	1. 05
Pacific				−. 03	. 18	. 29	. 66

[1] Wholesale price per 100 pounds.

[2] Dealers' weighted average buying price per hundredweight (f. o. b. city) for standard grade milk for distribution as milk. Prices not available prior to 1935.

TABLE 50.—*Butter, American cheese and nonfat dry milk: Wholesale price differences between selected central markets and central market in surplus producing area, 1921–54*

BUTTER, GRADE A (92-SCORE)

Central market	Price per pound above base price, specified averages [1]						
	1921–24	1925–29	1930–34	1935–39	1940–44	1945–49	1950–54
	Cents	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
New York	1.3	1.4	1.0	0.9	0.7	0.6	0.7
Philadelphia	1.9	2.3	2.0	1.5	[2] 1.1	1.4	1.9
San Francisco	−1.2	.9	.9	1.5	1.7	2.6	2.6

AMERICAN CHEESE

New York	-------	1.4	1.0	0.8	[3] 0.9	[3] 1.8	1.3
Philadelphia	-------	1.4	1.0	.9	[3] 1.0	[3] 1.2	[4] 1.4
San Francisco	-------	[5] −.5	−.3	.4	.4	1.1	1.1
Chicago [6]	1.8	1.9	1.9	1.8	2.4	4.1	5.3

NONFAT DRY MILK

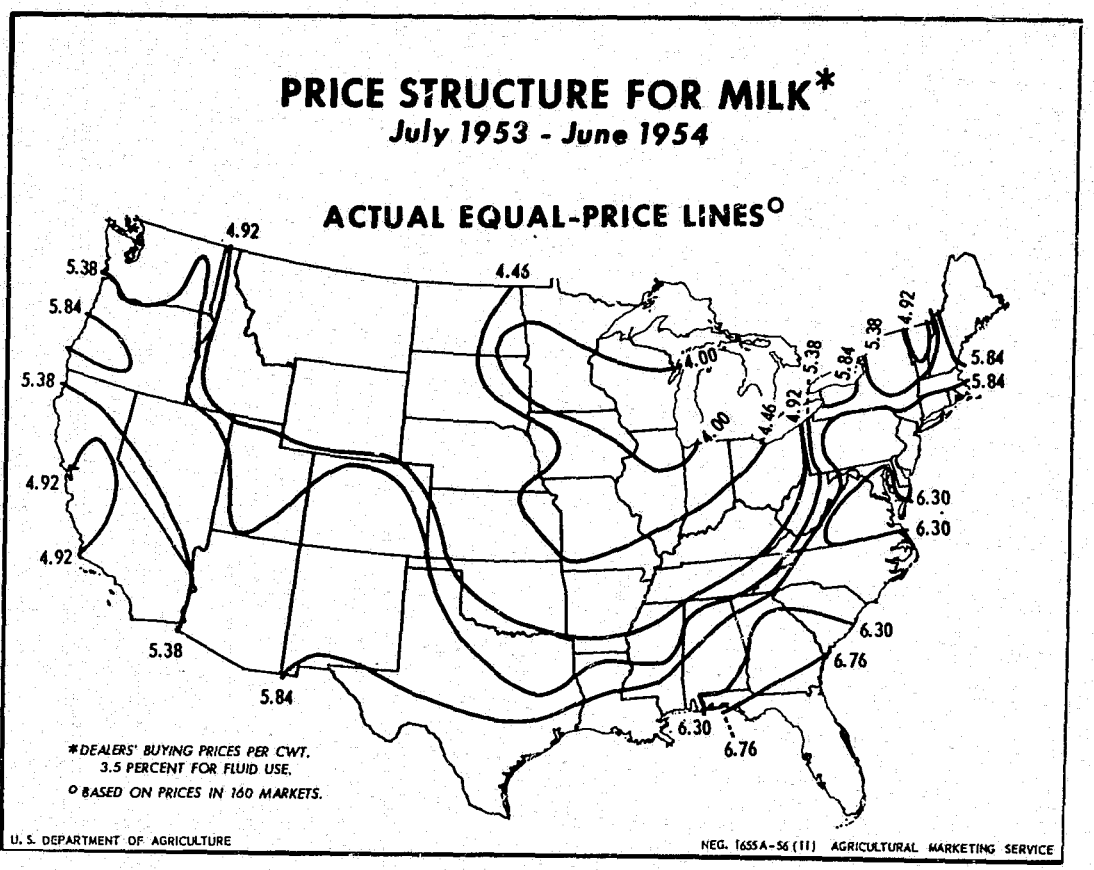
New York	-------	-------	-------	-------	-------	0.4	0.2
San Francisco	-------	-------	-------	-------	-------	.3	.9

[1] Wholesale price per pound at Chicago used as base price.
[2] Three-year average, prices for 1943 and 1944 unavailable.
[3] Three-year average, prices for 1943–46 unavailable.
[4] Average for 1950–53.
[5] Average for 1927–29.
[6] Wholesale price per pound at Plymouth, Wis., used as base price.

suggested by these price differences appears consistent with the regional price pattern indicated in figure 12.

As expected, prices for milk used for fluid outlets exceed prices in the surplus area by the largest amount. Smaller differences occur for evaporated milk, cheese, butter, and nonfat dry milk. For example, during the period 1950–54, prices in the Middle Atlantic region were higher than those in the Midwest by $1.42 and $0.18 per hundredweight for milk in fluid outlets and evaporated milk, respectively. Similarly, during the same period for approximately the same geographic area, prices in New York City were 0.7, 0.2, and 1.3 cents higher for butter, nonfat dry milk and Cheddar cheese, respectively, than they were at Chicago. These price differences when expressed in terms of a hundred pounds of an equivalent quantity of milk used in making each product are 39 cents for evaporated milk, 7 cents for butter and nonfat dry milk combined, and 13 cents for Cheddar cheese.

Similar comparisons of price differences from prices in the main surplus milk producing area could be made for other markets or regions and for other time periods. If prices in any market are closely related to prices in the surplus producing area, prices in these markets


PRICE STRUCTURE FOR MILK*
July 1953 - June 1954
ACTUAL EQUAL-PRICE LINES°
4.92
5.38
5.84
5.38
4.92
4.92
5.38
5.84
4.46
4.00
5.38
5.84
5.38
4.92
5.84
5.84
4.00
4.46
4.92
6.30
6.30
6.30
6.76
6.30
6.76
*DEALERS' BUYING PRICES PER CWT.
3.5 PERCENT FOR FLUID USE.
° BASED ON PRICES IN 160 MARKETS.
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NEG. 1655A-56 (11) AGRICULTURAL MARKETING SERVICE

are expected to increase relative to prices in the surplus area with each increase in the distance of these markets from the surplus producing area. In addition, prices will increase with distance substantially more for bulkier products such as fluid milk than they will for the more concentrated products.

As expected, prices for fluid milk in the several regions in relation to prices in the North Central region reflect the influence of local supplies as well as the potential cost of importing milk from the main surplus producing area of the United States. (See table 49.) Also, as expected, prices in regions located nearer the main surplus producing area are more closely related to prices in the East North Central region than are prices in the regions most distantly located. Prices for fluid milk in the Mountain and Pacific regions are substantially determined by their own supplies and demand for milk, but in recent years may also have been influenced by Midwestern prices of dairy products, or by the price of manufactured dairy products on the national market.

On the other hand, in recent years, prices for fluid milk in markets east of the Rockies appear to follow an overall pattern suggested by transportation costs. A recent study by the Agricultural Marketing Service (*145*, p. 91) relating dealers' buying prices in 143 markets east of the Rockies with the price at Eau Claire, Wis., for the period July 1953 to June 1954 found that the price increased an average of 1.92 cents per hundredweight per 10 miles increase in distance from the point in Wisconsin. The report also stated that rates charged by four large firms for transporting milk by tank truck ranged from 1.75 to 2.00 cents per 10 miles. However, even east of the Rockies, prices in some markets are influenced more by local supply-demand conditions than by prices in the Midwest. For example, during recent years, prices in New England averaged approximately the same as those in the Middle Atlantic region even though the New England States are more distant from the surplus producing area of the Midwest. Price relationships for fluid milk between Boston and New York City, the principal markets in each of these regions, are influenced by conditions in the surplus milk area in upstate New York and Vermont.

The overall pattern of several major supply areas for fluid milk markets is more clearly demonstrated by the price structure for fluid milk for the United States indicated by geographical equal-price lines shown in figure 13, reproduced from the study by the Agricultural Marketing Service previously cited. During the period July 1953–June 1954, geographic low points in prices were found in the Midwest, in upstate New York and Vermont, and on the West Coast.

After allowing for changes in the price level, prices for fluid milk in the northeastern part of the United States appear to have maintained the same relative relation to prices in the Midwest since the mid-1930's.

FIGURE 13.—Normally there is a wide range among regions in the average dealers' buying prices of milk for fluid use. Geographic low points in prices are found in the Midwest, upstate New York, and Vermont, and on the West Coast. These variations in prices reflect comparative natural suitability for production of milk, distances from consuming centers, and differences in institutional requirements under which milk is produced and marketed.

427487—57——14

In all other regions, prices for fluid milk increased relatively more than prices in the East North Central region, indicating an increase in demand relative to milk supplies in these areas. However, prices in the Mountain and Pacific regions still differ by substantially less than the cost of transporting milk between the two regions, indicating that fluid markets in these regions still are determined chiefly by their own supply-demand positions.

Table 49 also shows that manufacturers' selling prices for evaporated milk appear to follow a logical geographical pattern. However, these prices in most regions are higher than prices in the East North Central region by apparently less than the cost of transporting evaporated milk. Further, on the basis of distance, one would expect prices in New England and the Middle Atlantic region to be higher in relation to prices in the East North Central region than were prices in the West North Central region. Lower prices in the northeastern part of the United States probably reflect relative location of condenseries. Condenseries require a large volume of milk to operate efficiently and therefore are usually located in areas of reasonably high density of milk production.

Wholesale prices of butter at New York differ from prices at Chicago by about the cost of transportation, although they probably were slightly above this level before 1940 and somewhat below since then (table 50). Wholesale prices for butter at Philadelphia consistently appear to run higher relative to prices at Chicago than do prices at New York even though these two markets are about the same distance from Chicago. During 1950–54, prices in Philadelphia were 1.2 cents per pound higher than in New York. Price differences in these cities may result from stricter grading requirements in Philadelphia. Sales in small lots may also be a factor.

Wholesale prices of cheese at Philadelphia and New York also differ from prices at Chicago by about the cost of transportation. Any discrepancies between these price differences and actual costs of transportation probably reflect differences in grades of cheese demanded by people in the different cities.

Prior to the mid-1930's, the Mountain and Pacific States were nearly self-sufficient in relation to manufactured dairy products. This explains why wholesale prices of butter and cheese were lower in San Francisco than in Chicago during the early years included in the analysis. Even when the West Coast imports butter and cheese, price differences reflect transportation costs from actual shipping points rather than from Chicago. In the case of butter, the shipping points might be Iowa, Missouri, or Colorado, which are considerably closer than Chicago.

Results from Regression Analyses

Least squares regression analyses were run to relate wholesale prices of butter and cheese in selected markets with prices at Chicago, and to relate wholesale prices of milk for fluid use and evaporated milk in each region with prices in the East North Central region. Logarithmic relationships were assumed to prevail since prices of dairy products and costs of transportation probably change relatively by the same amount over time. The analyses were based on data in (1)

logarithms, to measure the average long-run regional relationship among prices and (2) first differences of logarithms, to determine the average short-run regional price relationships. Results of these analyses are shown in tables 51 and 52.

TABLE 51.—*Relation of prices for evaporated milk and milk for fluid use in geographic regions to region in surplus producing area* [1]

Region	Coefficient of determination	Standard error of estimate	Constant term	Change in price associated with a 1-percent change in basing-point price	
				Net effect	Standard error
EVAPORATED MILK [2]					
Based on data in—					
Logarithms:				*Percent*	*Percent*
New England	0.997	0.007	0.018	0.989	0.009
Middle Atlantic	.997	.007	.010	.997	.010
South Atlantic	.995	.009	.013	.997	.013
West North Central	.998	.006	−.009	1.019	.008
South Central	.992	.011	.007	1.007	.016
North Western	.997	.007	.001	1.016	.010
South Western	.996	.009	−.009	1.033	.012
First differences of logarithms:					
New England	.963	.009	.000	.981	.034
Middle Atlantic	.964	.009	.000	.979	.034
South Atlantic	.970	.008	−.001	.994	.031
West North Central	.968	.009	.000	1.018	.033
South Central	.969	.008	.000	.988	.032
North Western	.957	.009	.000	.938	.036
South Western	.962	.009	.000	.939	.033
MILK FOR FLUID USE [3]					
Based on data in—					
Logarithms:					
New England	0.927	0.034	0.189	0.873	0.056
Middle Atlantic	.957	.029	.121	.976	.047
South Atlantic	.923	.042	.089	1.050	.070
West North Central	.991	.014	−.049	1.081	.023
East South Central	.979	.023	−.017	1.132	.038
West South Central	.952	.042	−.120	1.327	.068
Mountain	.924	.054	−.170	1.344	.089
Pacific	.968	.029	−.045	1.142	.047
First differences of logarithms:					
New England	.519	.021	−.001	1.157	.102
Middle Atlantic	.724	.016	−.003	1.362	.077
South Atlantic	.584	.018	.001	1.366	.085
West North Central	.989	.005	.002	1.038	.023
East South Central	.892	.013	.003	1.170	.063
West South Central	.677	.023	.008	1.018	.108
Mountain	.518	.025	.010	.984	.120
Pacific	.769	.020	.005	1.053	.094

[1] East North Central region used as basing-point price.
[2] Wholesale price per case of 14½-ounce cans. Based on data for 1921–54.
[3] Dealers' weighted average buying price per hundredweight (f. o. b. city) for standard grade milk for distribution as milk. Based on data for 1935–55.

TABLE 52.—*Relation of prices for butter and American cheese at selected central markets to central market in surplus producing area, 1921–54*

BUTTER, GRADE A (92-SCORE)[1]

Central market	Coefficient of determination	Standard error of estimate	Constant term	Change in price associated with a 1-percent change in basing-point price	
				Net effect	Standard error
Based on data in—					
Logarithms:				*Percent*	*Percent*
New York	0.999	0.003	0.052	0.974	0.004
Philadelphia [2]	.999	.006	.082	.961	.006
San Francisco [3]	.998	.009	.032	.992	.010
First differences of logarithms:					
New York	.998	.003	.000	.986	.007
Philadelphia [2]	.998	.003	.000	.970	.009
San Francisco [3]	.970	.012	.001	.971	.035
AMERICAN CHEESE[4]					
Based on data in—					
Logarithms:					
New York [4]	0.999	0.005	0.054	0.977	0.005
Philadelphia [5]	.999	.005	.063	.970	.005
San Francisco [6]	.996	.012	−.036	1.030	.012
Chicago [7]	.996	.011	.065	.989	.011
First differences of logarithms:					
New York [4]	.992	.005	.000	.964	.018
Philadelphia [5]	.993	.005	.000	.992	.018
San Francisco [6]	.962	.013	.000	.984	.039
Chicago [7]	.995	.005	.001	.916	.012

[1] Wholesale price per pound at Chicago used as basing-point price.
[2] Data for 1943 and 1944 unavailable.
[3] Based on data for 1929–54.
[4] Based on data for 1925–54 except 1943–46 which are unavailable.
[5] Based on data for 1925–54 except 1943–46 and 1954 which are unavailable.
[6] Based on data for 1927–54.
[7] Wholesale price per pound at Plymouth, Wis., used as basing-point price.

In the long run, regional prices of all dairy products are closely related. In all the selected markets and regions, 99 percent of the variation in wholesale prices of butter, cheese, and evaporated milk were associated with variations in the corresponding product prices in the surplus milk producing area. Although the degree of association among regional prices was somewhat reduced for milk for fluid uses, regional prices were still closely related in the long run. Variations in prices in the East North Central region were associated with 92 to 99 percent of the average long-run variation in prices in the other regions. As expected, the closest long-run price relationship occurred between the West and East North Central regions.

Results of analyses based on first differences of logarithms also indicated close regional price relationships among processed dairy products in the short run. Ninety-nine percent of the year-to-year variations in wholesale prices of butter and cheese at New York and Philadelphia were associated with year-to-year variations in corresponding product prices at Chicago. For these two products, the percentage of variation in prices at San Francisco associated with yearly changes in prices at Chicago was 96 and 97 percent for cheese and butter, respectively. The percentage of variation in yearly changes in manufacturers' selling prices of evaporated milk in the several regions associated with yearly changes in prices in the East North Central region ranged between 95 and 97 percent.

In contrast to processed dairy products, the percentage of variation in yearly changes in prices of milk for fluid use in the several regions associated with yearly changes in prices of fluid milk in the East North Central region varied considerably. These percentages varied from a low of 52 percent for the Mountain and New England States to a high of 99 percent for the West North Central region. The close year-to-year relationship between prices in the East and West North Central regions reflects the fact that short-run changes in fluid milk prices in markets located in these regions reflect changes in prices of manufactured dairy products which also are closely related among markets. On the other hand, short-run changes in fluid milk prices in other regions are based to a considerable extent on factors other than prices for manufactured dairy products (see p. 143).

PRICE DIFFERENCES IN MARKETS

In any single market, differences in prices for any one dairy item may occur, reflecting grades, quality, and methods of packaging and merchandising. This section illustrates some of these differences in the retail prices of fluid milk and cheese, and the wholesale price of butter

RETAIL PRICES OF FLUID MILK

Several factors cause differences in retail prices of bottled or packaged fluid milk. Method of processing which results in its sale either as raw milk, pasteurized milk, or pasteurized and homogenized milk affects prices. Pasteurized and homogenized milk would be expected to cost more than raw milk because of the added costs of processing. However, in some markets where most of the milk is sold as pasteurized and homogenized, the price of raw milk may be the same or even higher because of the small volume of raw milk handled in the market. A price-raising factor with respect to raw milk in some markets is that additional sanitary restrictions are imposed before granting permission to sell milk in this form. Vitamin fortification of milk usually raises the price by a cent a quart.

The price of milk also varies with the quantity of milkfat present; high fat Jersey or Guernsey milk usually commands some price premium. In addition, in some markets, the same dairy firm may offer milk for sale under several brands. The lower-priced brands usually

contain less butterfat. Prices of the lowest and highest of these competitive brands may differ by as much as 6 cents a quart.

In some markets, milk is sold at stores for as much as 2 cents a quart less than milk delivered to homes, for the same volume. In addition, consumers may effect further savings in some markets when they purchase milk at stores in 2-quart containers or in gallon jugs. Volume per delivery also may affect prices, with savings up to 3 cents a quart when large quantities are taken. In summary, all these factors affect prices differently in each market, depending on local market customs and institutions.

RETAIL PRICES OF CHEESE

Sanders (*115*) describes more than 400 varieties of cheese and lists the names of more than 800 kinds. Retail prices per pound of cheese differ considerably among varieties due to several factors, including differences in fat and nonfat solids content, kind of milk used in making cheese (for example, cow's milk, sheep's milk, etc.), and the special demand factors associated with each kind of cheese. Price differences among varieties of cheese also may reflect the method of processing, shrinkage arising from dehydration, and the time required to age the cheese. If cheese is to be aged, the value must increase enough to cover storage costs. Some cheese foods are lower priced than regular cheese because they include noncheese ingredients which are lower priced than cheese.

Even for the same variety of cheese, price differences in markets may result from the degree of aging, size of package, and methods of packaging and merchandising. Cheese may be prepackaged before reaching the store, prepackaged at the store, or packaged upon sale. Cheese may be sold as processed or natural. An indication of the price differences that can occur are shown in the following tabulation of retail cheese prices per pound for the period April 1954 to March 1956 based on consumer panel data for the United States (*150*):

Cheese:	*Cents*
Natural:	
American	63. 0
Swiss	74. 1
Cream	75. 2
Other	77. 1
Processed:	
Cheese	61. 0
Cheese foods	44. 9
Cheese spreads	51. 5
Cottage	28. 3

In addition to price differences among the domestically produced cheeses (including foreign types), a wide spread in prices also occurs between domestic and imported cheeses. Imported cheeses usually are higher priced than similar domestically produced foreign type cheeses.

WHOLESALE PRICES OF BUTTER

Butter is graded on a score count usually ranging from 89 to 93 or Grades C, B, A, and AA. These grades are based on factors such as taste, color, odor, and salt. As indicated on p. 208, wholesale prices of butter of the same grade may differ among cities because of different grading requirements in the area. Table 53 compares the wholesale price of Grade AA, Grade B, and Grade C butter at Chicago with prices of Grade A butter in that market. In recent years, prices of Grade AA butter tended to be less than a cent per pound greater than prices of Grade A butter, while prices of Grade B and Grade C butter were slightly over 1 and 3 cents lower, respectively. Of interest is that differences between prices of the different grades of butter have become relatively less in recent years. In percentage terms, prices of Grade AA butter were less than 1 percent greater than prices of Grade A butter in recent years compared with close to 3 percent greater in the early 1930's. Similarly, prices of Grade B butter were only 2 percent less, but in the early 1930's they were 5 percent less. A similar pattern can be observed for prices of Grade C butter. As expected, the year-to-year fluctuations in prices of different grades of butter have been closely associated (table 54). Over 99 percent of the variations in prices of butter with different grades were associated with variations in prices of Grade A butter.

TABLE 53.—*Butter: Relation of wholesale prices by grades to prices of Grade A (92-score) at Chicago, 1927–54* [1]

ACTUAL DIFFERENCE

Grade	Price per pound above price for Grade A for average of years					
	1927–29	1930–34	1935–39	1940–44	1945–49	1950–54
	Cents	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
C	−2.8	−2.0	−1.5	[2] −1.5	[2] −3.7	[2] −3.3
B	−1.6	−1.2	−.8	−.7	−1.3	−1.3
AA	(3)	.7	.6	.5	[4] .7	.4

PERCENTAGE DIFFERENCE

	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
C	93.8	92.2	94.9	[2] 95.6	[2] 94.6	[2] 94.9
B	96.5	95.3	97.3	98.1	97.9	98.0
AA	(3)	102.7	102.0	101.3	[4] 101.2	100.6

[1] Based on data from Agricultural Marketing Service.
[2] Data for 1943–47 not available.
[3] Data for 1952 not available.
[4] Data for 1927, 1928 and 1948 not available.

TABLE 54.—*Butter: Relation of year-to-year changes in wholesale prices by grades to prices of Grade A (92-score) at Chicago, 1927–54* [1]

Grade	Coefficient of determination	Standard error of estimate	Constant term	Change in price associated with a 1-cent change in price for Grade A	
				Net effect	Standard error
		Cents	*Cents*	*Cents*	*Cents*
C [2]	0.991	0.572	0.228	1.013	0.023
B	.996	.423	.030	.979	.012
AA [3]	.998	.305	.000	1.008	.010

[1] Based on data from Agricultural Marketing Service.
[2] Data for years 1943–47 and 1952 not available.
[3] Data for 1927, 1928 and 1948 not available.

SEASONAL VARIATION

Seasonal variation in prices of dairy products results from the inbalance between production of milk and consumption of fluid milk and manufactured dairy products month by month throughout the year.

PRODUCTION

Production of milk always has reached a peak in May or June of each year and a low point in November (table 55). In some years, milk production at the annual peak level has exceeded the month of lowest production by 50 percent or more. Table 55 also shows the seasonal variation in production of creamery butter, American cheese, and evaporated milk for the period between World Wars I and II and the period following World War II. Seasonal variation in production of these processed dairy products exceeds the seasonal variation in production of milk because, in areas producing milk primarily for fluid outlets, production of these items is curtailed in times of short supply. Milk sold in the form of fluid milk or other fluid milk products is relatively perishable; thus, the excess of production over demand for milk in fluid form is utilized in processed dairy products which can be stored. On the average, production of American cheese and evaporated milk at peak levels has been about two and a half times the low point in monthly production. The seasonal high in the production of creamery butter averaged close to twice the seasonal low in production.

CONSUMPTION

In contrast to the wide seasonal swings in production of milk and processed dairy products, the swing between seasonal peaks and dips in consumption is relatively small. As stated on p. 125, consumption of fluid milk is at a minimum during June, July, and August when milk supplies are relatively large. Moreover, sales of fluid milk in

TABLE 55.—*Milk and dairy products: Index numbers of seasonal variation in production, 1921–40 and 1947–55* [1]

Period and item	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1921–40:												
Creamery butter	82	78	88	98	132	143	129	113	96	88	75	73
American cheese	66	67	82	98	137	160	140	121	104	94	68	63
Milk:												
Evaporated	76	78	98	115	147	155	127	103	87	82	64	68
All [2]	88	84	97	103	123	127	117	105	94	91	84	87
1947–55:												
Creamery butter	86	84	100	108	136	134	121	107	89	83	72	80
American cheese	72	73	93	111	149	152	131	114	93	80	65	67
Milk:												
Evaporated	71	73	97	115	154	150	128	114	91	78	63	66
All	87	84	101	108	126	125	117	107	94	88	80	83

[1] Average of ratios to 12-month moving average centered, adjusted to total 1,200 and to eliminate abnormal fluctuations.
[2] Averages of period 1929–40.

22 selected Federal order markets in the month of the annual peak level averaged only 6 index points higher than sales in the month of lowest level (table 29, p. 127). Series on monthly consumption of dairy products in the home are not available for any considerable length of time. However, limited information based on data obtained from a national consumer panel for the period April 1954 to March 1956 indicates that seasonal swings in consumption of processed dairy products is considerably less than the wide seasonal swings in the production of these items (table 56). Household purchases of selected dairy products during the quarter of highest purchases exceeded those in the quarter of lowest purchases by the following percentages: 14 percent for butter, 15 percent for American natural cheese, 7 percent for processed cheese, and 4 percent for Swiss cheese. The seasonal differences for some other kinds of cheeses were somewhat higher. However, some contraseasonal pattern among kinds of cheeses is indicated, reflecting substitution among them. The period of analysis is too short to establish the true seasonal pattern but long enough to indicate that the seasonal swings in the direct consumption of processed dairy products is substantially less pronounced than swings in production of these items.

TABLE 56.—*Specified dairy products: Household purchases in each quarter expressed as a percentage of the annual average, April 1954–March 1956*

Product	Jan.–Mar.	Apr.–June	July–Sept.	Oct.–Dec.
	Percent	*Percent*	*Percent*	*Percent*
Butter	104	95	94	107
Nonfat dry milk	111	100	92	97
Cheese:				
Natural:				
American	108	95	94	103
Swiss	102	99	98	101
Cream	115	97	80	108
Other	113	94	85	108
Processed:				
Cheese	101	103	100	96
Cheese foods	91	117	101	91
Cheese spreads	117	94	91	98
Cottage cheese	115	103	93	89

Based on data obtained from a national consumer panel of the Market Research Corporation of America, under contract with the U. S. Department of Agriculture (*160*).

WHOLESALE PRICES

Prices usually are lowest in the months of heaviest production of milk and dairy products, and highest in periods of low production. The swing between seasonal peaks and dips in prices depends on (1) the seasonal inbalance between production and consumption of milk and dairy products, as previously discussed, and (2) the cost of storage.

Table 57 shows the seasonal variation in wholesale prices for specified dairy products for periods between World Wars I and II

TABLE 57.—*Specified dairy products: Index numbers of seasonal variation in wholesale prices, United States and specified markets, 1921–40 and 1947–55* [1]

Period and item	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1921–40:												
Milk:												
Fluid [2]	103	101	100	99	97	96	97	99	100	102	103	103
Evaporated [3]	102	101	100	99	99	99	99	99	99	100	101	102
Condensed [3]	98	97	97	97	97	96	102	102	103	103	104	104
Butter [4]	102	103	102	96	90	91	94	96	102	105	109	110
Cheese [5]	105	103	100	93	92	94	94	99	103	106	105	106
Dry whole milk [3]	103	102	99	98	97	97	98	98	100	102	103	103
Nonfat dry milk [6]	103	101	97	94	94	96	98	101	103	104	104	105
Casein [7]	101	99	97	95	95	98	100	103	104	103	103	102
1947–55:												
Milk:												
Fluid [2]	102	102	100	97	95	95	97	100	101	103	104	104
Evaporated [3]	101	101	101	99	99	99	99	100	100	100	100	101
Butter [4]	102	103	100	97	97	98	99	100	101	99	101	103
Cheese [5]	102	101	99	97	98	98	98	100	100	101	102	104
Dry whole milk [3]	101	101	101	99	101	98	98	99	100	99	100	103
Nonfat dry milk [3]	102	101	99	98	98	98	99	100	100	101	102	102

[1] Average of ratios to 12-month moving average centered, adjusted to total 1,200 and to eliminate abnormal fluctuations.

[2] Dealers' buying prices for standard grade milk for fluid distribution. Simple average of prices at country shipping points for period 1922–41. For period 1947–55, prices are f. o. b. city plant and are weighted by population in individual markets.

[3] United States averages of manufacturers' selling prices. Prices for dry whole milk for 1927–41. Prices for nonfat dry milk are for human food.

[4] Wholesale prices of Grade A (92-score) creamery butter at Chicago.

[5] Wholesale prices of American Cheddar cheese on the Wisconsin Cheese Exchange.

[6] For period 1922–41, human consumption, known brands at New York City.

[7] Average wholesale prices for domestic casein at New York for 1925–40.

and following World War II. The seasonal pattern of prices differs substantially among products. During the period between World Wars I and II, the seasonal index for wholesale prices of butter reached the low point of 90 in May, and the high point of 110 in December. The low point of 92 in the seasonal index for American cheese occurred in May, and the high point of 106 in October and December. In contrast, the index of seasonality of manufacturers' selling prices for evaporated milk ranged only from 99 to 102.

For most of the processed dairy products, seasonal variation in wholesale prices was reduced in the period following World War II compared with the pattern before World War II. In some of the years during the postwar period, market prices of butter and American cheese were about equal to purchase prices of the Commodity Credit Corporation under the price support program (table 33, p. 160). Beginning with 1950, these purchase prices did not vary seasonally in any given marketing year. Market prices of nonfat dry milk also have been at support levels since 1949. Because of the close relationship among prices of manufactured dairy products, the seasonal variation in prices of other dairy products also has been reduced in the period following World War II.

In contrast to processed dairy products, the seasonal variation in dealers' buying prices for standard grade milk for fluid distribution remained about the same in both periods of analysis. The swing between the seasonal peaks and dips was less for these prices than for wholesale prices of butter and cheese before World War II, but it was somewhat greater in the period following World War II. As discussed on p. 144, seasonal swings in dealers' buying prices for fluid milk usually are determined by provisions in pricing formulas which provide for seasonal adjustments in prices of milk for fluid uses.

RETAIL PRICES

Table 58 shows the seasonal variation in retail prices of fluid milk, evaporated milk, butter, and American cheese for the period between World Wars I and II and the period following World War II. Seasonal swings in retail prices normally are smaller than seasonal swings in wholesale prices of the same items. Seasonal indexes are percentages and, assuming constant costs of distributing products in any given year, an absolute change in retail price associated with an equivalent change in wholesale price from month to month is less in percentage terms at the retail level than at the wholesale level. The differences between the seasonal variation in prices at the wholesale and retail levels for butter and dealers' buying prices for fluid milk tend to substantiate this hypothesis. On the other hand, no observed seasonal pattern in retail prices of American cheese is noted even though a seasonal pattern existed for wholesale prices. Several factors may explain this apparent inconsistency. Cheese is aged for varying periods of time. Thus the lag between production and consumption of cheese varies with the time allowed for the aging process. This variable lag tends to dampen any seasonal pattern in retail prices. Wholesale prices of Cheddar cheese on the Wisconsin Cheese Exchange usually refer to fresh cheeses. As for manufacturers' selling prices, retail prices of evaporated milk did not vary seasonally.

TABLE 58.—*Specified dairy products: Index numbers of seasonal variation in retail prices, 1924–41 and 1947–55* [1]

Period and item	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1924–41:												
Milk:												
Fluid	101	100	100	99	98	98	99	100	101	101	102	101
Evaporated	101	101	100	99	99	100	99	100	100	100	100	101
Butter	102	102	101	98	95	94	96	98	101	103	104	106
American cheese	101	101	100	99	99	100	99	100	100	100	100	101
1947–55:												
Milk:												
Fluid	102	101	100	99	97	97	98	99	101	102	102	102
Evaporated	100	101	101	100	99	100	99	100	100	100	100	100
Butter	103	102	101	99	99	98	98	99	100	99	100	102
American cheese	102	101	101	100	99	99	99	99	100	100	100	100

[1] Average of ratios to 12-month moving average centered, adjusted to total 1,200 and to eliminate abnormal fluctuations. Retail price data from Bureau of Labor Statistics.

EXPORTS AND IMPORTS OF DAIRY PRODUCTS

Table 59 shows the imports and exports of specified dairy products of the United States beginning with the year 1915. (See also tables 60–65, pp. 236 to 249.) In relation to total domestic production of milk, both imports and exports have been relatively unimportant.

During most of the period between World Wars I and II, the United States imported slightly more total dairy products, in terms of milk equivalent, than it exported. During the period 1924–39, total imports, fat-solids basis, ranged between 0.5 and 1.5 billion pounds while exports ranged between 0.3 and 0.8 billion pounds (table 14, p. 52). The excess of imports over exports ranged between 0.2 and 1.0 percent of the total domestic production of milk. In these and subsequent comparisons, the term "export" includes both regular exports and shipments to territories of the United States.

During World War II, exports of dairy products increased sharply, and at the peak of war operations they amounted to 7 billion pounds, fat-solids basis, and were equivalent to about 6 percent of production of milk. Practically all of the wartime exports were under Government programs.

Following World War II, total exports decreased almost without interruption from the wartime peak until about 1952. In that year they were only at about 1 billion pounds of milk equivalent of dairy products, fat-solids basis, or less than 1 percent of total domestic production of milk. Beginning with 1953, owing to the impetus given by Government programs in disposing of surplus dairy products, total exports began increasing again, and by 1955 they comprised about 5 percent of domestic output of milk. In 1955 about four-fifths of the exports were under the Government programs, discussed on p. 166 in connection with disposal programs of the Commodity Credit Corporation. (See tables 36 and 37, p. 167.) In 1955, commercial exports of dairy products still were about 1 billion pounds of milk equivalent. Practically all of the exports of butter, cheese, and nonfat dry milk are sponsored under Government programs. (See tables 60, 62, 65, pp. 236, 242, 248.) In recent years, exports of evaporated milk and dry whole milk comprised a large part of the commercial exports of dairy products. In 1955, these two items made up about four-fifths of the commercial exports.

In contrast to butter and cheese, evaporated milk and dry whole milk were able to meet most price competition in world markets. In a study of 11 major dairy products exporting countries, McCabe and Scholz (*85*, tables III and IV) found that 75 and 65 percent of the United States commercial exports of canned milk and dried milk, respectively, were exported to Asia during 1954. In the same year, United States commercial exports comprised 16 and 42 percent of the canned milk and dried milk, respectively, in export trade conducted by these 11 major exporting countries. In contrast, during the same period, commercial exports of United States butter and cheese contributed less than 1 percent of the total export trade carried on by these 11 countries.

Many countries have import duties on United States dairy products. In a study of 147 countries, Silcox (*120*, pp. 2–8) found that only 20 and 17 countries, respectively, admitted butter and Cheddar cheese

duty free. The import duty for butter in 35 percent of the countries was higher than the 7-cent import duty of the United States, and for cheese it was higher in 75 countries than the import duty of the United States. The United States duty for cheese is 5 cents per pound when the export price is more than 20 cents, but not greater than 25 cents, and 15 percent ad valorem when the price is over 25 cents. Of 148 countries, only 26 admitted evaporated and condensed milk duty free. However, more than half of the countries imposed duties on evaporated milk of less than 2 cents per pound; the duty in 88 countries was higher than that in the United States—1 cent per pound. Of the 148 countries studied, 28 admitted dry whole milk duty free, and 30 countries admitted nonfat dry milk duty free. More than a fourth of the countries had duties on dry whole milk that were lower than that of 3.1 cents per pound in the United States. Nearly a fourth of the countries had charges for nonfat dry milk lower than the 1.5 cent rate prevailing in the United States.

As indicated previously, imports of dairy products in terms of whole milk exceeded exports until 1939. Since 1939, imports exceeded commercial exports only in 1952. In most years since 1949, imports on a milk equivalent (fat solids) basis averaged about half a billion pounds or about 0.5 percent of domestic production of milk. Foreign type cheeses and casein since 1952 have been the only products of importance to be imported. Some of the imported cheeses probably do not compete directly with the foreign type cheeses produced domestically.

In addition to the import duties noted, imports of butter and most other dairy products are subject currently to licensing controls under authority of Section 22 of the Agricultural Adjustment Act, as amended. Under authority granted by this legislation, the President directed the Tariff Commission to investigate the effects of unrestricted imports of dairy products on the Government's price support program. On the basis of the findings of the Tariff Commission, the following annual import quotas were established to take effect when the Defense Production Act expired on June 30, 1953: [52]

Commodity	Quota
	Pounds
Butter	707, 000
Cheese:	
Blue mold	4, 167, 000
Cheddar	2, 780, 100
Edam and Gouda	4, 600, 200
Italian cows' milk	9, 200, 100
Milk:	
Dry whole	7, 000
Malted	6, 000
Nonfat dry	1, 807, 000
Dry buttermilk	496, 000
Dried Cream	500
Casein	Not controlled

[52] Section 104 of the Defense Production Act of 1950, as amended in 1951, provided that no dairy product should be imported which the Secretary of Agriculture determined would: (1) Impair or reduce domestic consumption; (2) interfere with orderly domestic storing and marketing; or (3) result in an unnecessary burden or expenditure under any Government price support program. For further discussion of import licensing controls see the report by the United States Foreign Agricultural Service (*177*).

TABLE 59.—*Exports and imports of specified dairy products, United States, 1915–56*

Year	Butter		Cheese		Condensed milk		Evaporated milk		Dried whole milk		Dried skim milk	
	Exports [1]	Imports [2]	Exports [1]	Imports [2]	Exports [1]	Imports [2]	Exports [1]	Imports [2]	Exports	Imports [3]	Exports	Imports [3]
	Mil. lb.	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*
1915	18.1	1.5	63.2	38.9	[4] 75.7	-------	-------	-------	-------	-------	-------	-------
1916	26.6	.7	54.2	28.5	[4] 219.7	-------	-------	-------	-------	-------	-------	-------
1917	7.2	1.3	53.5	6.3	[4] 428.6	-------	-------	-------	-------	-------	-------	-------
1918	26.2	1.7	48.5	7.6	[4] 551.1	-------	-------	-------	-------	-------	-------	-------
1919	34.6	9.5	14.6	11.3	[4] 853.8	-------	-------	-------	-------	-------	-------	-------
1920	17.7	37.5	19.2	16.0	277.3	-------	134.0	-------	-------	-------	-------	-------
1921	9.0	18.6	11.9	26.9	94.3	-------	195.9	-------	-------	-------	-------	-------
1922	11.1	7.0	5.3	46.6	57.9	-------	131.0	-------	-------	-------	-------	-------
1923	6.9	23.7	8.5	64.4	57.5	-------	136.9	-------	-------	-------	-------	-------
1924	9.4	19.4	4.6	59.2	64.2	4.7	142.3	1.7	-------	-------	-------	-------
1925	5.6	7.2	9.7	62.4	42.8	4.0	105.1	.6	-------	-------	-------	-------
1926	6.1	8.0	4.1	78.4	38.7	.3	75.8	1.3	-------	-------	-------	-------
1927	4.5	8.5	4.0	79.8	35.0	.5	68.2	2.1	-------	-------	-------	-------
1928	4.4	4.7	2.8	81.4	38.9	1.1	76.9	1.5	-------	-------	-------	-------
1929	3.9	2.8	3.0	76.4	41.3	.6	69.1	2.0	-------	-------	-------	-------
1930	3.0	2.5	2.1	68.3	30.3	1.4	60.9	.2	-------	-------	-------	-------
1931	2.0	1.9	1.9	62.0	19.8	.6	56.2	.6	-------	-------	-------	-------
1932	1.6	1.0	1.5	55.6	11.9	.7	39.6	.5	1.9	0.6	1.7	[5]
1933	1.3	1.0	1.4	48.4	5.0	1.0	32.4	.1	1.6	.4	.9	0.1
1934	1.2	1.3	1.4	47.5	8.2	.3	38.0	[5]	1.7	[5]	1.4	[5]
1935	1.0	22.7	1.2	48.9	4.9	.6	32.2	[5]	1.6	2.5	1.2	.3
1936	.8	9.9	1.1	59.8	2.4	2.2	23.6	[5]	1.8	4.2	1.9	20.0
1937	.8	11.1	1.2	60.6	8.0	1.5	22.9	.1	2.1	1.5	2.1	1.4
1938	2.0	1.6	1.5	54.4	5.4	.7	23.7	[5]	3.8	.1	6.4	[5]
1939	2.3	1.1	1.5	59.1	2.3	.2	27.5	[5]	6.3	[5]	2.1	.9
1940	2.9	1.4	2.3	32.6	27.4	[5]	118.7	[5]	7.5	[5]	8.7	[5]
1941	3.3	3.7	94.9	20.0	81.6	[5]	601.8	[5]	14.6	[5]	35.5	[5]
1942	15.2	20.1	307.7	24.2	14.6	[5]	381.2	[5]	13.4	[5]	134.9	[5]
1943	85.6	3.3	165.4	25.2	44.1	[5]	568.4	[5]	39.7	[5]	232.0	[5]

1944	87.6	1.7	294.7	9.0	52.0	(5)	591.4	.1	48.0	(5)	236.9	(5)
1945	45.5	3.7	201.8	8.3	117.6	(5)	759.2	4.6	65.0	(5)	302.6	.1
1946	11.4	7.0	207.9	20.8	84.6	(5)	955.9	.6	151.6	(5)	229.5	(5)
1947	11.2	3.8	177.4	8.7	108.2	(5)	469.8	(5)	100.9	(5)	283.1	(5)
1948	5.8	.2	95.6	23.6	110.1	(5)	316.5	(5)	100.5	(5)	159.2	3.1
1949	4.2	.3	98.0	32.0	78.3	.1	249.5	(5)	81.4	(5)	214.5	5.3
1950	[6] 26.3	(5)	[6] 54.6	56.2	27.9	(5)	150.1	.4	62.6	(5)	[6] 331.1	2.5
1951	[6] 21.9	.1	[6] 81.0	52.3	28.9	(5)	203.4	(5)	59.5	9.0	[6] 224.1	1.0
1952	.9	.5	3.8	49.2	29.6	(5)	97.1	(5)	42.3	37.4	[6] 59.5	.6
1953	[6] 24.6	.1	[6] 20.1	56.2	18.0	(5)	[6] 134.3	.5	46.1	5.9	[6] 182.5	.4
1954	[6] 54.5	1.0	[6] 34.4	49.9	1.4	(5)	131.4	.1	42.4	(5)	[6] 257.2	.7
1955	[6] 226.1	.7	[6] 150.4	52.0	8.0	(5)	154.8	(5)	45.9	(5)	[6] 548.7	1.8
1956 [7]	[6] 171.2	.7	[6] 173.5	53.7	39.9	(5)	170.1	(5)	40.5	(5)	[6] 604.5	1.4

[1] Reexports included 1915–33.
[2] General imports, 1915–33; beginning 1934, imports for consumption.
[3] Imports for consumption.
[4] Condensed and evaporated milk; not reported separately prior to 1920.
[5] Less than 50,000 pounds.
[6] Includes donations and deliveries to programs not included in Census data. In some years, especially in 1954–56, data included butter oil, in terms of butter.
[7] Preliminary.

Compiled from reports of the Bureau of the Census except for the period during World War II when this information was supplemented and partially replaced by data from Department of Agriculture records. Exports include military shipments for relief abroad beginning 1944. In some cases, therefore, the export data shown in this table are not comparable with such data shown in the supply and distribution tables published elsewhere by the Agricultural Marketing Service.

427487—57——15

It should be noted that imports of some dairy products such as dry whole milk and dry buttermilk, which never have been important imported items, are well under the quotas allowed.

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APPENDIX

This section presents the specific steps that were used in obtaining the estimated decreases in farm and retail prices of milk and specified dairy products which would have occurred if the Commodity Credit Corporation had not purchased dairy products for price support. (See table 34, p. 162.) The basic assumptions underlying these price estimates are discussed on p. 162. The specific assumptions—(1) constant price elasticities of demand at retail level and (2) constant absolute marketing margins—which underly the derivation of formulas for estimating price decreases are discussed on p. 163. Our purpose in deriving these formulas was to obtain a set of demand relations which enabled us to determine simultaneously price and quantity changes in all specified dairy products consistent with the simultaneous equations approach discussed on p. 75 and the assumptions specified above.

Based on assumed logarithmic demand relations at retail, hypothetical increases in the consumption of several dairy products were estimated for price decreases in corresponding retail prices equivalent to several assumed price decreases in the price received by farmers for all milk at wholesale. The price decreases for all milk at wholesale ranged between $0.22 and $1.22 per 100 pounds. The base quantities and prices used were actual or estimated values for 1955. The same marketing margin, that is, the margin prevailing in 1955, was maintained at all price levels. The constant price elasticities of demand at retail which are implied by the logarithmic demand relations are shown on p. 163.

The estimated increase in consumption for each product was then related to the corresponding decrease in the farm price for all milk at wholesale. When the semi-logarithmic relationship

$$\Delta q = \log a + b\Delta \log p \qquad (68)$$

was used for each product, all coefficients of determination exceeded 0.99, indicating a nearly functional fit. In this relation, q is the quantity of the dairy product consumed and p is the price received by farmers for all milk at wholesale.

Equation (68) can be considered as the demand for milk at the farm level in a single outlet. As the relationship is linear, the demand for total milk can be obtained by the summation of the individual n demand equations for the n uses of milk. Therefore, the farm demand for total milk becomes

$$\Delta q_t = \log A + B\Delta \log p \qquad (69)$$

where q_t is the summation of the q's, A is the summation of the a's and B is the summation of the b's in the n demand equations for the n different uses of milk.

If Δq_t is given, then $\Delta \log p$ can be estimated from equation (69). This estimate of $\Delta \log p$ then may be used in the n demand equations to estimate the n Δq's in the individual demand equations. Thus all the relevant prices and quantities can be determined simultaneously for any change in Δq_t since the demand relation for total milk and the n demand relations for individual outlets form a complete structural model at the farm level not unlike the complete structural models which were discussed beginning on p. 75.

The farm demand relations, which are similar to equations (68) and (69), and which are consistent with assumed constant retail price elasticities and constant marketing charges, were fitted by least squares. These relations are presented below:

$$\Delta q_1 = 0.084 - 71.4\ \Delta \log p \quad (70)$$
$$\Delta q_2 = 0.077 - 24.8\ \Delta \log p \quad (71)$$
$$\Delta q_3 = -0.519 - 247.3\ \Delta \log p \quad (72)$$
$$\Delta q_4 = -0.089 - 70.9\ \Delta \log p \quad (73)$$
$$\Delta q_5 = 0.014 - 20.1\ \Delta \log p \quad (74)$$
$$\Delta q_6 = 0.063 - 18.7\ \Delta \log p \quad (75)$$
$$\Delta q_7 = 0.053 - 34.1\ \Delta \log p \quad (76)$$
$$\Delta q_8 = -0.186 - 38.8\ \Delta \log p \quad (77)$$
$$\Delta q_t = -0.503 - 526.1\ \Delta \log p \quad (78)$$

In the equations shown above, the q_1 to q_8 are the quantities of milk utilized in the consumption of fluid milk, fluid cream, butter, American cheese, other cheeses, evaporated milk, ice cream, and other dairy products, respectively.

Equations (70) to (78) are basic to the determination of the percentage price decreases shown in table 34. These relations determine simultaneously the expected decrease in the farm price for total milk, $\Delta \log p$, and the distribution of the excess in demand, Δq_t, over the prevailing support level in commercial channels for domestic consumption that would have occurred in the absence of the purchase program. Once the increases in quantities have been estimated, corresponding percentage decreases in retail prices for each product can be determined from

$$\Delta \log q_i = b \Delta \log p_i \quad (79)$$

where q_i and p_i are the quantity and retail price, respectively, for the ith dairy product and b the assumed constant price elasticity shown in the tabulation on p. 163. Percentage decreases in prices of manufacturing milk and butterfat were based on the dollar-and-cent relationship which prevailed between these prices and the price received by farmers for all milk wholesale in the year under consideration.

TABLE 60.—*Butter, actual weight: Supply and distribution, United States, 1909–56*

Year	Supply				Distribution									
							Department of Agriculture					Domestic disappearance		
	Production [1]	Beginning commercial stocks [2]	Imports [3]	Total supply	Ending commercial stocks [2]	Commercial exports and shipments [3]	Beginning stocks	Ending stocks	Deliveries	Net purchases	Use in margarine [4]	Military	Civilian	
													Total	Per capita
	Million pounds	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Pounds*
1909	1,622	-------	1	1,623	-------	6	-------	-------	-------	-------	6	-------	1,611	17.5
1910	1,706	-------	1	1,707	-------	6	-------	-------	-------	-------	6	-------	1,695	18.1
1911	1,762	-------	1	1,763	-------	9	-------	-------	-------	-------	6	-------	1,748	18.4
1912	1,592	-------	1	1,593	-------	8	-------	-------	-------	-------	6	-------	1,579	16.3
1913	1,608	-------	4	1,612	-------	6	-------	-------	-------	-------	6	-------	1,600	16.2
1914	1,685	-------	7	1,692	-------	7	-------	-------	-------	-------	5	-------	1,680	16.7
1915	1,751	-------	2	1,753	-------	21	-------	-------	-------	-------	3	-------	1,729	17.0
1916	1,793	49	1	1,843	46	31	-------	-------	-------	-------	3	-------	1,763	17.1
1917	1,644	46	1	1,691	51	11	-------	-------	-------	-------	4	-------	1,625	15.5
1918	1,503	51	1	1,555	44	29	-------	-------	-------	-------	5	-------	1,477	13.9
1919	1,647	44	7	1,698	54	38	-------	-------	-------	-------	6	-------	1,600	15.0
1920	1,574	54	38	1,666	59	21	-------	-------	-------	-------	4	-------	1,582	14.6
1921	1,748	59	18	1,825	48	12	-------	-------	-------	-------	1	-------	1,764	16.0
1922	1,870	48	7	1,925	27	15	-------	-------	-------	-------	1	-------	1,882	16.9
1923	1,993	27	21	2,041	30	10	-------	-------	-------	-------	2	-------	1,999	17.6
1924	2,066	30	19	2,115	66	12	-------	-------	-------	-------	2	-------	2,035	17.6
1925	2,082	66	7	2,155	53	8	-------	-------	-------	-------	2	-------	2,092	17.8
1926	2,132	53	7	2,192	34	8	-------	-------	-------	-------	2	-------	2,148	18.1
1927	2,188	34	8	2,230	46	7	-------	-------	-------	-------	2	-------	2,175	18.0
1928	2,120	46	4	2,170	44	8	-------	-------	-------	-------	3	-------	2,115	17.3
1929	2,184	44	3	2,231	82	8	-------	-------	-------	-------	3	-------	2,138	17.3
1930	2,149	82	3	2,234	63	7	-------	-------	-------	-------	2	-------	2,162	17.3

1931	2,239	63	2	2,304	27	7	-------	-------	-------	-------	(5)	-------	2,270	18.0
1932	2,307	27	1	2,335	22	7	-------	-------	-------	-------	(5)	-------	2,306	18.2
1933	2,375	22	1	2,398	111	6	-------	-------	-------	-------	(5)	-------	2,281	17.9
1934	2,286	111	1	2,398	47	6	-------	-------	-------	-------	(5)	-------	2,345	18.3
1935	2,211	47	23	2,281	40	7	-------	-------	-------	-------	(5)	-------	2,234	17.3
1936	2,168	40	10	2,218	61	6	-------	-------	-------	-------	-------	-------	2,151	16.6
1937	2,135	61	11	2,207	43	6	-------	-------	-------	-------	-------	-------	2,158	16.5
1938	2,252	43	2	2,297	129	8	-------	-------	-------	-------	-------	-------	2,160	16.4
1939	2,210	129	1	2,340	55	9	-------	-------	-------	-------	-------	-------	2,276	17.2
1940	2,240	55	1	2,296	41	11	-------	-------	-------	-------	-------	-------	2,244	16.7
1941	2,268	41	4	2,313	114	13	-------	-------	-------	-------	-------	70	2,116	15.8
1942	2,130	114	20	2,264	[6] 24	9	-------	1	14	15	-------	124	2,092	15.7
1943	2,015	[6] 24	3	2,042	[7] 35	6	1	123	88	210	-------	266	1,525	11.7
1944	1,818	[7] 35	2	1,855	[8] 21	6	123	7	91	−25	-------	321	1,532	11.8
1945	1,699	[8] 21	4	1,724	[9] 28	[10] 8	7	[11] 13	[10] 47	53	-------	222	1,413	10.8
1946	1,502	[9] 28	7	1,537	23	[10] 6	[11] 13	-------	[10] 11	−2	-------	54	1,456	10.4
1947	1,640	23	4	1,667	22	[10] 17	-------	-------	-------	-------	-------	28	1,600	11.1
1948	1,504	22	(5)	1,526	32	8	-------	-------	-------	-------	-------	36	1,450	9.9
1949	1,688	32	(5)	1,720	26	6	-------	[12] 107	-------	107	-------	32	1,549	10.4
1950	1,648	26	(5)	1,674	39	5	[12] 107	[13] 66	[14] 23	−18	-------	34	1,614	10.6
1951	1,443	39	(5)	1,482	24	4	[13] 66	[13] 3	[14] 20	−43	-------	52	1,445	9.4
1952	1,402	24	(5)	1,426	64	2	[13] 3	[13] 9	-------	6	-------	38	1,316	8.5
1953	1,607	64	(5)	1,671	30	2	[13] 9	[13] 252	[14] 24	267	-------	43	1,329	8.4
1954	1,628	30	1	1,659	35	3	[13] 252	[13] 344	[14] 53	145	-------	63	1,413	8.8
1955	1,552	35	1	1,588	28	8	[13] 344	[13] 135	[14] 221	12	-------	75	1,465	8.9
1956 [15]	1,558	28	1	1,587	23	27	[13] 135	[13] 3	[14] 155	23	-------	71	1,443	8.6

See footnotes on p. 238.

FOOTNOTES FROM TABLE 60.

[1] 1909–16, estimates of total butter production were based on data of Census of Manufactures, Census of Agriculture, and market receipts. 1917–38, annual estimates of factory production based on data from Census of Manufactures, State Departments of Agriculture, and from data received directly from creameries by the former Bureau of Agricultural Economics; 1939–date, data are as published by the Agricultural Marketing Service in Production of Manufactured Dairy Products. Farm butter production, 1917–23, estimated primarily from Census of Agriculture and from 1924–date from reports by farmers, in addition to Census data, and published by AMS. Data prior to 1909 available in U. S. Department of Agriculture Technical Bulletin No. 722, Production and Consumption of Manufactured Dairy Products.

[2] Stock data cover quantities in commercial storage warehouses, reported beginning 1916 in Cold Storage Report, AMS.

[3] Imports, exports, and shipments are those published by the Department of Commerce, except for the period during World War II when this information was supplemented and partially replaced by data from Department of Agriculture records. Import data prior to 1918 are "general imports," while for 1918 and following years they are "imports for consumption." Shipments to Alaska and Hawaii excluded starting with April 1948.

[4] Use of butter in margarine prior to 1914 estimated; 1914–16 and beginning 1920 from Bureau of Internal Revenue; 1917–19 (fiscal year data), from Institute of Margarine Manufacturers.

[5] Less than 500,000 pounds.

[6] Cold-storage stocks of 25 million pounds include about 1 million pounds owned by Department of Agriculture and the Armed Forces.

[7] Total of 35 million pounds includes approximately 30 million pounds in cold storage and 5 million pounds outside cold storage. Cold-storage figure of 155 million pounds includes about 125 million pounds of Department of Agriculture and military stocks.

[8] Cold-storage total of 60.5 million pounds includes approximately 39.6 million pounds of Department of Agriculture and military stocks.

[9] Includes 3 million pounds in process of transfer as of January 1 from military holdings to civilian channels via Production and Marketing Administration.

[10] Includes butter equivalent of butter spread and butter oil.

[11] In process of transfer from the military as of January 1.

[12] Includes 10 million pounds for distribution to School Lunch Program in 1950.

[13] Government stocks as reported in Cold Storage Report.

[14] Includes donations and, in 1954–56, butter oil (in terms of butter).

[15] Preliminary.

TABLE 61.—*All cheese: Supply and distribution, United States, 1909–56*

Year	Supply				Distribution								
							Department of Agriculture				Domestic disappearance		
												Civilian	
	Production [1]	Beginning commercial stocks [2]	Imports [3]	Total supply	Ending commercial stocks [2]	Commercial exports and shipments [3]	Beginning stocks	Ending stocks	Deliveries	Net purchases	Military	Total	Per capita
	Million pounds	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Pounds*
1909	313	-------	38	351	-------	5	-------	-------	-------	-------	-------	346	3.8
1910	355	-------	44	399	-------	4	-------	-------	-------	-------	-------	395	4.2
1911	345	-------	45	390	-------	15	-------	-------	-------	-------	-------	375	3.9
1912	323	-------	49	372	-------	4	-------	-------	-------	-------	-------	368	3.8
1913	359	-------	56	415	-------	4	-------	-------	-------	-------	-------	411	4.2
1914	367	-------	55	422	-------	5	-------	-------	-------	-------	-------	417	4.1
1915	440	-------	39	479	-------	64	-------	-------	-------	-------	-------	415	4.1
1916	422	29	29	480	32	56	-------	-------	-------	-------	-------	392	3.8
1917	472	32	6	510	70	55	-------	-------	-------	-------	-------	385	3.7
1918	415	70	8	493	30	50	-------	-------	-------	-------	-------	413	3.9
1919	486	30	11	527	65	16	-------	-------	-------	-------	-------	446	4.2
1920	423	65	13	501	51	19	-------	-------	-------	-------	-------	431	4.0
1921	434	51	27	512	42	15	-------	-------	-------	-------	-------	455	4.1
1922	432	42	47	521	45	8	-------	-------	-------	-------	-------	468	4.2
1923	471	45	64	580	67	11	-------	-------	-------	-------	-------	502	4.4
1924	474	67	59	600	68	8	-------	-------	-------	-------	-------	524	4.5
1925	503	68	62	633	77	13	-------	-------	-------	-------	-------	543	4.6
1926	468	77	78	623	74	7	-------	-------	-------	-------	-------	542	4.6
1927	462	74	79	615	66	6	-------	-------	-------	-------	-------	543	4.5
1928	479	66	31	626	89	5	-------	-------	-------	-------	-------	532	4.4

See footnotes at end of table.

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TABLE 61.—*All cheese: Supply and distribution, United States, 1909–56*—Continued

Year	Supply				Distribution								
							Department of Agriculture				Domestic disappearance		
												Civilian	
	Production [1]	Beginning commercial stocks [2]	Imports [3]	Total supply	Ending commercial stocks [2]	Commercial exports and shipments [3]	Beginning stocks	Ending stocks	Deliveries	Net purchases	Military	Total	Per capita
	Million pounds	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Pounds*
1929	499	89	76	664	86	5						573	4.6
1930	510	86	68	664	83	4						577	4.6
1931	499	83	62	644	78	4						562	4.5
1932	491	78	56	625	69	3						553	4.4
1933	548	69	48	665	92	3						570	4.5
1934	587	92	48	727	102	4						621	4.8
1935	628	102	49	779	100	4						675	5.2
1936	650	100	60	810	110	4						696	5.4
1937	653	110	61	824	104	4						716	5.5
1938	726	104	54	884	120	4						760	5.8
1939	710	120	59	889	109	4						776	5.8
1940	785	109	33	927	130	6						791	5.9
1941	956	130	20	1,106	159	8		56	92	148	11	780	5.8
1942	1,112	159	24	1,295	[4] 119	8	56	[5] 20	305	269	56	843	6.3
1943	993	[4] 119	25	1,137	[6] 79	3	[5] 20	142	168	290	128	637	4.9
1944	1,017	[6] 79	9	1,105	[7] 75	4	142	35	297	190	212	624	4.8
1945	1,117	[7] 75	8	1,200	87	8	35	[8] 66	182	213	31	861	6.6
1946	1,106	87	21	1,214	121	10	[8] 66	9	202	145	8	930	6.6
1947	1,183	121	9	1,313	147	137	9		45	36	4	989	6.8
1948	1,098	147	24	1,269	148	[9] 94					22	1,005	6.8
1949	1,199	148	32	1,379	168	102		23	1	24	10	1,075	7.2

1950	1,191	168	56	1,415	181	13	23	[10] 31	[11] 46	54	12	1,155	7.6
1951	1,161	181	52	1,394	221	46	[10] 31	[10] 1	[11] 39	9	23	1,095	7.1
1952	1,170	221	49	1,440	237	8	[10] 1	[10] 2	1	2	23	1,170	7.5
1953	1,344	237	56	1,637	190	6	[10] 2	[10] 242	[11] 17	257	21	1,163	7.3
1954	1,383	190	50	1,623	192	8	[10] 242	[10] 357	[11] 30	145	17	1,261	7.8
1955	1,363	192	52	1,607	240	8	[10] 357	[10] 279	[11] 146	68	16	1,275	7.8
1956 [12]	1,393	240	54	1,687	250	16	[10] 279	[10] 191	[11] 161	73	16	1,332	8.0

[1] Items covered: All types of cheese except full-skim American cheese and cottage, pot, and bakers' cheese. Includes production by factories and quantities made on farms until 1927 when farm cheese ceased to be a significant factor. Data for 1909 as reported by Census of Manufactures; for 1910–17 estimates of total production were derived by interpolation on the basis of market receipts. 1918–39, annual estimates of factory production based on data from Census of Manufactures, State Departments of Agriculture, and from data received directly from cheese factories by the former Bureau of Agricultural Economics; 1940–date, data are as published by the Agricultural Marketing Service in Production of Manufactured Dairy Products. Output of cheese on farms through 1926 was determined by interpolation between census years.

[2] Stock data cover quantities in commercial storage warehouses, reported beginning 1916 in Cold Storage Report, AMS.

[3] Data on imports, exports, and shipments are those published by the Department of Commerce, except for the period during World War II when this information was supplemented and partially replaced by data from Department of Agriculture records. Import data prior to 1934 are "general imports," while for 1934 and following years they are "imports for consumption."

[4] Cold-storage stocks of 131 million pounds include approximately 12 million pounds held by USDA and military.

[5] The total stocks of 20 million pounds include about 8 million pounds held outside commercial cold storage.

[6] Cold-storage stocks of 176 million pounds include about 102 million pounds held by Department of Agriculture and military. USDA holdings outside of commercial cold storage estimated at 40 million pounds and commercial holdings at 5.5 million pounds.

[7] Cold-storage total of 145 million pounds includes 75 million pounds held by USDA and military. USDA holdings outside commercial cold storage totaled approximately 11 million pounds and commercial holdings were about 5 million pounds.

[8] Includes 23 million pounds transferred from military stocks.

[9] Excludes 5.5 million pounds for civilian feeding abroad; included in military.

[10] Government stocks as reported in Cold Storage Report.

[11] Includes donations.

[12] Preliminary.

TABLE 62.—*American cheese: Supply and distribution, United States, 1909–56*

Year	Supply				Distribution								
							Department of Agriculture				Domestic disappearance		
												Civilian	
	Production [1]	Beginning commercial stocks [2]	Imports [3]	Total supply	Ending commercial stocks [2]	Commercial exports and shipments [3]	Beginning stocks	Ending stocks	Deliveries	Net purchases	Military	Total	Per capita
	Million pounds	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Pounds*
1909	228	-------	-------	228	-------	5	-------	-------	-------	-------	-------	223	2.4
1910	259	-------	-------	259	-------	4	-------	-------	-------	-------	-------	255	2.7
1911	252	-------	-------	252	-------	15	-------	-------	-------	-------	-------	237	2.5
1912	236	-------	-------	236	-------	4	-------	-------	-------	-------	-------	232	2.4
1913	262	-------	-------	262	-------	4	-------	-------	-------	-------	-------	258	2.6
1914	268	-------	-------	268	-------	5	-------	-------	-------	-------	-------	263	2.6
1915	321	-------	-------	321	-------	64	-------	-------	-------	-------	-------	257	2.5
1916	308	29	-------	337	32	56	-------	-------	-------	-------	-------	249	2.4
1917	345	32	-------	377	67	55	-------	-------	-------	-------	-------	255	2.4
1918	297	67	-------	364	20	50	-------	-------	-------	-------	-------	294	2.8
1919	350	20	-------	370	53	16	-------	-------	-------	-------	-------	301	2.8
1920	300	53	-------	353	34	19	-------	-------	-------	-------	-------	300	2.8
1921	319	34	-------	353	28	15	-------	-------	-------	-------	-------	310	2.8
1922	329	28	-------	357	33	8	-------	-------	-------	-------	-------	316	2.8
1923	372	33	-------	405	49	11	-------	-------	-------	-------	-------	345	3.0
1924	380	49	1	430	50	8	-------	-------	-------	-------	-------	372	3.2
1925	404	50	(5)	454	59	13	-------	-------	-------	-------	-------	382	3.3
1926	374	59	12	445	57	7	-------	-------	-------	-------	-------	381	3.2
1927	362	57	13	432	50	6	-------	-------	-------	-------	-------	376	3.1
1928	379	50	7	436	71	5	-------	-------	-------	-------	-------	360	2.9
1929	388	71	8	467	69	5	-------	-------	-------	-------	-------	393	3.2
1930	389	69	3	461	67	4	-------	-------	-------	-------	-------	390	3.1
1931	383	67	2	452	60	4	-------	-------	-------	-------	-------	388	3.1
1932	378	60	1	439	58	3	-------	-------	-------	-------	-------	378	3.0
1933	419	58	1	478	78	3	-------	-------	-------	-------	-------	397	3.1
1934	447	78	1	526	90	4	-------	-------	-------	-------	-------	432	3.4
1935	482	90	1	573	87	4	-------	-------	-------	-------	-------	482	3.7
1936	499	87	11	597	95	4	-------	-------	-------	-------	-------	498	3.8

1937	500	95	5	600	89	4	----	----	----	----	----	507	3.9
1938	567	89	2	658	102	4	----	----	----	----	----	552	4.2
1939	543	102	6	651	88	4	----	----	----	----	----	559	4.2
1940	607	88	1	696	113	6	----	----	----	----	----	577	4.3
1941	757	113	[5]	870	129	8	----	56	92	148	11	574	4.3
1942	921	129	7	1,057	[6] 100	8	56	[7] 20	305	269	56	624	4.7
1943	770	[6] 100	[5]	870	[8] 54	3	[7] 20	142	168	290	128	395	3.0
1944	807	[8] 54	[5]	861	[9] 62	4	142	35	297	190	212	393	3.0
1945	876	[9] 62	[5]	938	73	8	35	[10] 66	182	213	31	613	4.7
1946	804	73	[5]	877	91	10	[10] 66	9	202	145	8	623	4.4
1947	938	91	[5]	1,029	128	118	9	----	45	36	4	743	5.1
1948	858	128	[5]	986	126	[11] 89	----	----	----	----	20	751	5.1
1949	936	126	3	1,065	148	98	----	23	1	24	9	786	5.3
1950	895	148	13	1,056	156	12	23	[12] 31	[13] 46	54	11	823	5.4
1951	874	156	12	1,042	194	45	[12] 31	[12] 1	[13] 39	9	21	773	5.0
1952	851	194	7	1,052	203	6	[13] 1	[12] 2	1	2	21	820	5.3
1953	1,022	203	8	1,233	159	5	[12] 2	[12] 242	[13] 17	257	19	793	5.0
1954	1,045	159	3	1,207	162	7	[12] 242	[12] 357	[13] 30	145	15	878	5.4
1955	1,004	162	3	1,169	213	6	[12] 357	[12] 279	[13] 146	68	15	867	5.3
1956 [14]	[15] 1,008	213	3	1,224	210	13	[13] 279	[19] 191	[13] 161	73	14	914	5.5

[1] 1909–17, total production of cheese in the United States was divided between American and other cheese in accordance with the ratio between those two items for factory production in 1918–22. 1918–39, annual estimates of factory production based on data of Census of Manufactures, State Departments of Agriculture, and from data received directly by the former Bureau of Agricultural Economics; farm production included through 1926, broken down between American and other cheese on basis of factory production of those items. 1940–date, data are as published by the Agricultural Marketing Service in Production of Manufactured Dairy Products.

[2] Stock data cover quantities in commercial storage warehouses, reported beginning 1916 in Cold Storage Report, A. M. S.

[3] Data on imports, exports, and shipments are those published by the Department of Commerce, except for the period during World War II when this information was supplemented and partially replaced by data from Department of Agriculture records. Imports prior to 1934 are "general imports" while for 1934 and following years they are "imports for consumption." 1909–46, exports are for total cheese; beginning 1947, all export classifications used as American cheese except "Other, not processed."

[4] Imports of cheese from Canada; assumed to be Cheddar cheese. [5] Less than 500,000 pounds.

[6] Cold-storage stocks include approximately 12 million pounds held by USDA and military.

[7] The total stocks of 20 million pounds include about 8 million pounds held outside commercial cold storage.

[8] Cold-storage holdings of 151 million pounds include about 102 million pounds held by USDA and military. USDA holdings outside of commercial cold storage estimated at 40 million pounds and commercial holdings at 5.5 million pounds.

[9] Cold-storage holdings of 131 million pounds include 75 million pounds held by USDA and military. USDA holdings outside commercial cold storage totaled approximately 11 million pounds and commercial holdings were about 5 million pounds.

[10] Includes 23 million pounds transferred from military stocks.

[11] Excludes 5.5 million pounds for civilian feeding abroad; included in military.

[12] Government stocks as reported in Cold Storage Report. [13] Includes donations. [14] Preliminary.

[15] Includes estimate of 2 million pounds part-skim American.

TABLE 63.—*Evaporated milk: Supply and distribution, United States, 1909–56*

Year	Supply				Distribution								
							Department of Agriculture				Domestic disappearance		
												Civilian	
	Production [1]	Beginning commercial stocks [2]	Imports [3]	Total supply	Ending commercial stocks [2]	Commercial exports and shipments [3]	Beginning stocks	Ending stocks	Deliveries	Net purchases	Military	Total	Per capita
	Million pounds	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Pounds*
1909	127		1	128								128	1.4
1910	148		1	149		13						136	1.5
1911	174		1	175		16						159	1.7
1912	203		2	205		18						187	1.9
1913	238		15	253		17						236	2.4
1914	276		34	310		21						289	2.9
1915	373		18	391		55						336	3.3
1916	495		18	513		146						367	3.5
1917	645		30	675		278						397	3.8
1918	834		20	854		353						501	4.7
1919	1,194		16	1,210		543						667	6.3
1920	980	98	5	1,083	171	146						766	7.1
1921	1,028	171	2	1,201	152	206						843	7.7
1922	950	152	1	1,103	48	141						914	8.2
1923	1,253	48	2	1,303	156	148						999	8.8
1924	1,190	156	2	1,348	102	154						1,092	9.4
1925	1,202	102	1	1,305	126	116						1,063	9.0
1926	1,158	126	1	1,285	71	88						1,126	9.5
1927	1,274	71	2	1,347	140	81						1,126	9.3
1928	1,337	140	1	1,478	153	89						1,236	10.1
1929	1,500	153	2	1,655	212	82						1,361	11.0
1930	1,449	212	(4)	1,661	202	74						1,385	11.1

1931	1,429	202	1	1,632	132	72	----	----	----	----	----	1,428	11.4
1932	1,571	132	(4)	1,703	100	55	----	----	----	----	----	1,548	12.2
1933	1,717	100	(4)	1,817	210	50	----	----	----	----	----	1,557	12.2
1934	1,712	210	(4)	1,922	157	56	----	----	----	----	----	1,709	13.3
1935	1,839	157	(4)	1,996	73	56	----	----	----	----	----	1,867	14.5
1936	2,044	73	(4)	2,117	259	48	----	----	----	----	----	1,810	13.9
1937	1,903	259	(4)	2,162	182	50	----	----	----	----	----	1,930	14.8
1938	2,104	182	(4)	2,286	205	52	----	----	----	----	----	2,029	15.4
1939	2,171	205	(4)	2,376	186	58	----	----	----	----	----	2,132	16.1
1940	2,465	186	(4)	2,651	188	148	----	----	----	----	----	2,315	17.3
1941	3,247	188	(4)	3,435	328	147	----	82	495	577	165	2,218	16.6
1942	3,519	328	(4)	3,847	83	50	82	813	378	1,109	432	2,173	16.3
1943	3,057	83	(4)	3,140	184	23	813	281	594	62	661	2,210	16.9
1944	3,428	184	(4)	3,612	143	29	281	146	587	452	1,218	1,770	13.6
1945	3,776	143	5	3,924	72	87	146	[5] 463	527	844	816	2,105	16.1
1946	3,051	72	1	3,124	129	192	[5] 463	26	827	390	51	2,362	16.8
1947	3,208	129	(4)	3,337	159	445	26	----	76	50	88	2,595	17.9
1948	3,383	159	(4)	3,542	425	258	----	1	76	77	113	2,669	18.1
1949	2,756	425	(4)	3,181	243	232	1	----	40	39	36	2,631	17.6
1950	2,882	243	(4)	3,125	160	134	----	----	37	37	74	2,720	17.9
1951	2,896	160	(4)	3,056	226	200	----	----	28	28	146	2,456	16.0
1952	2,840	226	(4)	3,066	382	122	----	----	----	----	156	2,406	15.5
1953	2,553	382	(4)	2,935	263	139	----	(4)	23	23	103	2,407	15.2
1954	2,534	263	(4)	2,797	207	160	(4)	----	(4)	----	68	2,362	14.6
1955	2,580	207	(4)	2,787	213	191	----	----	----	----	86	2,297	14.0
1956 [6]	2,541	213	(4)	2,754	224	207	----	----	----	----	66	2,257	13.5

[1] 1909–18 annual production estimates were interpolated on the basis of Census of Manufactures data for 1909 and 1914. For 1919–55 the total output is as published by the Agricultural Marketing Service in Production of Manufactured Dairy Products.

[2] Manufacturers' stocks as published by AMS in Evaporated, Condensed, and Dry Milk Report.

[3] 1909–41, based on data reported by the Department of Commerce; 1942–46, from records of the Department of Agriculture and Department of Commerce; beginning 1947, as reported by the Department of Commerce.

[4] Less than 500,000 pounds.

[5] Includes 347 million pounds transferred to the Department of Agriculture and 4 million pounds transferred to the United Nations Relief and Rehabilitation Administration from military stocks in 1946.

[6] Preliminary.

TABLE 64.—*Dry whole milk: Supply and distribution, United States, 1910–56*

Year	Supply				Distribution								
							Department of Agriculture				Domestic disappearance		
												Civilian	
	Production [1]	Beginning commercial stocks [2]	Imports [3]	Total supply	Ending commercial stocks [2]	Commercial exports and shipments [3]	Beginning stocks	Ending stocks	Deliveries	Net purchases	Military	Total	Per capita
	Million pounds	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Pounds*
1910	1			1								1	0.01
1911	1			1								1	.01
1912	2			2								2	.02
1913	3			3								3	.03
1914	4			4								4	.04
1915	4			4								4	.04
1916	4			4								4	.04
1917	4			4								4	.04
1918	4			4								4	.04
1919	9			9								9	.08
1920	10			10		2						8	.07
1921	4	1		5	1	5						[4] −1	
1922	6	1	(5)	7	1	4						2	.02
1923	7	1	1	9	1	1						7	.06
1924	8	1	1	10	1	3						6	.05
1925	9	1	1	11	1	2						8	.07
1926	11	1	2	14	1	2						11	.09
1927	11	1	3	15	1	2						12	.10
1928	10	1	3	14	2	2						10	.08
1929	13	2	3	18	3	3						12	.10
1930	15	3	1	19	4	4						11	.09

1931	13	4	(5)	17	2	7	--	--	--	--	--	8	.06
1932	12	2	(5)	14	3	2	--	--	--	--	--	9	.07
1933	13	3	(5)	16	3	2	--	--	--	--	--	11	.09
1934	16	3	(5)	19	2	2	--	--	--	--	--	15	.12
1935	19	2	2	23	3	3	--	--	--	--	--	17	.13
1936	18	3	4	25	4	3	--	--	--	--	--	18	.14
1937	14	4	2	20	3	3	--	--	--	--	--	14	.11
1938	21	3	(5)	24	4	5	--	--	--	--	--	15	.11
1939	24	4	(5)	28	4	7	--	--	--	--	--	17	.13
1940	29	4	(5)	33	5	9	--	--	--	--	--	19	.14
1941	46	5	(5)	51	6	16	--	--	--	--	8	21	.16
1942	62	6	(5)	68	7	12	--	--	3	3	20	26	.20
1943	138	7	(5)	145	8	12	--	12	29	41	34	50	.38
1944	178	8	(5)	186	16	14	12	12	36	36	76	44	.34
1945	217	16	(5)	233	12	23	12	[6] 55	47	90	60	48	.37
1946	188	12	(5)	200	18	61	[6] 55	5	93	43	7	71	.51
1947	165	18	(5)	183	12	95	5	2	10	7	4	65	.45
1948	170	12	(5)	182	18	97	2	--	15	13	12	42	.29
1949	126	18	(5)	144	11	94	--	--	--	--	2	37	.25
1950	125	11	(5)	136	10	77	--	--	--	--	7	42	.28
1951	131	10	9	150	18	70	--	--	1	1	20	41	.27
1952	102	18	37	157	15	56	--	--	--	--	16	70	.45
1953	104	15	6	125	10	61	--	--	--	--	14	40	.25
1954	94	10	(5)	104	8	57	--	--	--	--	9	30	.19
1955	107	8	(5)	115	9	61	--	--	--	--	5	40	.24
1956 [7]	108	9	(5)	117	11	56	--	--	--	--	3	47	.28

[1] 1910–17, approximated on basis of Census of Manufactures data for 1914 and the estimate for 1918 by the former Bureau of Agricultural Economics. 1918 to date, as reported by the Agricultural Marketing Service in Production of Manufactured Dairy Products.

[2] Manufacturers' stocks as published by AMS in Evaporated, Condensed, and Dry Milk Report.

[3] Imports are "imports for consumption," Department of Commerce. For the years 1920–31, the Department of Commerce reported a composite figure on exports of milk and cream, powdered or dried. For this period, exports of whole milk were assumed to be 57 percent of the reported composite, the ratio which dry whole represented of the total of dry whole and dry skim in 1932–34. Likewise, shipments of dry whole for 1928–31 were assumed to be 39 percent of the combined shipments of dried whole and dried skim milk, the relationship which prevailed when the items were reported separately in 1932–34. Beginning 1932, exports are those published by the Department of Commerce except for the period during World War II when this information was supplemented and partially replaced by data from Department of Agriculture records.

[4] Exports and change in stocks exceed production by 1 million pounds.

[5] Less than 500,000 pounds.

[6] Includes 36 million pounds transferred to U. S. Department of Agriculture from military stocks.

[7] Preliminary.

TABLE 65.—*Nonfat dry milk solids: Supply and distribution, United States, 1920–56*

Year	Supply				Distribution								
							Department of Agriculture				Domestic disappearance		
												Civilian	
	Production [1]	Beginning commercial stocks [2]	Imports [3]	Total supply	Ending commercial stocks [2]	Commercial exports and shipments [3]	Beginning stocks	Ending stocks	Deliveries	Net purchases	Military	Total	Per capita
	Million pounds	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Pounds*
1920	27	-------	-------	27	-------	1	-------	-------	-------	-------	-------	26	0.2
1921	25	-------	-------	25	-------	4	-------	-------	-------	-------	-------	21	.2
1922	26	-------	1	27	-------	3	-------	-------	-------	-------	-------	24	.2
1923	40	-------	2	42	-------	1	-------	-------	-------	-------	-------	41	.4
1924	45	-------	1	46	-------	2	-------	-------	-------	-------	-------	44	.4
1925	47	-------	4	51	-------	2	-------	-------	-------	-------	-------	49	.4
1926	60	-------	4	64	-------	1	-------	-------	-------	-------	-------	63	.5
1927	77	-------	3	80	-------	1	-------	-------	-------	-------	-------	79	.7
1928	96	-------	1	97	-------	2	-------	-------	-------	-------	-------	95	.8
1929	135	-------	(4)	135	-------	2	-------	-------	-------	-------	-------	133	1.1
1930	169	17	(4)	186	22	3	-------	-------	-------	-------	-------	161	1.3
1931	170	22	(4)	192	14	6	-------	-------	-------	-------	-------	172	1.4
1932	176	14	(4)	190	9	2	-------	-------	-------	-------	-------	179	1.4
1933	187	9	(4)	196	16	1	-------	-------	-------	-------	-------	179	1.4
1934	192	16	(4)	208	19	1	-------	-------	-------	-------	-------	188	1.5
1935	188	19	(4)	207	6	1	-------	-------	-------	-------	-------	200	1.6
1936	224	6	20	250	22	2	-------	-------	-------	-------	-------	226	1.7
1937	245	22	1	268	21	3	-------	-------	-------	-------	-------	244	1.9
1938	289	21	(4)	310	28	7	-------	-------	-------	-------	-------	275	2.1
1939	268	28	1	297	9	3	-------	-------	-------	-------	-------	285	2.1
1940	322	9	(4)	331	26	10	-------	-------	-------	-------	-------	295	2.2

1941	366	26	(4)	392	19	8	--------	3	30	33	7	325	2.4
1942	565	19	(4)	584	26	4	3	72	133	202	17	335	2.5
1943	510	26	(4)	536	22	1	72	47	234	209	31	273	2.1
1944	583	22	(4)	605	38	1	47	96	220	269	104	193	1.5
1945	643	38	(4)	681	14	5	96	[5] 74	193	171	243	248	1.9
1946	653	14	(4)	667	39	12	[5] 74	24	174	124	41	451	3.2
1947	678	39	--------	717	15	72	24	[6] 16	102	94	119	417	2.9
1948	682	15	3	700	44	33	[6] 16	17	85	86	52	485	3.3
1949	935	44	5	984	49	30	17	251	56	290	134	481	3.2
1950	881	49	3	933	22	21	251	263	315	327	4	[7] 549	3.6
1951	702	22	1	725	42	48	263	52	182	−29	10	[7] 637	4.2
1952	863	42	1	906	128	39	52	38	23	9	12	[7] 711	4.6
1953	1,214	128	(4)	1,342	74	21	38	466	159	587	11	[7] 647	4.1
1954	1,402	74	1	1,477	51	9	466	[8] 239	253	26	3	[7] 817	5.1
1955	1,410	51	2	1,463	81	25	[8] 239	[8] 141	528	430	4	[7] 907	5.5
1956 [9]	1,484	81	1	1,566	69	31	[8] 141	[8] 165	580	604	3	837	5.0

[1] Production for food uses, prior to 1935, based on proportion produced for food in 1936–40 applied to data on total output as reported by the former Bureau of Agricultural Economics for 1920–34. Beginning with 1935, data are as published by the Agricultural Marketing Service in Production of Manufactured Dairy Products.

[2] Manufacturers' stocks as reported by AMS in Evaporated, Condensed, and Dry Milk Report.

[3] Imports are "imports for consumption," Department of Commerce. For the years 1920–31 the Department of Commerce reported a composite figure on exports of milk and cream, powdered or dried. For this period, exports of dry skim milk were assumed to be 43 percent of the reported composite, the portion which dry skim represented of the total of dry whole and dry skim in 1932–34. Likewise, shipments of dry whole for the period 1928–31 were assumed to be 61 percent of the combined shipments of dried whole and dried skim milk, the relationship which prevailed when the items were reported separately in 1932–34. Beginning 1932, exports are those published by the Department of Commerce, except from the beginning of World War II when this information was supplemented and partially replaced by data from Department of Agriculture records.

[4] Less than 500,000 pounds.

[5] Includes 12 million pounds transferred to UNRRA and PMA from military stocks in 1946.

[6] Includes 5 million pounds purchased by Dairy Products Marketing Association during 1947 and transferred to PMA during 1948.

[7] Excludes quantities sold domestically by USDA for animal feed: 1950, 10 million pounds; 1951, 17; 1952, 7; 1953, 2; 1954, 571 million pounds; 1955, 16 million pounds; and 1956, 22 million pounds.

[8] Change in stocks established so as to be consistent with independently determined "deliveries" and "net purchases."

[9] Preliminary.

TABLE 66.—*Ice cream: Supply and distribution, United States, 1909–56*

Year	Net milk used				Product weight			
	Production [1]	Domestic disappearance			Production [2]	Domestic disappearance		
		Military	Civilian			Military	Civilian	
			Total	Per capita			Total	Per capita
	Million pounds	*Million pounds*	*Million pounds*	*Pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Pounds*
1909	337	-------	337	3.7	141	-------	141	1.5
1910	428	-------	428	4.6	179	-------	179	1.9
1911	516	-------	516	5.4	216	-------	216	2.3
1912	607	-------	607	6.3	254	-------	254	2.6
1913	695	-------	695	7.0	291	-------	291	3.0
1914	808	-------	808	8.0	338	-------	338	3.4
1915	930	-------	930	9.1	389	-------	389	3.8
1916	1,052	-------	1,052	10.2	440	-------	440	4.3
1917	1,195	-------	1,195	11.4	500	-------	500	4.8
1918	1,581	-------	1,581	14.9	672	-------	672	6.3
1919	1,692	-------	1,692	15.9	719	-------	719	6.8
1920	1,894	-------	1,894	17.5	805	-------	805	7.5
1921	1,949	-------	1,949	17.7	824	-------	824	7.5
1922	2,123	-------	2,123	19.0	898	-------	898	8.0
1923	2,381	-------	2,381	21.0	1,007	-------	1,007	8.9
1924	2,381	-------	2,381	20.6	1,003	-------	1,003	8.7
1925	2,722	-------	2,722	23.2	1,128	-------	1,128	9.6
1926	2,703	-------	2,703	22.7	1,120	-------	1,120	9.4
1927	2,882	-------	2,882	23.9	1,182	-------	1,182	9.8
1928	2,944	-------	2,944	24.1	1,194	-------	1,194	9.8
1929	3,301	-------	3,301	26.7	1,303	-------	1,303	10.6
1930	3,040	-------	3,040	24.4	1,201	-------	1,201	9.6
1931	2,677	-------	2,677	21.3	1,064	-------	1,064	8.5
1932	1,989	-------	1,989	15.7	789	-------	789	6.2
1933	1,895	-------	1,895	14.9	760	-------	760	6.0
1934	2,245	-------	2,245	17.5	900	-------	900	7.0
1935	2,565	-------	2,565	19.9	1,030	-------	1,030	8.0
1936	3,054	-------	3,054	23.5	1,215	-------	1,215	9.4
1937	3,442	-------	3,442	26.4	1,368	-------	1,368	10.5
1938	3,378	-------	3,378	25.7	1,346	-------	1,346	10.2
1939	3,625	-------	3,625	27.3	1,437	-------	1,437	10.8
1940	3,818	-------	3,818	28.5	1,501	-------	1,501	11.2
1941	4,648	124	4,524	33.8	1,842	49	1,793	13.4
1942	5,455	268	5,187	38.9	2,186	107	2,079	15.6

See footnotes at end of table.

TABLE 66.—*Ice cream: Supply and distribution, United States, 1909–56*—Continued

Year	Net milk used				Product weight			
	Production [1]	Domestic disappearance			Production [2]	Domestic disappearance		
		Military	Civilian			Military	Civilian	
			Total	Per capita			Total	Per capita
	Million pounds	*Million pounds*	*Million pounds*	*Pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Pound*
1943	4, 523	521	4, 002	30. 6	1, 910	220	1, 690	12. 9
1944	4, 730	424	4, 306	33. 0	2, 020	181	1, 839	14. 1
1945	5, 176	339	4, 837	37. 0	2, 166	142	2, 024	15. 5
1946	8, 202	186	8, 016	57. 1	3, 269	74	3, 195	22. 8
1947	7, 532	101	7, 431	51. 4	2, 903	39	2, 864	19. 8
1948	6, 722	101	6, 621	45. 0	2, 721	41	2, 680	18. 2
1949	6, 821	123	6, 698	44. 8	2, 651	48	2, 603	17. 4
1950	6, 894	131	6, 763	44. 4	2, 633	50	2, 583	17. 0
1951	7, 001	244	6, 757	44. 1	2, 719	95	2, 624	17. 1
1952	7, 541	281	7, 260	46. 7	2, 845	106	2, 739	17. 6
1953	7, 797	264	7, 533	47. 6	2, 904	98	2, 806	17. 7
1954	7, 767	245	7, 522	46. 6	2, 865	92	2, 773	17. 2
1955	8, 160	270	7, 890	48. 0	3, 017	100	2, 917	17. 7
1956 [3]	8, 477	270	8, 207	49. 0	3, 125	100	3, 025	18. 1

[1] The net amount of milk (equivalent) used in making ice cream and miscellaneous frozen products (milk fat basis) has been estimated annually beginning with 1916 by the Agricultural Marketing Service on the basis of total quantity of milk fat used in frozen dairy products and deducting approximate quantities supplied in the form of butter and condensed whole milk. (These quantities are included in the tables on butter and evaporated and condensed whole milk.) Approximate allowance for this duplication was made for the years prior to 1916 on basis of the magnitude of duplication in 1924–29 and the estimated quantity of ice cream produced 1909–15.

[2] Output 1909–15 approximated on basis of Census of Manufactures for 1914 and revised AMS estimates for 1916–39; 1940 to date, as published by the Agricultural Marketing Service in Production of Manufactured Dairy Products. Production reported in gallons, converted to pounds assuming a gallon of ice cream weighed 4.7 pounds through 1939 and 4.8 pounds since 1952; slightly lower weights prevailed during the war and early postwar years.

[3] Preliminary.

TABLE 67.—*Dairy products: Estimated index numbers of retail prices, 1924–56*

(1947–49=100)

Year	Fluid milk and cream [1]	Butter [1]	American process cheese [2]	Manufactured dairy products, excluding—		
				Butter		Butter and cheese [3]
				First series [3]	Second series [4]	
1924	58	64		62		
1925	60	68		64		
1926	61	66		64		
1927	62	69		66		
1928	63	70		67		
1929	64	69		65		
1930	62	58		58		
1931	54	44		47		
1932	44	34		38		
1933	43	34		38		
1934	47	39		40		
1935	50	44		44		
1936	53	49		47		
1937	55	50		49		
1938	54	43		45		
1939	53	41		42		
1940	55	45		45		
1941	60	51		51		
1942	67	59		59		
1943	71	66		65		
1944	73	63		63		
1945	74	64		64		
1946	85	89	81	85	92	96
1947	94	101	96	97	99	100
1948	106	108	106	107	108	109
1949	100	91	98	96	93	91
1950	98	92	97	95	93	91
1951	111	102	111	107	104	102
1952	117	107	114	111	107	105
1953	116	99	113	108	101	97
1954	114	91	109	102	97	93
1955	115	89	109	101	95	91
1956 [5]	120	91	108	102	96	92

[1] Computed to apply to quantities consumed in farm households and by all nonfarm people.

[2] Beginning with 1950 based on retail price of American process cheese, and for 1946–49 computed from estimated prices for process cheese based on prices of natural cheese.

[3] Based on retail prices of butter, American cheese and evaporated milk, weighted to apply to quantity of manufactured dairy products excluding butter.

[4] Based on national average wholesale and retail prices of American cheese, butter, evaporated milk, ice cream, condensed milk, and dry whole milk and the price of cream at Boston, weighted to apply to quantity of manufactured dairy products, excluding butter.

[5] Prices are the same as listed in footnote 4, except that the retail price of American cheese is omitted.

[6] Preliminary.

END