AN ECONOMIC ANALYSIS OF CLASS I MILK PRICING IN LOWER MICHIGAN

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ABSTRACT

AN ECONOMIC ANALYSIS OF CLASS I MILK
PRICING IN LOWER MICHIGAN

by Robert Lee Beck

Pricing formulas are used in Federal milk order markets in establishing a minimum Class I price. The two types of formulas commonly used are the manufacturing milk formula and the economic formula. A manufacturing milk formula bases the Class I price on the value of milk used for manufacturing dairy products while an economic formula bases the price on a series of economic indicators.

The two formulas differ in the underlying assumptions and the rationale upon which each is based. The use of a manufacturing formula assumes: (1) the primary market for milk is for the manufacturing of dairy products and (2) resources used in the production of milk have few alternative uses. The economic formula assumes: (1) the primary market for milk is for fluid uses and (2) the resources used in milk production are faced with many alternatives, both farm and nonfarm uses.

A manufacturing milk formula is used as a basis for establishing minimum Class I prices in the Federal order markets in Michigan. Trends in urbanization and industrialization and substantial declines in production of milk of manufacturing quality have led to the suggestion that the use of an economic formula, as a basis for Class I pricing, would be more applicable to existing economic conditions in Lower Michigan. This study was designed to examine these conditions in light of the differing assumptions upon which the use of

the two types of formulas is based.

First, a thorough examination of the dairy industry in Michigan was made with the view of determining the relative importance of the fluid milk sector and the manufacturing milk sector and thus determine the primary market for milk. Secondly, an analysis of both the farm and nonfarm alternatives for resources used in milk production was made to determine the degree to which milk production competes for factors of production.

From the study, the following general conclusions were drawn:

1. The declining production of manufacturing quality milk, the increasing production of milk eligible for fluid consumption, and the resultant dependency of the manufacturing market on Class II milk as a source of supply leads to the conclusion that the primary market for milk in Michigan is the fluid sector.

2. Milk production competes with nonfarm industries for labor; urban development and other nonagricultural uses compete for land; and other farm enterprises compete for all factors of production -- land, labor, capital, and management. Thus, the conclusion that resources used in the production of milk have alternatives and that the dairy industry must offer comparable returns to these factors in order to hold them, or attract other resources, seems justified.

3. The conclusions that milk is produced primarily for the fluid market and that the factors of production have alternatives agree with the assumptions upon which the use of an economic formula is based. Thus, the feasibility of the use of an economic formula as a basis for establishing Class I prices in the Lower Michigan markets was suggested.

4. This study does not support the hypothesis that existing economic conditions in Michigan justify the continued use of a manufacturing milk formula as a basis for establishing Class I prices. It does support an implied alternative hypothesis that changed conditions now suggest the use of an economic formula.

Based upon these conclusions, an economic type formula was developed as a basis for establishing minimum Class I prices in Lower Michigan. The dependent variable chosen was the effective Class I price in the Southern Michigan Federal order market. To reflect changes in general economic conditions, supply, and demand, the following independent variables were selected: (1) index of U. S. wholesale prices, (2) index of prices paid for manufacturing milk, (3) index of prices received by Michigan farmers for all farm products except dairy products, and (4) index of the percentage of total receipts used as Class I. Each independent variable was assigned a weight by the single equation regression model:

$$Y_j = \alpha + \beta_1 X_{1_j} + \beta_2 X_{2_j} + \beta_3 X_{3_j} + \beta_4 X_{4_j} + u_j.$$

Using annual indexes for the period 1935-61, the following coefficients were obtained:

$$\hat{Y} = -.68 + .49X_1 + .40X_2 + .07X_3 + .04X_4.$$

With this model, 98 percent of the variation in the Class I price, on an annual basis, was explained or associated with the changes in the four independent variables selected.

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CHAPTER I

INTRODUCTION

The type of formula used for establishing Class I milk prices should be a function of the economic conditions which exist within the dairy industry and the economic environment of the society within which the industry operates. As these conditions change, it is necessary to adjust the pricing formula accordingly.

Basically, there are two types of formulas commonly used in pricing fluid milk. The manufacturing milk formula bases the Class I price on the value of milk used for manufacturing purposes. The economic formula uses indexes of economic factors as a basis for establishing the Class I price. The two formulas differ significantly with reference to the assumptions regarding the primary market for milk and the alternative uses for factors of production.

A manufacturing milk formula is used as a basis for establishing Class I prices in the Federal order markets of Lower Michigan. However, recent discussion among dairy leaders in the state regarding formula types has led to the suggestion that economic indexes as a basis for Class I pricing might be more applicable to existing economic conditions. For that reason, the author has attempted an economic analysis of Class I milk pricing in Lower Michigan.

Objectives

There are three objectives of this study. The first is to

analyze the changes and trends in Michigan's dairy industry in light of the underlying assumptions of the manufacturing type formula and those of the economic type formula concerning the primary market for milk.

A second objective is to examine the alternatives for resources used in producing milk. This analysis is directed at an examination of the alternatives as they relate to the differing assumptions of the two types of formulas.

The third objective is to suggest a Class I pricing formula for Lower Michigan which will reflect the findings of this study.

Hypothesis

The basic hypothesis of this study can be stated as follows: The existing structure of the dairy industry in Michigan and the economic environment within which the industry functions justify the continued use of a manufacturing milk formula as a basis for establishing Class I price.

The basis for rejecting or not rejecting the hypothesis will be a thorough analysis of the existing conditions as they relate to the economic rationale and the assumptions of the different types of formulas.

Organization of Thesis

The procedure followed in this study is that of first reviewing the history of fluid milk pricing and presenting theoretical models which might be helpful in explaining price determination in the dairy industry. In addition, the assumptions, components, and rationale of the two types of pricing formulas will be discussed in

detail. Chapter III is devoted to an examination of the changes and trends in Michigan's dairy industry and the implications for the type of pricing formula. The analysis attempts to determine the relative importance of the fluid and manufacturing milk sectors in determining which sector represents the primary market for milk. Chapter IV is an examination of the alternatives for resources used in milk production. The basis for Chapter IV is the differing assumptions of the formulas concerning whether there are alternative uses for the resources used in milk production. A recommended Class I pricing plan is presented in Chapter V. The plan uses the type of pricing formula which seemed applicable based upon the results found in Chapters III and IV. The summary and conclusions are set forth in Chapter VI.

CHAPTER II

A REVIEW OF THE HISTORY AND THEORY OF FLUID MILK PRICING[1]

Theoretical Models Used in Fluid Milk Pricing

In an analysis of fluid milk pricing the use of theoretical models facilitates an understanding of price determination. This section is devoted to: (1) a discussion of the location of milk production and (2) price determination in a market in which a producer bargaining association controls a large portion of the supply of fluid milk and in which Federal order provisions provide for price discrimination through a system of classified pricing.

Location of Production

The location of agricultural production, as set forth by Von Thunen in the early part of the 19th century is particularly relevant to the location of milk production and to the form in which milk is marketed. Von Thunen's isolated state, in explaining the location of agricultural production with respect to the consuming

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[1]Throughout this study, numerous references will be made to fluid milk, manufacturing milk, Class I, and Class II milk. Fluid milk is defined as that milk which is produced under sanitary standards which make it eligible for fluid consumption. Manufacturing milk refers to milk produced under less rigorous sanitary standards and, as a result, is only eligible for use in manufacturing dairy products. Class I and Class II designates the use classifications of fluid milk. Milk and cream consumed in fluid form make up Class I. Class II milk is the amount above Class I use and is used in manufacturing dairy products.

center, states that the production of goods will be determined by their value in relation to the costs of transportation and by their form. As one moves away from the consuming center, land will be used less intensively and devoted increasingly to goods which are relatively less perishable and which are valuable enough to bear the cost of transportation. When this principle is applied to the location of milk production and the form in which milk is marketed, the zones from which the different products are shipped will tend to take the form of concentric circles around the consuming center. The boundary lines between adjacent product zones are defined by the formula $P_1 - T_1R = P_2 - T_2R$. P_1 and P_2 equals the price of one hundred pounds equivalents of milk made into products 1 and 2, respectively, while T_1 and T_2 are the transportation rates for products 1 and 2. Solving the equation for R establishes the boundary between the two zones.

Based on the Von Thunen type analysis, the relation of price to distance from the market in establishing product zones may be represented graphically as in Figure 1.

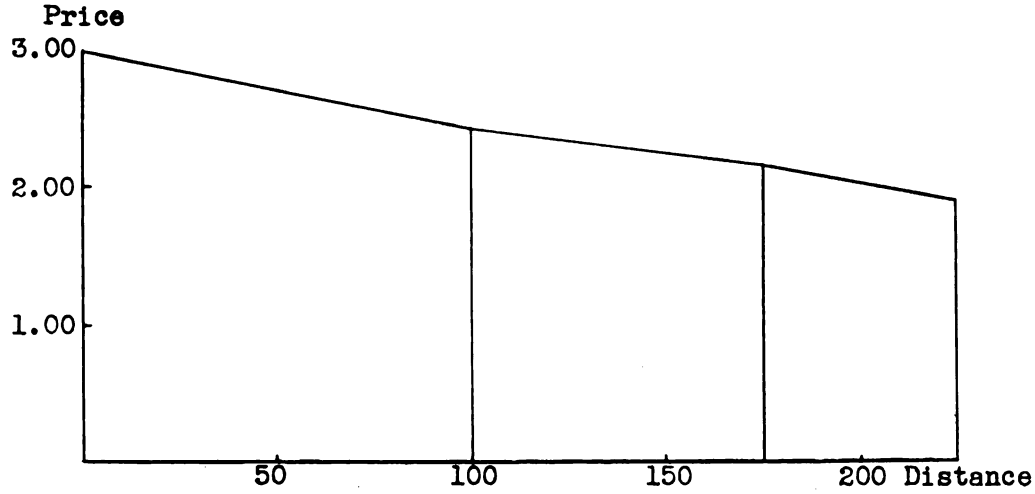

Figure 1.--The relation of the price of milk to distance from market in different product zones.

The product zones change when changes occur in transportation rates or in the relative prices of the different products.

Price Determination in a Fluid Milk Market

The forces of supply and demand generate market prices within the limits of an organizational framework. At one limit of the range of possible organizational patterns is the purely competitive market. At the other limit is the monopoly. Between these two extremes there exists an array of market structures. As the market structure approaches that approximating monopoly conditions, the market price becomes a function of the relative bargaining power of the buyer and seller.

Recent developments in the organization of supply in some fluid milksheds have brought about a market composed of one major producer bargaining association which sells a high percentage of the milk furnished for that market to a few buyers. This has introduced a market structure similar to that of a bilateral monopoly and is often referred to as monopolistic oligopsony. Because of the similarity, in terms of the market structure, a bilateral monopoly model is often used to cast light on price determination in the fluid milk industry. It should be pointed out that while it is possible to fix definite limits within which price may be agreed upon, the exact price level within these limits is indeterminate, from a strictly economic point of view. The actual price will depend upon the relative bargaining strength of the buyer and seller.

The form of bargaining which prevails in some fluid milk markets is that in which the cooperative and the distributor negotiate the price of milk for some future period during which the supply may

change. There is no attempt to fix the total quantity of milk to be supplied nor the total amount of money to be paid.

The limits of the bargaining range for a Class I price are shown in Figure 2. Given the assumption of profit maximization, the seller would seek to establish price Oj, at which he would furnish OA quantity of milk. At this point, the seller would maximize profits. The buyer would be equally desirous of establishing a price Od. At this price the buyer could maximize profits by purchasing OG quantity of milk. The conflict of objectives involves the buyer's efforts to force the price down to Od, where the seller will produce not less than quantity OG, while the seller is striving to force the price up to Oj, where the buyer will purchase quantity OA. Since the price becomes, within comparatively broad limits, a question of relative bargaining power, the outcome will be dependent upon factors affecting the bargaining position of each party.

The introduction of a third party, namely, a Federal milk marketing order, into the analysis changes both the relative bargaining positions and the bargaining range. The basis for referring to a Federal marketing order as a third party in the bargaining process is based on the philosophy and objectives of Federal regulation of markets as set forth in the Agricultural Marketing Agreement Act of 1937. These objectives include the following:

> Whenever the Secretary finds, upon the basis of the evidence adduced at the hearing required by section 608b of this title or this section, as the case may be, that the parity prices of such commodities are not 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 agreement, order, or amendment relates, he shall fix such prices

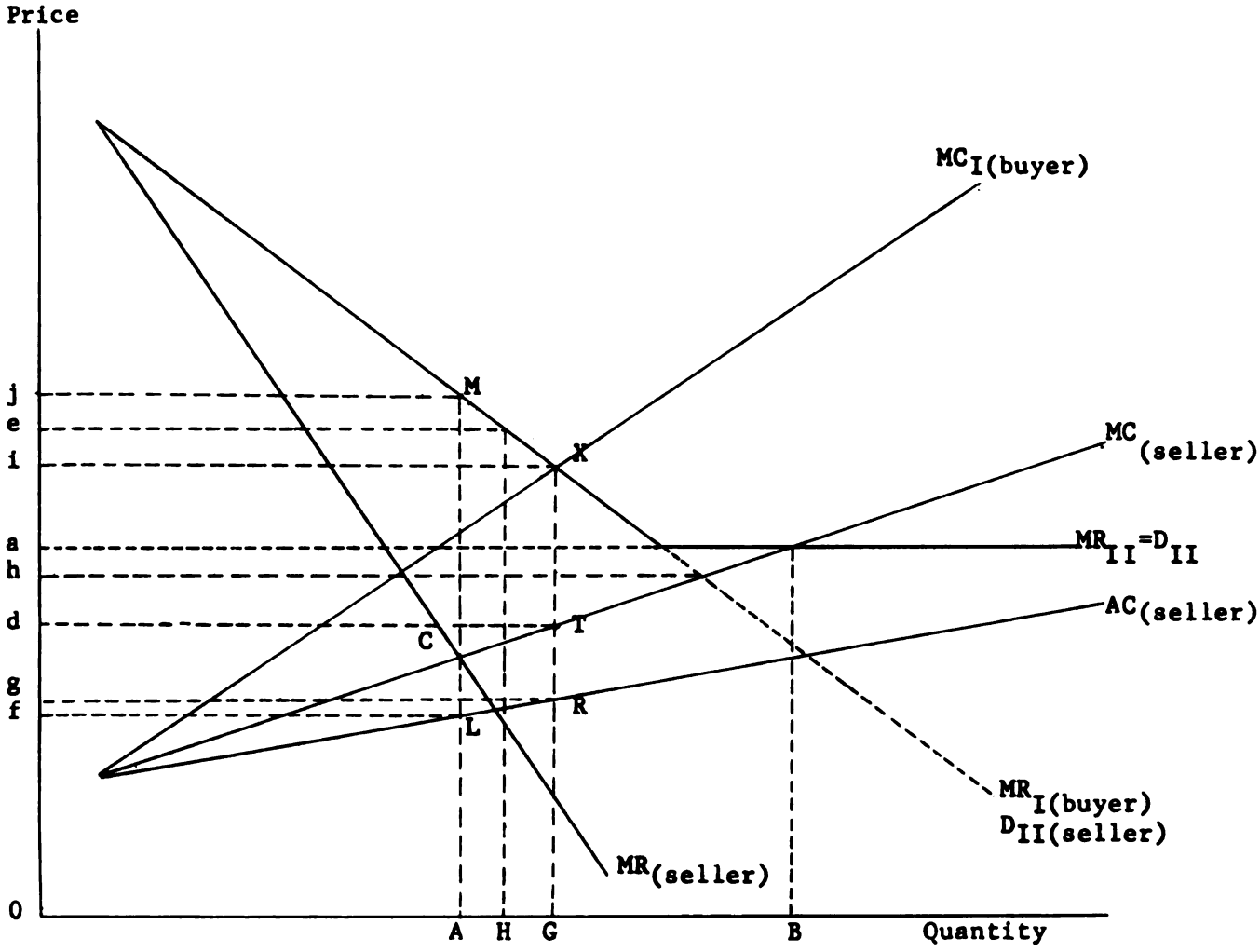

Figure 2.--A hypothetical model of a bilateral monopoly and discriminatory pricing by a seller in two markets.

> as he finds will reflect such factors, insure a sufficient quantity of pure and wholesome milk, and be in the public interest.[1]

The statement "be in the public interest" leaves the connotation that society is being represented. This point is further exemplified by the philosophy associated with market performance and the role played by society in influencing market performance.[2] As society develops, policies and programs evolve which have an objective of influencing the marketing environment. The type of programs and the extent of their use is an expression of the set of values and beliefs held by society at a given time. These values and beliefs are brought to bear on the marketing system through the political system. If we assume that society has accepted some notion of market performance which involves the welfare of the market participants as well as society then it follows that this notion is expressed in the formulation and implementation of policies which it believes will bring about such performance.

It is in this context that Federal milk marketing orders may be viewed as a third party in the bargaining process. Through the political system, society has expressed its notion of the market performance expected from the dairy industry and the procedure it believes will bring about such performance.

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[1]United States Department of Agriculture, Compilation of Statutes Relating to Research, Statistics, and Reports Service and Regulatory Work, and Food Distribution, Agriculture Handbook No. 201 (Washington: U. S. Government Printing Office, 1961), p. 40.

[2]Market performance refers to the economic results that flow from the industry as an aggregate of firms. Society is concerned with how an industry performs in terms of its efficiency, its progressiveness, and its stability. For a discussion of the principal dimensions of market performance see Joe S. Bain, Industrial Organization (New York: John Wiley and Sons, Inc., 1959), p. 12.

If an additional assumption is specified, generalizations may be made relative to the bargaining range when a Federal order minimum price is introduced into the bargaining process.[1] If it is assumed that the cost structures of both the buyer and seller remain unchanged after a Federal marketing order becomes effective, the establishing of a minimum Class I price narrows the bargaining range except in that case in which the Federal order minimum price is Od or below, or price Oj or above. In such a case, the bargaining range remains unchanged and the Federal order minimum price becomes irrelevant in the bargaining process. If the Federal order minimum price is below Od, the buyer would bid up the price to Od to maximize profits. Likewise, the seller would bid down any price above Oj. Thus the bargaining range is narrowed by the amount which the Federal order minimum price exceeds price Od.

Profits are influenced by the level of price. Within limits, the higher the price established for milk, the greater the seller's aggregate profits; the lower the price established, the greater the buyer's profits. These limits are established by the prices and quantities which maximize the total profits of the buyer and seller, respectively. Profits are definable at these two points. If the seller dominates the bargaining process and can dictate the terms of exchange, he would choose a price of Oj and quantity OA. At this point the seller's profit would be fLMj. If the buyer dominates and is able to establish his desires, he will pay price Od for quantity OG.

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[1]This modification of the method of establishing a price via collective bargaining may be referred to as authoritative-negotiated pricing. With the Federal order minimum price as a lower limit to the bargaining range, a Class I premium above the minimum price is negotiated.

In this case, the seller's profit is gRTd. In the long-run, however, MC = AC and this profit disappears. The buyer gains a profit dTXi plus any profits he may gain from selling to the final consumer. In the same manner, profits can be shown for any given price and quantity.

The distributor is not only a monopsonist with respect to the seller but is a monopolist in selling to the consumer. Thus, he will try to maximize total profits by negotiating a price such that the total of monopsony profits which he is able to extract from the seller plus the monopoly profits which he is able to extract from the consumer is greatest. If we assume that monopoly price is defined as that price above which the seller is willing to take and likewise, monopsony price as that price below which the buyer is willing to pay, for a given quantity, then, dTXi becomes monopsony profit to the buyer. If, on the other hand, we assume that monopoly profit is defined as profits over and above the implicit cost elements, provided that average revenue is above average cost, and that monopsony profits accrue to a firm because it is able to pay factor-owners less than the competitive factor-income price,[1] the buyer's monopsony profit is not the same as above but, rather, is dependent upon the level of the competitive price.

The introduction of a Federal minimum order price influences, to some extent, the distribution of profits between the buyer and seller. The level of the minimum price as well as the definition of monopoly and monopsony price is crucial to the discussion of the distribution of profits. Again, if we define monopoly as that price

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[1]John F. Due, Intermediate Economic Analysis (Homewood, Illinois: Richard D. Irwin, Inc., 1956), pp. 440-441.

above which the seller is willing to take and monopsony price as that price below which the buyer is willing to pay, a Federal order minimum price above Oh limits the handler to the monopoly profits which he is able to extract from the consumer. If we assume monopoly and monopsony price to be associated with implicit costs and competitive factor prices, respectively, the handler may still extract monopsony profits from the seller provided the Federal order minimum price is below the competitive market price for factors. Again, monopsony profit is dependent upon the level of the competitive market price for the given quantity.

When the Class I price has been negotiated, given the supply and demand functions for each market, the quantity to be sold in the Class I and Class II markets is determined. The quantity and price for each market are shown in Figure 2. If, for example, the negotiated price is Oe, quantity OH will be sold in the Class I market and quantity HB will be disposed of in the Class II market at a lower price, Oa. This method of selling milk in two separate markets is referred to as classified pricing of milk. This method was developed by producer bargaining associations in the sale of milk to handlers in city markets and represents the application of a practice known as price discrimination. Price discrimination is the term applied to any practice whereby a seller sells a homogeneous commodity at the same time to different buyers at different prices.

There are two conditions which are essential to the successful application of discriminatory pricing to milk pricing. These are: (1) different elasticities of demand for the commodity in the price categories established and (2) the markets must be kept separated.

The seller practicing price discrimination determines the distribution of sales among the different markets. For any given volume of sales, the seller will distribute them among the markets in such a manner that the marginal revenue in all markets is equal. Since more milk than the buyer is willing to take at the agreed Class I price is produced, the Class II milk must be disposed of at a lower price. In this case, the cooperative will profit by diverting part of the supply to the Class II market in order to protect the Class I price.

The essential condition that makes discriminatory pricing a profitable practice is the existence of demand functions with different slopes in the fluid and manufacturing markets. The demand for Class I milk is normally quite inelastic within the range of reasonably anticipated price changes while the demand for Class II milk is relatively elastic in most fluid markets. Demand functions with different slopes may be associated with geographic areas, or with income, occupation, and ethnic groupings within the same area. The differing elasticities of demand for milk and manufactured dairy products, however, are usually attributed to the fact that the market for manufactured dairy products is nationwide while the Class I market is limited by the bulkiness and perishability of fluid milk and by local health regulations.

The producer association is limited, to some extent, in practicing price discrimination.[1] If the seller has some degree of

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[1]For a discussion of certain features which differentiate classified pricing of milk from the more usual application of price discrimination by sellers, see: Edmond S. Harris, Classified Pricing of Milk, Some Theoretical Aspects, USDA Technical Bulletin 1184 (Washington: U. S. Government Printing Office, 1958), pp. 37-39.

monopoly control over prices and distribution he will distribute sales such that marginal revenue in all the markets is equal. Total revenue is greatest when the quantity is divided between markets in this manner. However, the producer association is unable to do this except as is implicit in the negotiated price. If the bargaining association is strong enough to dominate the bargaining, prices may be set which would equate the marginal revenue in the Class I and Class II markets. If the producer association occupies a relatively weak bargaining position, it is conceivable that the price might be one which would not equate the marginal revenue in both markets. Since the seller faces a relatively elastic demand curve for Class II milk, this market is used primarily to salvage as much revenue as possible from the Class II milk.

This section may be concluded by stating that these models can prove useful in shedding light on price determination in the dairy industry by providing a conceptual framework for an evaluation of Class I milk pricing.

The Evolution of Fluid Milk Pricing

The methods of determining prices to be paid producers for fluid milk have passed through at least four phases during the past century. The first phase was characterized by numerous unorganized producers and many buyers, none of which could affect prices by their actions. Under these conditions, the price of fluid milk was a function of the impersonal movements of supply and demand. The intersection of the supply schedule and the demand schedule indicated the equilibrium. Price changes were brought about by the interaction of adjustments in the demand for and the supply of milk.

The second phase in the evolution of price determination occurred simultaneously with the development of large scale operations in the fluid milk industry. The trend toward a few large distributors controlling a major portion of the fluid market was followed by the formation of producer associations for the purpose of bargaining collectively with the handlers. This type of price determination under conditions of imperfect competition is referred to as administered pricing. This introduced a market situation closely related to a bilateral monopoly and described by Nicholls as monopolistic oligopsony.[1] The producer bargaining associations became more active in their role as bargaining agents for the producer. To overcome the problems associated with a flat-rate price for all milk, the associations developed a classified pricing system wherein milk was priced according to the form in which it was used by the distributor. By practicing price discrimination in the Class I and Class II markets, the seller was able to increase total returns. Producers shared equally the lower prices received in the Class II market as well as the higher prices received in the Class I market. Distributors also received equal treatment in that each was given the same competitive advantage regardless of varying class utilization.

The third phase of this evolutionary process is called authoritative pricing and consists of price determination by public action through government regulation. In general, this has been limited to the determination and legal enforcement of minimum prices by both Federal and state agencies. In the early thirties, milk

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[1]William H. Nicholls, Imperfect Competition Within Agricultural Industries (Ames: Iowa State College Press, 1941), p. 14.

prices declined rapidly and to very low levels in relation to other agricultural products. Producer associations, which for a short period had prevented a decline in price, were unable to cope with the problem. Meanwhile the Federal government was taking steps to prevent further declines and even restore the pre-depression price levels for farm commodities. A series of Acts, starting with the Agricultural Adjustment Act of 1933, was passed by Congress. The Acts were specifically designed to increase prices of agricultural products. The Agricultural Adjustment Act authorized the Secretary of Agriculture to enter into marketing agreements between producer associations and distributors of milk. Marketing agreements established minimum producer prices but they were unsuccessful in establishing minimum resale prices for milk. In 1934, the Department of Agriculture terminated all former agreements on minimum resale price and directed its activities toward the determination and maintenance of producer prices only. The terminated marketing agreements were replaced by licenses which reflected the new policy of administering only producer prices. Following a series of amendments and constitutionality cases involving the Agricultural Adjustment Act, the order-agreement provisions were included in the Agricultural Market Agreement Act of 1937. The Act, as amended, has successfully withstood some of the tests of constitutionality wherein the order-agreement provisions of the Agricultural Adjustment Act failed.

It is on the basis of the provisions of the Agricultural Market Agreement Act of 1937 that Federal milk marketing orders operate. Such orders establish minimum class prices. Authoritative pricing of fluid milk came into use during a period in which all

agriculture was in a depressed condition and needed help. It has remained as an aid in the marketing of a perishable product.

A fourth phase may be referred to as authoritative-negotiated pricing. Through collective bargaining, a Class I price is established above the Federal order minimum price. This method of pricing is used in several Federal order markets, including those in Michigan. The Federal order minimum price becomes a floor from which to negotiate. The level of the negotiated price is determined by the relative bargaining position of the producer associations and the handlers. The effect of the Federal order minimum price on the bargaining range and on the relative bargaining positions of the buyer and seller was discussed in the previous section.

Formula Pricing

Formula pricing of milk dates back to World War I. At that time milk prices in most major markets were under government regulation. The formula technique was an attempt to introduce automatic elements into an administered fluid milk pricing system.

As classified pricing developed, formulas were used for pricing Class II milk in markets where the classified pricing plan was in operation. The price of Class II milk was based upon the value of milk used in manufacturing dairy products. Aside from that, there was very little emphasis on formula pricing until the mid 1930's. A formula system for pricing Class I milk was adopted in the Chicago market in 1935, almost four years prior to the establishment of a Federal order for that market. Class I premiums above the minimum Federal evaporated milk code price were established. The evaporated milk code price was determined by a formula

based on the prices of butter and cheese.

Prior to the passage of the Agricultural Marketing Agreement Act of 1937, Class I prices in markets regulated by the Federal government were fixed prices. They were established or changed by a public hearing. However, the Act established a more rigorous procedure for issuing and amending orders which greatly increased the time required to make changes in Class I prices. Because of the time required to establish prices under these conditions, formula pricing was adopted in many markets as a means of making Class I prices more responsive to changes in economic conditions. This trend was interrupted by World War II conditions which necessitated the use of price controls. Very few changes in the pricing structure in fluid milk markets occurred during this period. However, the anticipated rise in price with the removal of price ceilings gave further impetus to the adoption of formula pricing in Federal order markets. Formula pricing is now the accepted method of establishing Class I price in all Federal order markets.

Types of Pricing Formulas

There are basically two types of formulas used in pricing Class I milk. The type most commonly used is the manufacturing milk formula which bases the Class I price upon the value of milk used for manufacturing dairy products. The second type, usually referred to as an economic formula, bases the price of Class I milk on a series of economic indicators.

Manufacturing milk formula

An analysis of a fluid milk market will suggest many factors

which may influence Class I price. It will also indicate certain relationships or correlation between the historical Class I price in the market and other prices. The manufacturing milk formula does not attempt to isolate and incorporate the relationship between Class I price and all the factors influencing the price of fluid milk. Instead, the formula is based upon the assumption of a close and reasonably constant relationship between fluid milk prices and the price of milk used in manufacturing dairy products. The formula attempts to maintain what appears to be a normal relationship between the Class I price and the price of one or more dairy products in the market. This is based on an analysis of past relationships and a knowledge of the difference in costs of producing milk for different uses. Prior to the development of health regulations, milk was considered a homogeneous product and could be used for fluid consumption or manufacturing purposes without restriction. Under those conditions there was a direct causal relationship between the price of manufactured dairy products and fluid milk. Health regulations did not destroy this relationship but the relationship became less automatic because of the increased costs associated with the production of milk for fluid consumption.

The assumption of a close and reasonably constant relationship between fluid milk prices and prices received for manufactured dairy products may be questioned on the basis of differing effects on fluid milk and various manufactured dairy products of the same economic forces. An example is the effect of changes in income on the consumption of fluid milk and manufactured dairy products. Estimates of income elasticities for fluid milk and cream and manufactured dairy

products for the post World War II period of 1947-54 are given by Rojko as follows:[1]

Fluid milk and cream	0.27
Butter	0.36
American Cheese	-0.99
Other dairy products	3.06

This is only one example of the differing effects of a demand shifter on the various milk products. Perhaps other shifters of supply or demand act similarly.

Because of the assumption of a close correlation between fluid milk prices and the price of manufactured milk products in the past, the manufacturing milk formula has been extensively employed in markets where the causal relationships were considered evident. These markets are located primarily in the middlewest and the far western section of the United States.

Manufacturing milk formulas vary in composition. However, the raison d'etre of pricing Class I milk on the basis of the value of milk used for manufacturing purposes remains unchanged. To accomplish this objective, some manufacturing milk formulas use the prices paid for whole milk used for manufacturing dairy products. The midwest condensery price has long been used as one of the principal measures of the value of manufacturing milk. However, because of the declining number of plants used in this price series, the Minnesota-Wisconsin price series has been developed as an alternative measure. The Minnesota-Wisconsin price series provides a much broader base since it represents the prices paid for more than 50 percent of the

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[1]Anthony S. Rojko, The Demand and Price Structure for Dairy Products, USDA Technical Bulletin 1168 (Washington: U. S. Government Printing Office, 1957), p. 105.

manufacturing milk produced in the United States.

Other manufacturing milk formulas use the market price of various dairy products such as butter, cheese, and non-fat dry milk powder to derive a measure of the value of manufacturing milk. This value is then used as a basis for determining Class I price. Regardless of the technique used to derive a measure of the value of manufacturing milk, the basis for the Class I milk price remains unchanged.

The assumptions and the philosophy associated with the types of formulas are crucial to this analysis. The reasoning used for basing the Class I price on the value of milk used for manufacturing purposes is the assumption that the manufacture of dairy products represents the primary market for milk. It is further assumed that the factors of production have limited alternative uses other than in the production of milk.

The latter assumption implies that factor alternatives differ among markets and that formulas differ with respect to the extent to which they reflect opportunity costs in the Class I price of milk. The use of a manufacturing milk formula or an economic formula in any given market assumes that knowledge regarding the alternative uses for resources used in milk production in that market have been taken into account in considering the economic feasibility of the formula.

Economic formula

Failure of the manufacturing milk formula to make prompt price adjustments for major changes in economic conditions prompted a search for a new type of Class I pricing formula following World

War II. In an effort to devise a formula which would be acceptable and at the same time make these adjustments promptly, the Boston Milkshed Price Committee was appointed to study the pricing problem in the Boston market. The committee's major objective was that of determining an alternative method of establishing future Class I prices in the Boston market. The resulting economic formula recommended by the committee differed from the manufacturing milk formula in that it abandoned the attempt to correlate the Class I price of milk to the value of manufacturing milk. Instead, Class I price was associated with what was considered to be several of the major factors with which movements of Class I prices were associated. These factors then became the price movers in this new type Class I pricing formula.

Price movers for economic formulas may vary because of the individual market conditions but basically they fall into the following interrelated categories: (1) factors which indicate a change in the general price level, (2) factors which reflect a change in supply, and (3) those which reflect changes in demand. Various combinations and modifications of price movers may be used, depending upon the market.

The primary function of a factor which measures the general price level is to keep the Class I price of milk in a reasonable relationship with the general level of economic conditions. A secondary function is to stabilize short-run price movements which may be associated with irregular or episodic time elements. Fluctuations in the general price level are usually less violent than those brought about by other shifters of the supply and demand function for milk.

Factors which reflect changes in the local supply of and the demand for milk are usually confined to the local market. To a large extent, fluid milk markets are still locally oriented and thus price should reflect the changes in supply and demand which occur in each market.

The assumptions and the economic rationale upon which the economic formula are based differ from those of the manufacturing milk formula. The use of an economic formula assumes that the primary market for milk is the fluid market. The manufacturing market is considered the residual market for the Class II milk from the fluid market. The use of an economic formula also assumes that the resources used in fluid milk production are not faced with limited alternative uses, as is assumed by the use of a manufacturing milk formula, but that there are alternative uses such as other farm enterprises and nonfarm uses. If resources used in producing fluid milk have alternative uses each factor must, in the long run, earn a return which will prevent its shifting to other uses. In order to take alternative opportunities for resource use into account, a formula must include variables which will result in milk prices which reflect the earning power of the resources in competing alternatives.

CHAPTER III

CHANGES AND TRENDS IN MICHIGAN'S DAIRY INDUSTRY AND IMPLICATIONS FOR THE TYPE OF PRICING FORMULA

The dairy industry in Michigan has experienced tremendous changes during the past decade. The trend toward specialization in milk production has left this segment of the industry in a position to be greatly affected by decisions made outside agriculture. An example is the dependence on credit for greater investments, the rates of which are determined in the money market. With the trend toward specialization, there has been a trend toward increased production of milk for the fluid market. The total receipts of fluid milk in the Southern Michigan Federal order market increased 43 percent during the period 1952-1959. At the same time, total sales of whole milk increased 19.5 percent. This indicates that an increasing portion of manufactured dairy products are being made from milk of fluid quality.

The changes and trends in the dairy industry have implications for the type of Class I pricing formula. One objective of this study was to examine these changes as they relate to Class I pricing.

Fluid Milk Sector

Production of milk for the fluid market has increased although the number of producers has decreased. This may be attributed to

increased production per cow and increased herd size. The average number of producers delivering milk to regulated handlers in the Southern Michigan order market decreased 1.5 percent per year for the period 1952-59. The average daily delivery of milk per producer in this market was 60.5 percent greater in 1959 than in 1952.[1]

A comparison of these changes with the structural changes which occurred in the production units of all milk producers presents a more meaningful view of the relative importance of the fluid milk segment. As shown in Table I, the number of dairy farms decreased 46 percent while the number of cows per dairy farm increased 72.7 percent.

Table II indicates a decline in the number of farms reporting less than 20 milk cows while the number with 20 or more cows increased during the period 1950 to 1959. This is significant in view of the fact that most manufacturing milk producers fall into the less-than-20-cows-per-farm category. Also, the rate of decrease in the number of fluid milk producers has been less than the rate of decrease for manufacturing milk producers.

In Michigan, 96 percent of the milk sold by farmers in 1961 was in the form of whole milk. This represented a 15 percent increase over the amount sold as whole milk in 1947. A large portion of this milk is produced under sanitary conditions which make it eligible for the fluid market. In 1961, forty-one percent of the total milk produced was used for manufactured dairy products. Since this included Class II milk from fluid markets, a much higher percentage than the 59 percent indicated was of fluid milk quality.

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[1]This type of comparison is valid despite the fact that the marketing areas for the two years are different.

TABLE I.-Structural changes in the organizational units of milk production, Michigan, 1950-1959[1]

Item	1950	1959	Percent change
Farms reporting milk cows	105,990	50,587	52.3
Average number of cows per farm reporting milk cows	7	12	71.4
Number of dairy farms[2]	45,729	24,673	46.0
Number of cows per dairy farm	11	19	72.7
Total number of milk cows on farms	794,341	628,044	21.4
Average production per cow (pounds)	6,200	7,830	26.2
Farms reporting sales of milk and cream	91,426	43,110	52.8

[1]United States Bureau of the Census, U. S. Census of Agriculture: 1950, Vol. 1, Pt. 6 (Washington: U. S. Government Printing Office, 1952).

United States Bureau of the Census, U. S. Census of Agriculture: 1959, Vol. 1, Pt. 6 (Washington: U. S. Government Printing Office, 1962).

[2]As defined by the census of agriculture.

TABLE II.-Distribution of farms reporting milk cows by the number of cows per farm, Michigan, 1950-59[1]

	Less than 5 cows	5-9 cows	10-19 cows	20-49 cows	More than 50 cows
			(number of farms)		
1950	40,600	34,787	25,943	4,856	136
1959	15,996	10,912	13,937	10,244	685

[1]C. R. Hoglund, Michigan Dairy Farming, Agricultural Experiment Station Special Bulletin 440 (East Lansing: Michigan State University, 1962), p. 8.

Major developments and trends in the processing of fluid milk are evident from the data shown in Table III. The most noticeable changes were: (1) a decline in the number of fluid milk processing plants, (2) an increase in the size of plant, and (3) shifts in the product line.

The number of processing plants decreased 52 percent during the period 1950-1960. The increase in average plant size of fluid milk plants, in terms of pounds of milk received, was even more noticeable. This average increased from 4.9 million pounds of milk in 1950 to 12.2 million pounds in 1960, or an increase of 149 percent. Other data in the same table indicate changes which occurred in the product lines of fluid milk plants.

The fluid milk segment of Michigan's dairy industry, even though changed in structure, has become an increasingly important part of the industry. The trend in production is toward fewer and larger producers. Fluid milk sales have increased, even though per capita consumption has decreased. Fewer, larger, and more

TABLE III.-Changes in the number, size, and product line of fluid milk plants, Michigan, 1950-1960[1]

Item	1950	1960	Percent change
Number of plants	562	269	52
Amount of milk received (million pounds)	2,770.4	3,273.2	18
Percent used as Class I[2]	68.0	64.0	n.a.[3]
Average size of plant (million pounds)	4.9	12.2	149
Whole milk sold for direct consumption (million pounds)	1,719.4	2,218.4	129
Number of plants processing various milk products			
Fluid cream for direct consumption	512	255	50
Butter	53	19	64
Creamed cottage cheese	138	67	51
Ice cream	143	83	42
Ice cream mix	90	76	16
Percent of total milk products processed by fluid milk plants			
Fluid cream for direct consumption	100	100	n.a.
Butter	11	11	"
Creamed cottage cheese	45	51	"
Ice cream	25	35	"
Ice cream mix	30	45	"

[1]Glynn McBride, Structural Changes in Michigan's Dairy Industry and Their Implications, Department of Agricultural Economics Preliminary Report (East Lansing: Michigan State University, 1962).

[2]Southern Michigan Federal order market area.

[3]Not applicable.

specialized plants are now handling the increased production and sales. These changes have implications which are relevant in considering formula types which might be used in pricing Class I milk.

Manufacturing Milk Sector

Changes and trends similar to those observed for the fluid sector are also evident in the manufacturing milk segment, but on a somewhat larger scale. One major difference is the fact that the production of milk for manufacturing purposes is decreasing at an extremely fast rate as compared to the trend in fluid milk production. A recent study of changes which occurred in the manufacturing milk sector between 1955 and 1957 indicated a 27.6 percent decrease in receipts of milk (milk equivalents) for manufacturing purposes for the plants in the sample.[1] A more recent study indicated that the trends in the 1955-57 study were continuing in 1960.[2] The decreasing relative importance of manufacturing milk is apparently due to the tendency to shift to fluid milk production and a failure on the part of remaining producers to increase the herd size.

Data are not available to determine the portion of the total milk production which is produced for manufacturing uses. Some insight is provided by a comparison of the data in Tables III and IV. During the period 1950-1960, the amount of milk marketed as whole milk in the state increased 18 percent. During the same period, the

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[1]Glynn McBride and Willard H. Blanchard, Changes in Michigan's Manufacturing Milk Industry, Agricultural Experiment Station Special Bulletin 427 (East Lansing: Michigan State University, 1959), p. 19.

[2]Glynn McBride and William B. Hellegas, "Fewer Producers of Manufacturing Milk," Michigan Farm Economics, No. 216, (January, 1961), pp. 1-2.

amount of milk received by fluid milk plants increased 18 percent while the amount received by manufacturing plants declined 7 percent. The composition of the change in the amount received by manufacturing plants is more significant than the actual change. The manufacturing milk sector is the market for a considerable portion of the Class II milk of the fluid sector. The increase in fluid milk receipts and a relatively stable Class I use means that a higher portion of the milk received by manufacturing milk plants was produced under conditions which made it eligible for the fluid market. When the Class II milk used for manufacturing purposes is accounted for, the amount of milk marketed as manufacturing quality actually declined more than the 7 percent indicated.

TABLE IV.-Change in the number and size of manufacturing milk plants, Michigan, 1950-1960[1]

Item	1950	1960	Percent change
Number of plants	201	153	24
Amount of milk received (million pounds)	3,090.6	2,885.6	7
Average size of plant (thousand pounds)	15,376	18,860	23

[1]Glynn McBride, Structural Changes in Michigan's Dairy Industry and Their Implications, Department of Agricultural Economics Preliminary Report (East Lansing: Michigan State University, 1962).

In conjunction with the decline in production of manufacturing quality milk, manufacturing plants decreased in number but increased in size. The number of manufacturing plants declined 24

percent during the period 1950-1960. At the same time the average capacity per plant increased 23 percent.

Thus, the trend is toward a continuing decline in importance of the manufacturing milk sector of Michigan's dairy industry. Because of an apparent shift of resources to fluid milk production and to nonfarm alternatives, the sector devoted to the production of milk for manufacturing purposes is declining, not only in absolute terms, but also relative to the fluid milk sector.

There is also a trend toward the use of higher quality milk for manufacturing purposes. Class II milk from the fluid markets continues to increase in importance as a source of supply for manufacturing plants. The increased use of this milk for manufacturing purposes indicates the changing relative importance of the two sectors of the industry.

If the present trends continue in both sectors, it is conceivable that the manufacturing milk sector may become entirely dependent on Class II milk from the fluid markets as a source of supply. This point is fundamental to the type of Class I pricing formula used since the formulas differ in the assumption concerning the primary market for milk.

Negotiated Class I Prices

Federal milk order regulations establish minimum class prices. Producers may bargain for higher prices if they wish. Negotiated Class I premiums have been paid to fluid milk producers in Michigan since 1956. Through 1961, negotiated premiums increased the Class I price in the Southern Michigan Federal order market an average of 59 cents per hundredweight. This means that the effective Class I price

has been a negotiated price rather than the minimum price established by the Federal orders.

Negotiated premiums are often pointed to as evidence of the shortcomings of the present formula for establishing Class I prices in Michigan. While there are other factors involved in negotiating Class I premiums, it is still an indication of the need for an evaluation of the formula in use. The fact that the effective Class I price has been a negotiated price rather than the formula price is one basis for questioning the appropriateness of the manufacturing milk formula. It is on this basis that negotiated premiums are here regarded.

Implications

This chapter has been devoted to an analysis of the changes and trends in Michigan's dairy industry during the past decade. The objective was to relate these trends to the type of pricing formula which might be considered as being applicable to existing market conditions.

Changes have occurred in the relative positions of the fluid and the manufacturing milk sectors of the industry indicating the declining importance of the manufacturing sector and the increasing emphasis on production of milk for the fluid market. A second change has been the use of negotiated prices rather than order prices for Class I milk.

Since the type of formula used should reflect existing economic circumstances and since it should be reasonably consistent with the rationale underlying its use, these findings appear significant in considering changes in the type of formula now being used.

CHAPTER IV

RESOURCE ALTERNATIVES AND THE IMPLICATIONS FOR THE TYPE OF PRICING FORMULA

In a free enterprise economy, resources are allocated among different uses in such way as to increase the efficiency of the economy.[1] Resource prices furnish the mechanism for reallocation of resources. A resource will shift when its VMP (value of marginal product) in one use exceeds its VMP in another use. The transfer will continue until its VMP is equalized in all its uses.

There are a number of forces which prevent the reallocation of resources. Even though the price system is free to operate as an allocator, there are other impediments to the movement of resources. Lack of knowledge on the part of resource owners may prevent their movement to alternative uses. This is particularly true in the case of labor where sociological and psychological factors may impede movements. Ties to particular communities, friends, or family may restrict mobility. Virtues of a particular occupation, community, or way of life may restrict mobility.

Spatial location is extremely important when considering land resource alternatives. The location of agricultural production, as set forth by Von Thunen in the early part of the 19th century seems

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[1]For a detailed discussion of resource allocation refer to R. H. Leftwich, The Price System and Resource Allocation (Revised edition; New York: Holt, Rinehart and Winston, 1960), Chapter xv, pp. 320-337.

particularly relevant in relating the location of fluid milk production to the alternative uses for resources used in milk production.

Von Thunen's isolated state model of explaining the location of agricultural production may be applied quite meaningly to the dairy industry in Michigan in explaining the location of milk production, location of plants, and the form in which milk is marketed.[1] This in turn, should be enlightening in the following analysis of the alternatives for resources used in milk production.

Population Growth and the Urban Movement

During the period 1950-60, the total population of Michigan increased 22.8 percent.[2] The most significant change was the trend toward centralization. In 1960, based upon residence, 73.4 percent of the state's population was classified as urban and 26.6 percent as rural. The percentages for 1950 were 70.7 urban and 29.3 rural. The numerical and percentage distributions by residence, since 1920, are shown in Table V.

During the past decade, there has been a growing concentration of population in the southern part of the state. The ten Standard Metropolitan Statistical Areas, comprising only 14 counties, account for 87 percent of the urban population and 36 percent of the rural

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[1]Supra, p. 4.

[2]Allan Beegle et al., Michigan Population, 1960, Agricultural Experiment Station Special Bulletin 438 (East Lansing: Michigan State University, 1962), p. 4.

population of the state.[1] This fact becomes more significant when it is noted that the greatest concentration of fluid milk producers is found in the same general area. This situation leads to competition for the land between urban and agricultural uses. As the demand for land for nonagricultural uses becomes greater, the resource will move from agricultural to nonagricultural uses and agricultural production will shift farther away from the population centers.

TABLE V.-Population of Michigan, 1920-1960[1]

Census year	Population			Percent	
	Total	Urban	Rural	Urban	Rural
1920	3,668,412	2,241,560	1,426,852	61.1	38.9
1930	4,842,325	3,302,075	1,540,250	68.2	31.8
1940	5,256,106	3,454,867	1,801,239	65.7	34.3
1950	6,371,766	4,503,084[2]	1,868,682	70.7	29.3
1960	7,823,194	5,739,132	2,084,062	73.4	26.6

[1]Bureau of Business and Economic Research, Michigan Statistical Abstract, 4th edition, compiled under the direction of David I. Verway (Graduate School of Business Administration, Michigan State University, 1962), p. 4.

[2]The new urban definition includes unincorporated urban places.

[1]A Standard Metropolitan Statistical Area (SMSA) is a county or group of contiguous counties which contains at least one city of 50,000 or more or "twin cities" with a combined population of at least 50,000. Contiguous counties are included in the SMSA if they are metropolitan in character and are socially and economically integrated with the central city. Ibid., p. 10.

Data are not available to indicate the quality of the acreages which go into nonfarm uses. There is little doubt, however, that much of the land now in urban and related uses was the better grades of agricultural land. Cities are usually located in places most accessible from the standpoint of transportation. This is usually the lowest, most level, land in the area. Much of the urban residential expansion takes place in the areas most easily developed. Railroads and highways are usually located on the most easily traveled routes. An exception is that parks and recreation areas tend to take land which is not particularly suited for agriculture. Thus, the urban movement of Michigan's population has provided an alternative use for land which is not available in states which are more agriculturally oriented.

There are other factors associated with the urban movement which deserve mention in this discussion of resource alternatives. These include: (1) the sociological aspects of the changes in values of the rural population, (2) the effect of urbanization on the farm property tax structure, and (3) the impact on the farm wage rate structure. These will be discussed as they relate to the analysis of resource alternatives.

Sociological Aspects

The impact of the urban movement on the rural population has been great. The declining isolation of farmers and the growth of larger trade center communities have contributed to the changes in rural society. The farmer's relative isolation from others in our society is largely disappearing because of modern transportation and communication systems. Many of the former rural institutions such as schools and churches have been transferred to the larger community.

The extension of industrial technology, the growth of urban markets, the increase of transportation facilities, and the general rise in the standard of living have exerted tremendous pressure upon the farmer to become a more integral part of the vast and infinitely complex economic system.

Values and ideals, once held exclusively by the rural segment of the population, are giving way to those normally held by urban residents. Values and attitudes regarding hard work and leisure and the concept of comfort no longer differentiate rural and urban society. With the adopted urban attitudes toward work, leisure, and comfort, rural people are taking on the status values of urban society. The concept of farming as a way of life, different from other occupations, is gradually changing. The way of life of the farmer and those in other occupations are becoming similar. Farmers, because of increased contacts and the change in the nature of the business of farming, are accepting the values and ideals which were once only associated with the urban society.

The location of milk production near urban centers puts the dairy farmer in close contact with these urban ideals. A recent study of the membership of Michigan Milk Producers' Association suggested a change in the attitude toward complete farmer independence.[1] Farmers recognize that they are a part of a larger society and are willing to accept broader roles. Off-farm work has brought farmers into contact with organized labor unions and their process of bargaining. The willingness of the membership to back

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[1]Glynn McBride and Glen L. Taggart, "Michigan Milk Producers' Association: An Analysis of MMPA-Member Relations, Attitudes, and Characteristics," Quarterly Bulletin, (February, 1957), 301-306.

their association in bargaining ventures indicates a change in attitudes toward bargaining and a recognition of their ability to influence their own well-being by such ventures.

Through closer contact with urban society, sociological and psychological barriers to resource reallocation are being removed. The rural population is becoming aware of the opportunities available and is willing to take advantage of them.

Property Tax

The upward trend in property tax has given rise to several important problems, not the least of which is the pressure on farmers located near urban areas. Increased property tax often results in the eventual shift of farm land to nonagricultural uses.

Rising taxes have added to the pressure on many farmers in peripheral areas to sell their lands for residential and other urbanized uses. The burden of the increased taxes has not been equally distributed. Most farmers have felt the squeeze of rising taxes against reduced farm incomes.

A recent study of property tax trends in Michigan, and their affect on farmers, provides evidence that an unequal tax burden has been placed upon farmers located near an urban area.[1] The high tax rates applied in the urbanized areas often constitute a real burden to those remaining farmers who depend upon agriculture for their livelihood.

Property taxes have risen in urbanized areas as a result of

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[1]William H. Heneberry and Raleigh Barlowe, Property Tax Trends Affecting Michigan Farmers, Agricultural Experiment Station Special Bulletin 421 (East Lansing: Michigan State University, 1959).

higher valuations and higher tax rates.[1] The farmers in these areas often find themselves paying more than their share of the tax load for two reasons. First, the delay in getting newly constructed properties on the tax rolls often shifts a major share of the expenses in the early years of suburban expansion to the farmers in the area. Second, there is a tendency in partially suburbanized areas to assess farm properties at higher levels relative to current market value. The assessed valuation of farm land is often based on its potential value as subdivided property rather than its productive capacity as farm land.

One measure of the impact of increased property taxes on farmers is the relationship of taxes to income. The property tax is levied without respect to the property owner's current income. Such taxes, however, represent a production expense to the farmer. Table VI shows the relationship of taxes on farm property to net farm income for the period 1949-1961. During that period, net income was quite variable while taxes on farm property increased steadily. In 1961, the amount of property taxes paid was almost triple the amount paid in 1949 while net income was considerably less. This combination of a rising level of taxes and a low average level of farm income has given rise to serious problems for some farmers. In Michigan, these problems are especially acute in areas surrounding urban expansion and in areas where farm lands are of relatively low productive potential.

What, then, are the implications of the changing property tax structure? First, the total tax burden is not likely to be lessened

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[1] Ibid., p. 25.

TABLE VI.-Farmers' realized net farm income and taxes levied on farm property, Michigan, 1949-1961[1]

Year	Farmers' realized net income		Taxes on farm property	Taxes as a percentage of net income	
	Before payment of property tax	After payment of property tax		Before taxes	After taxes
	million dollars			percent	
1949	316.5	302.0	14.5	4.58	4.80
1950	309.9	294.9	15.0	4.84	5.09
1951	360.9	344.9	16.0	4.43	4.64
1952	349.8	332.8	17.0	4.86	5.11
1953	330.4	312.9	17.5	5.30	5.59
1954	292.5	272.8	19.7	6.74	7.22
1955	266.1	242.2	23.9	8.98	9.87
1956	275.7	250.0	25.7	9.32	10.28
1957	294.4	265.0	29.4	9.99	11.09
1958	270.3	238.2	32.1	11.88	13.48
1959	233.4	199.7	33.7	14.44	16.88
1960	264.4	226.1	38.3	14.49	16.94
1961	278.9	238.4	40.4	14.49	16.95

[1]United States Department of Agriculture, Economic Research Service, Farm Income, State Estimates, 1949-61, Supplement to the Farm Income Situation FIS-187 (Washington: U. S. Government Printing Office, 1962), pp. 18, 41-65.

so long as the property tax remains an important part of the tax structure. This is because of the continued shift of the population to suburban areas and the increasing costs of services required in these areas. As the tax increases because of the higher value assessments associated with the ripening of the land for suburban uses, the cost of using land for agricultural purposes will become prohibitive and the land will shift to nonagricultural uses.

A second inference is that the location of milk production in relation to the population centers is such that the impact on dairy farmers is probably proportionately greater. Much of the land which shifts to nonfarm uses may shift away from use in milk production.

Farm Wage Rates

Farm wage rates in Michigan have increased during the past decade but at a slower rate than nonfarm wage rates, as shown in Table VII. However, this may not be representative of the effects of wage increases on the production of milk. Dairy farming requires a specialized type of hired labor and therefore must pay a higher wage. The index does not properly reflect the impact on milk production, because of the amount of lower paid, less specialized, farm labor used in Michigan. The location of milk production, with respect to the industrial centers, is such that it competes for labor and therefore must pay wages accordingly. This means a higher cost of production. Consequently, centralization of the population has influenced the farm wage rate structure. The dairy industry has felt undue pressure because of the high percentage of total hired farm labor which is used on dairy farms.

TABLE VII.-Index of nonfarm and farm wage rates, Michigan, 1950-1960[1]
(1947-49 = 100)

Year	Gross weekly earnings of production workers in manufacturing industries	Farm wage rates
1950	114	99
1951	123	114
1952	136	120
1953	143	125
1954	145	125
1955	157	128
1956	157	133
1957	162	136
1958	164	134
1959	179	138
1960	185	139

[1]United States Department of Agriculture, Crop Reporting Board, Farm Labor (February, 1961), p. 7.

Michigan Department of Labor, Michigan Labor and Industry, Vols. XVIII-XXIX.

Resource Alternatives in Nonagricultural Uses

Alternatives outside of agriculture have played a large role in the shift of resources out of agriculture in recent years. This is especially true for labor. Expansion in the nonfarm sector of our economy has facilitated the movement of labor to nonfarm jobs. During the past decade, resources have shifted to nonfarm uses in Michigan. The most noticeable shifts to nonagricultural uses have been observed for labor and land. An analysis of the changes in the employment of the labor force and the sources of income gives some indication of the nonfarm alternatives for labor. The movement of land to nonagricultural uses was discussed earlier in this chapter.

Employment of the Labor Force

Farm labor has been able to move quite readily into nonfarm employment in recent years. Some evidence of this is shown in Table VIII. The total labor force increased 6.5 percent since 1952. At the same time the nonfarm labor force increased 7.6 percent and the farm labor force decreased 10.7 percent, indicating a movement of labor from the farm to nonfarm labor force. During the same period, there was a slight increase in nonfarm employment.

Sources of Income

Another indication of the relative importance of agricultural and nonagricultural uses of labor is the sources of income. Table IX is an attempt to show the relative position of Michigan, Wisconsin, and Massachusetts, with respect to sources of income. Wisconsin is considered an important dairy state with few alternatives for resources, while Massachusetts is considered as being highly

TABLE VIII.-Michigan labor force and employment by major industries, selected years[1]

Item	1952	1961	Percent change, 1952 to 1961
	(thousands)		
Total labor force	2,790.0	2,971.7	6.5
Nonfarm labor force	2,623.0	2,822.5	7.6
Farm labor force	167.0	149.2	10.7
Total nonfarm employment	2,499.0	2,514.3	0.6
Wage and salary workers	2,275.0	2,221.2	2.4
Manufacturing industries	1,104.0	870.3	21.2
Durable good industries	924.0	682.3	26.2
Non-durable good industries	180.0	188.0	4.4
Non-manufacturing industries	1,171.0	1,015.0	13.3
Government[2]	-	336.0	-

[1]Bureau of Business and Economic Research, Michigan Statistical Abstract, 4th edition, compiled under the direction of David I. Verway (Graduate School of Business Administration, Michigan State University, 1962), pp. 64-65.

[2]Not available for 1952.

TABLE IX.-Industrial sources of civilian income received by persons participating in production, selected states, selected years[1]

Source	Michigan		Massachusetts		Wisconsin	
	1950	1960	1950	1960	1950	1960
	Million dollars					
Total civilian income	9,151	15,093	6,008	10,001	4,223	6,985
	Percent of total					
Farms	3.6	2.0	1.5	0.7	12.1	6.2
Mining	0.7	0.7	0.1	0.1	0.3	0.3
Contract construction	4.9	5.3	5.4	5.4	5.4	6.4
Manufacturing	48.6	45.3	38.2	36.1	36.7	38.3
Wholesale and retail trade	17.9	16.8	20.8	18.8	19.7	18.3
Finance, insurance and real estate	2.4	3.3	4.7	5.8	2.8	3.8
Transportation	3.7	3.3	4.0	3.3	4.5	4.1
Communications and public utilities	2.3	2.7	2.6	2.9	2.2	2.5
Services	8.6	10.5	12.0	15.0	8.6	10.5
Government	7.1	10.0	10.0	11.1	7.4	9.3
Other	0.1	0.1	0.5	0.4	0.2	0.2

[1]United States Department of Commerce, Office of Business Economics, Personal Income by States since 1929, a supplement to the Survey of Current Business (1956), pp. 210-213.

[2]United States Department of Commerce, Office of Business Economics, Survey of Current Business, XLII (August, 1961), p. 19.

industrialized, affording ample alternatives for resources used in milk production.

A comparison of the income sources for the three states reveals that only 36 percent of the civilian income in Massachusetts in 1960 originated from manufacturing as compared to 45 percent for Michigan and 38 percent for Wisconsin. Farm income accounted for 2 percent of the civilian income in Michigan, 0.7 percent in Massachusetts, and 6.2 percent in Wisconsin. While this is not conclusive evidence, it does give some idea of the relative importance of the nonagricultural sector of the economy and the alternatives for labor in nonagricultural uses in Michigan.

Resource Alternatives in Agricultural Uses

Dairy farming competes with both agricultural and nonagricultural users of resources for factors of production. Some degree of competition exists within the dairy industry itself between the production of fluid milk and manufacturing milk. The location of milk production with respect to the types of farming areas in the state indicates that resources have alternatives in other farm enterprises. Part-time farming also competes for resources on a limited basis.

Part-Time Farming

Dairy farming is an intensive user of labor and therefore does not readily lend itself to part-time farming.[1] In 1959, only 11 percent

[1]A part-time farm is defined by the census of agriculture as one with farm product sales of $50 to $2,499, the operator is under 65 years of age, and the operator worked off the farm 100 days or more or had a combined family income from nonfarm sources exceeding the value of farm products sold.

of the dairy farms in Michigan were classified as part-time farms. A comparison of this percentage with the 31 percent for all farms tends to corroborate the statement that dairy farming is not adaptable to part-time farming.

The number of farm operators working off their farms and those working off the farm 100 days or more is shown in Table X. In 1959, more than one-half (54 percent) of the farm operators worked off the farm. Forty-two percent worked off the farm 100 days or more. The trend in both cases has been toward a higher percentage of farm operators supplementing farm income with off-farm employment. It has been estimated that 46 percent of all Michigan farms had off-farm income which exceeded the value of farm products sold in 1959.[1]

Even though milk production is not a farm enterprise which is often engaged in on a part-time basis, the presence of part-time farming in the state suggests that alternatives for resources do exist in this combination of farm and nonfarm uses.

Alternative Farm Enterprises

Data are not available to show the shifts from dairy farming to other types of farming. However, the type of farming areas in Lower Michigan gives some indication of the alternatives available. Type of farming areas are designated on the basis of soil, climate, and markets for the different farm products.

Along the western edge of the state, dairy competes with fruit production and truck farming. In the areas of the highest concentration of fluid milk producers (surrounding the metropolitan areas in

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[1]A. Allan Schmid and Fred H. Abel, Michigan Agriculture, Cooperative Extension Service Miscellaneous Series Circular E-22 (East Lansing: Michigan State University, 1962), p. 15.

TABLE X.-Number of farm operators working off farms, Michigan, census years 1929-1959[1]

Census year	Farm operators working off their farms		Farm operators working off their farms 100 days or more	
	(number)	(percent)	(number)	(percent)
1929	60,311	35.6	25,135	14.8
1934	56,782	28.9	25,569	13.0
1939	60,468	32.2	39,792	21.2
1944	60,133	34.3	45,941	26.2
1949	72,494	46.6	49,595	31.9
1954	75,707	54.5	54,705	39.4
1959	60,626	54.2	47,161	42.1

[1]Michigan Department of Agriculture, Cooperative Crop Reporting Service, Michigan Agricultural Statistics (1961), p. 51.

Southern Michigan), the greatest competition is from the enterprises of corn, livestock, and small grains.

The competition with cash crops takes on added significance when considering the extent to which dairy farmers are already engaged in these enterprises. In 1961, home grown feeds made up 75 percent of the total concentrate ration fed to milk cows.[1] Corn and the small grains (oats, barley, and wheat) made up 88 percent of the total concentrate ration fed.[2] This indicates that a shift from dairy to cash crops would be relatively easy since conditions are conducive to cash crop farming and since much of the investment in equipment has already been made.

Implications

The analysis in this chapter has been directed at an evaluation of the alternative uses for resources used in milk production. The differing assumptions of the manufacturing milk formula and the economic formula relative to alternative uses for the factors of production are the bases for the analysis. The implications for Class I pricing become apparent when the findings are related to these assumptions.

The spatial location of milk production is such that resources used in milk production have alternatives available in both farm and nonfarm uses. The trend toward centralization of the population has placed pressure on agricultural land surrounding urban areas to shift to nonagricultural uses. Much of the pressure has been in the form of

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[1]United States Department of Agriculture, "Concentrate Rations Fed to Milk Cows, 1961," Milk Production, (March, 1962), p. 11.

[2]Ibid., p. 10.

high property taxes.

The resource, labor, has alternatives in nonfarm employment. During the period 1950-1960, the percent of total civilian income received from farming decreased from 3.6 percent to 2.0. At the same time, the farm labor force decreased 10.7 percent, indicating a movement of labor from the farm sector. Other farm enterprises compete with milk production for resources. The shift from dairy farming to cash crops or to beef feeding operations is relatively easy since much of the investment in equipment has already been made.

The analyses in the previous two chapters have focused on the changes, trends, and conditions within which the dairy industry operates and their implications for the type of pricing formula used in establishing Class I prices in the Federal order markets of Lower Michigan. The analysis in Chapter III indicated that the manufacturing milk sector is becoming relatively less important when compared to the fluid milk sector. The analysis in Chapter IV, relative to the alternatives for resources used in milk production, provided evidence that resources used in milk production have alternative uses in both farm and nonfarm uses and that dairy farming must compete for these factors.

When this evidence is considered in relation to the assumptions of the economic formula that the primary market for milk is the fluid market and that the resources used in fluid milk production have alternative uses in both farm and nonfarm uses and in light of the analysis, there appears to be justification for recommending a Class I pricing plan for Lower Michigan built around an economic formula.

CHAPTER V

A RECOMMENDED CLASS I PRICING PLAN FOR LOWER MICHIGAN

Introduction

A third objective of this analysis was to recommend a Class I pricing formula which would reflect the findings of this study relative to the assumptions of the manufacturing milk formula and the economic formula. The analyses, in the previous two chapters, of the changes which occurred in the dairy industry and of the alternatives for resources used in milk production suggest the appropriateness of an economic formula as a basis for establishing Class I prices in Michigan.

Economic Class I pricing formulas are not new to the dairy industry. They were first used in the Boston milk market in 1948. A few other markets have since adopted them. They have not, however, received widespread use. This is apparently because of the fact that economic circumstances to date have not appeared to warrant their consideration.

There are certain basic assumptions which must be adhered to in the use of any formula based on past relationships. First, it is assumed that the forces which influenced Class I prices in the past can be quantified. Second, these forces will remain as relevant influences in the future. Third, Class I milk prices should respond

to these forces in the future in approximately the same way as in the past.

Factors Associated with the Price of Milk

There are many factors affecting the Class I price of milk. These may be divided into two categories: (1) factors which affect prices generally and which reflect the broad up and down swings of the general level of commodity prices and (2) local supply and demand factors which may result in deviations which differ from those associated with the general price behavior.

Problems in pricing Class I milk occur most frequently during periods of rapid rise or fall in the general price level. This price level declined sharply in the early thirties. Milk prices declined more slowly than the wholesale prices of all commodities and wholesale food prices because of the bargaining position of the producer cooperative associations. However, when the Class I price started declining it declined faster and to lower levels than other prices. The adjustment would have been easier, perhaps, if the price of milk had started its downward adjustment more promptly and had not fallen so low.

There was another period of adjustment following the sharp increase in the general price level when price ceilings were removed in 1946. Serious shortages of milk prevailed in some markets. For these reasons, a formula to be used for establishing the Class I price of milk over a period of time should include at least one factor, the primary purpose of which is, to reflect changes in the general economic conditions.

Changes in the supply of and demand for fluid milk, on a local

basis, are of several kinds. First, there are those changes resulting from changing economic conditions in general and reflected in changes in the general price level. Second, there are changes which affect the dairy industry but do not affect the economy in general. Causes of these variations may be an increase in milk output per cow or a change in food habits favorable to milk and dairy product consumption. A third classification of forces includes changes which affect only the local dairy industry such as weather conditions, changes in local health regulations, or changes in the population of the local marketing area. In addition, seasonal changes in the supply of milk occur regularly each year.

There are many factors which might be used for the purpose of reflecting changes of a localized nature in the supply of and demand for milk. Some indicators such as Class I utilization, for example, may tend to reflect changes in both supply and demand while others are associated more closely with the changes which occur in either supply or demand.

Changes in the supply of fluid milk may be associated with many factors. The production of fluid milk is affected by the cost of feed, labor, and other items in relation to the prices which farmers receive for milk. Also, alternative opportunities in other farm enterprises and in nonfarm uses influence the amount of resources employed in milk production.

Changes in the amount and distribution of consumer purchasing power and changes in the price of fluid milk relative to the price of other dairy products and foods are among the most important factors associated with variations in the demand for milk. Changes

in the size and composition of the population and in the food habits also influence demand but these changes are gradual and do not account for much of the short-term fluctuations in fluid milk sales.

Because of the above forces and their influence on the supply of and demand for milk the following types of movements in Class I price occur. First, there are the wide swings associated with the price structure of the entire economy. Second, the small fluctuations, usually of short duration, associated with variations in the supply of and demand for milk in general cause the Class I price to vary. A third type of price fluctuation is associated with seasonal changes in the production of milk.

Construction of an Economic Formula

In the construction of an economic formula, consideration was given to the following components: (1) time period, (2) time unit, (3) base period for indexes, (4) method of weighting the variables, and (5) the selection of economic variables. These will be discussed in order.

Time Period

Careful attention should be given to selecting a time period over which factor relationships can be studied. Many series of data are not available over a long period of time. Therefore, it is sometimes necessary to compromise between the variables and the time period used.

Abnormal years such as war years are usually left out. The criterion used as a basis for determining whether to include or exclude certain years is that the period should be one in which there

occurred little, if any, change in price structure. If evidence of this is not readily ascertainable from observing the data, it is possible to statistically test the coefficient of analyses for different periods to determine if the coefficients differ significantly.

In attempting to arrive at a satisfactory time period, analyses for three periods were made to determine if a price structural change had occurred. The periods were: (1) the entire period of 1935-1961, (2) the entire period except the war years of 1942-46, and (3) the war years of 1942-46. The differences between the coefficients for the three analyses were not statistically significant.[1] It was concluded that results for the entire period should be used as the best predictor for the future. On this basis, the time period 1935-1961 was selected.

Time Unit

Most analyses of factors that affect the price or consumption of a given commodity are based on annual data -- either calendar or crop years. Annual data are satisfactory if conditions within the period are homogeneous. The time unit should be of such length as to average out the effect of irregular factors and to insure that a relatively homogeneous set of factors are operating. For products produced continuously throughout the year, available data usually relate to a calendar year. Since dairy products fall into this category, the calendar year was selected as the most convenient time unit to use.

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[1]The test used to determine if the coefficients differed significantly is equivalent to the test discussed in Richard J. Foote, Analytical Tools for Studying Demand and Price Structures, U. S. Department of Agriculture Handbook No. 146 (Washington: U. S. Government Printing Office, 1958), pp. 180-181.

Base Period for Indexes

A desirable characteristic of a base period is that it cover a period of fairly stable economic conditions. This means the use of periods other than war, threat of war, or depression. Consideration should also be given to the relationship of the period to present conditions so that recent changes may be clearly viewed. The base period should be long enough to cover several seasonal movements. A period of three years is generally accepted as a logical time period. A 1957-59 base was selected. Many U. S. price series already use this base. It has merit in that it is recent enough to be applicable to present conditions.

Method of Weighting Variables

After the independent variables are selected, each one must be assigned a weight. There are two methods commonly used for assigning weights to the variables. The method most commonly used is that of arbitrarily weighting each economic factor to obtain the closest fit between a formula price and the actual price of milk in the past. This is essentially a trial and error technique. The method is easy to understand and use.

A second method, which provides a statistical weighting for each independent variable, is that known as the regression method. The regression method employs the technique of least squares multiple regression in assigning weights to the variables. Once the regression coefficients, which are the weighting factors, are determined, the operation of the formula is precisely the same as in the case where weights are assigned arbitrarily. The regression method was selected for weighting the variables included in the recommended economic formula.

Variables Included in the Economic Formula

An important step in constructing an economic formula is selecting the independent variables. A number of variables were considered. The final decision regarding the variables which should be included in the milk pricing formula was based on a consideration of the following factors: (1) the degree of association with milk prices in the past, (2) availability of data, (3) limitation of the number of variables used and considerations regarding simplicity, and (4) reflection in the formula price of economic conditions both in the national and local economy. Although it is difficult to categorize the areas of influences of each variable, an attempt was made to include a variable in which the primary function was to: (1) reflect changes in the general price level, (2) reflect changes in local supply of milk, and (3) reflect changes in the demand for milk in the local market. Because there is no clearcut line of demarcation between these influences the categories are overlapping.

The group of variables most difficult with which to work, in terms of the past relationship to fluid milk prices, was the one which indicated a change in consumer demand. There are several factors affecting consumer demand. The ones most commonly used are those which show changes in consumer income. During the past decade, the trend in consumer incomes has been upward while the trend in the price of Class I milk has been downward. The opposite would generally be expected. Another variable often used is an index of the percentage of producer receipts sold for fluid consumption. A question is sometimes raised as to whether this variable should be used to indicate a change in supply or to indicate a change in demand since it

varies with both the amount of milk delivered to the market and the amount sold for fluid consumption. However, it does indicate a change in the relationship of supply and demand in the market and this is the relevant point.

There are conditions existing in each milk market unique to that market. For this reason, a pricing formula must be one that fits the existing market conditions. It was with this point in mind and in line with the above discussion that the following independent variables were selected as price movers in the economic formula recommended for Lower Michigan.

United States wholesale prices

The United States wholesale price index is one of many variables which reflects changes in general economic conditions. In the past, difficulty has been encountered in the dairy industry because fluid milk prices have not adjusted promptly to changes in the general price level. In some cases, shortages occurred. Therefore, a measure of the changes in the general economic conditions is desirable in an economic type pricing formula. Aside from the fact that the United States wholesale price index is the most commonly used indicator of changes in the general price level, it has the added desirable characteristic of being readily available on a monthly basis. While changes in the general price level eventually influence the supply of and demand for milk locally, the primary function of the United States wholesale price index in the pricing formula is to make adjustments in Class I prices which reflect the changing general economic conditions.

Percentage of Class I sales

The demand for fluid milk is a function of consumer income, population, tastes and preferences, and prices of other commodities. Changes in any or all of these will bring about a change in demand for fluid milk. The variables most used for reflecting changes in demand are ones which reflect changes in consumer income. The difficulty of using an income series for reflecting changes in demand for fluid milk has been discussed. The negative estimated coefficient obtained is contradictory with the logical assumption of the existence of a positive relationship between income and the demand for fluid milk which is made.

An index of the percentage of Class I sales in a market may, indirectly, reflect the influence of income on the demand for fluid milk. At the same time, the composition of the index is such that it may reflect a change in the supply of milk. The percentage of Class I sales indicates the relationship between the demand for and the supply of fluid milk in the market. Changes in supply and demand conditions in a given market may not be reflected in the other variables in the formula. This index tends to adjust the price of Class I milk as the supply and demand relationships within the market change. For these reasons, the index of the percentage of Class I sales is included as an important variable in the recommended economic formula.

Index of prices paid for manufacturing milk

The price paid for manufacturing milk reflects the changes in the price of various manufactured dairy products. Since manufactured dairy products are sold in a market which is national in scope, their price is established on a broad base. A second reason for including

the index of prices paid for manufacturing milk in the pricing formula is that the index gives an indication of changes affecting the supply of fluid milk. The supply of both manufacturing milk and fluid milk is influenced by many of the same factors. A third reason for including the index is the geographic location of Michigan with respect to the concentration of the manufacturing milk industry in nearby states. Even though the production of manufacturing milk is declining in importance in Michigan, the geographic location of the state does not permit the neglect of the price paid for manufacturing milk in establishing a Class I price.

Index of prices received by Michigan farmers for all farm products except dairy products

The index of prices received for all farm products except dairy products serves a double role in the pricing formula. The use of an economic formula assumes that fluid milk production competes with other farm enterprises for factors of production. The index of prices received tends to keep fluid milk prices in line with other farm products since it reflects changes in the prices received for competing products. The index also indicates changes in the costs of production. Prices received for feed grains and roughages make up part of the index. Changes in the price of feed in relation to the price of milk are often reflected in the amount of fluid milk marketed. The variation in feed prices will be reflected in the Class I milk price through this variable.

Model

A regression model was used to assign weights to each independent variable. The nature of the data and the type of analysis

limited the choice of statistical models. The typical form of a regression model is:

$$Y_j = \alpha + \beta_1 X_{1_j} + \beta_2 X_{2_j} + \text{-----} + \beta_p X_{p_j} + u_j$$

Where: Y_j is the j^{th} observation of a dependent variable

X_{i_j} is the j^{th} observation on the i^{th} independent variable

u_j is the j^{th} observation of a random error when j = 1, 2,--N

α and β_i are population parameters. α is the Y intercept when all X_i's equal zero. β is the slope of the simple regression line between Y and X_i when all other X_i's are held constant.

There are certain assumptions regarding the statistical properties of the regression model used. If the model is used only to get "good" estimates of Y, the only assumption needed is that the u's are randomly distributed with uniform variance. With this assumption, we can obtain the following estimating equation:

$$\hat{Y} = a + b_1 X_1 + b_2 X_2 + \text{-----} + b_p X_p.$$

$\hat{Y}$ is the estimated value of Y. a and b are estimates of α and β parameters.

However, to obtain valid statistical tests of significance about the a and b values, additional assumptions are needed. It is usually assumed that the u's are normally distributed with 0 mean and σ^2 variance. Even when some other probability distribution is assumed, the u's are assumed to be identically distributed. A further assumption is that the X's are independent of the u's. For each observation $\hat{u}_i = Y - \left[a + b_1 X_{1_i} + b_2 X_{2_i} + b_3 X_{3_i} + b_4 X_{4_i} \right]$; where u_i = 1, 2,----N and are assumed independent with mean = 0, variance = σ^2.

The following estimating formula was obtained when the regression model was applied to the data for the period 1935-1961.

$$\hat{Y} = -.68 + .49X_1 + .40X_2 + .07X_3 + .04X_4$$
$$(.086) \quad (.134) \quad (.110) \quad (.105)$$

$$R^2 = .98 \qquad S = 3.55 \qquad N = 27$$

Where: Y = Index of the effective Class I price for milk in the Southern Michigan Federal order market

X_1 = Index of U. S. wholesale prices (all commodities)

X_2 = Index of prices paid for manufacturing milk by midwest condenseries

X_3 = Index of prices received for all farm products except dairy products by Michigan farmers

X_4 = Index of percentage of total milk used in Class I sales in the Southern Michigan market.

Interpretation

The figures in parentheses are the standard errors of the net regression coefficients. The t-ratios are used to test if the coefficients differ from zero. The t-ratio is the ratio of an estimated coefficient to its standard error, i. e., $t_{b_i} = \frac{b_i}{S_{b_i}}$.

The significance probabilities associated with the t-ratios obtained from this regression equation are as follows:

.001 for b_1

.01 for b_2

.54 for b_3

.68 for b_4

These values represent the smallest significance level for which the $H_i : b_i = 0$, where i = 1, 2, 3, 4 respectively, would be rejected.

S is the standard error of estimate. It is also referred to as the standard deviation of the residuals $(Y - \hat{Y})$. The standard

error of estimate is an estimate of how well the regression line fits the data. A measure of the "goodness of fit" for the above formula is S = 3.55.

The coefficient of multiple determination (R^2) is defined as: $R^2 = \frac{\text{Sum of Squares Explained by Regression}}{\text{Total Sum of Squares of Y}}$. When the coefficient of multiple determination is converted to a percentage basis it indicates the percentage of the variance of Y explained by, or associated with, changes in the independent variables. The R^2 of .98 indicates that 98 percent of the variation in Class I milk prices was explained or associated with the changes in four independent variables.

When working with a predictive model, as in the case of the Class I pricing formula, the problem often arises as to the level of significance used for determining whether particular variables are useful in explaining the variation in the dependent variable. Usually, the arbitrary levels of 5 percent and 1 percent for α (probability of Type I error) are chosen without considering the cost or size of β (probability of Type II error). It is impossible to simultaneously minimize Type I and Type II errors. α and β are not independent. Their statistical relationship is dependent upon H, H_A, and the assumption made regarding the underlying probability distribution of the parameters in the population. The decision of which probability level to choose for the Type I error may be determined in terms of the costs of each type of error. The cost of one type of error may be high or low relative to the cost of the other type of error. Given a loss function, α and β should be

chosen so as to minimize the expected loss.[1]

There are other bases for leaving seemingly insignificant variables in a pricing formula. Reasons relating to particular variables were set forth in the section devoted to a discussion of the selection of variables to include in the formula. It was pointed out that changes in the supply and demand for milk may occur because of conditions unique to the particular market. While the changes are particularly relevant to fluid milk prices in that market, they may not be reflected by the remaining variables. An example is the impact of extreme weather conditions on supply in a particular market. Variables were included to reflect changes in economic conditions both locally and on a national scale. While these two areas are not always independent, there are times when both conditions are not reflected simultaneously by the same variable.

A similar argument can be made for retaining an independent variable which is highly intercorrelated with another independent variable. The usual procedure is to drop one of the variables or to combine the two highly intercorrelated variables. When two independent variables are highly intercorrelated, the interpretation of the b_i's is often misleading. Usually statements are made concerning one b_i assuming the other variable is constant. When two independent variables are highly interrelated, the joint effects as measured by both b_i's should be discussed.

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[1]For a more detailed discussion of the loss function as it relates to choosing a level of significance see Lester V. Manderscheid, An Introduction to Statistical Hypothesis Testing, Agricultural Economics Mimeo 867 (East Lansing: Michigan State University, 1962), pp. 1-5.

In spite of the low levels of significance, the high inter-correlation with other independent variables in the formula, and the fact that the $\bar{R}^2$ increases when variables X_3 and X_4 are deleted, these variables are retained as an important part of the Class I pricing formula.[1] The error of eliminating these variables might be greater than the error of leaving them in the formula.

Application

The estimated Y, using the above model, is referred to as the formula index. The application of the model to Class I pricing involves adjusting the Class I price for the base period by using the resulting formula index. The resulting price becomes the basic formula price which is subject to adjustments necessary to arrive at a minimum Class I price. The estimated coefficients of the model are applied to the most recent monthly indexes of the variables in order to derive a formula index used in establishing the current monthly Class I price.

Evaluation of the Economic Formula

One test for a predictive model is a demonstration of how well it predicts outside the sample period. In this case, the sample period used was 1935-61. The period of time since 1961 is not of sufficient length to permit this test. However, there are some desirable characteristics of a Class I price which may be observed. These may serve as criteria in evaluating the model. Some of these characteristics are: (1) price certainty, (2) seasonal price behavior, and (3) favorable inter-market price relationships.

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[1]The $\bar{R}^2$ increases from .9776 to .9782 when X_3 is deleted and to .9784 when X_4 is deleted.

Price Certainty

Uncertainties prevail in every phase of the production and marketing of milk. The price received for milk may vary sharply from one period to another. The uncertainty associated with wide fluctuations in price often hampers decision making at both the farm and processor levels. Formula pricing has eliminated, to some extent, much of the extreme fluctuations in milk prices and has injected a degree of certainty, which is crucial to the allocation of resources. The extreme fluctuations in milk prices following World War II precipitated an interest in economic formulas as a means of preventing any reoccurrence. Most Federal order pricing plans include provisions which prevent wide swings in prices and thus inject a degree of certainty into milk pricing. With the greater degree of certainty associated with Federal order pricing, the milk producer is able to plan a pattern of production which will facilitate the marketing process.

Seasonal Price Behavior

Most Federal orders contain provisions providing for variation in milk prices for different seasons of the year. This is an effort to encourage a pattern of production which is more closely aligned with consumption. Milk production tends to vary seasonally, while consumption remains relatively constant.

There are several reasons why a more even pattern of milk production throughout the year is desirable. The pattern of production has some affect upon prices received by milk producers. The amount of milk in a given market, above the amount sold for fluid consumption, must be disposed of at a price comparable to manufacturing

milk prices. Manufacturing plants must have sufficient capacity to handle the amount of milk received during the peak production season. In many cases, this means unused capacity during other seasons of the year. The excess capacity represents added investments in fixed assets and increased per unit fixed costs. During the past several years, manufacturing milk prices have been supported at some specified percent of parity. This has been made effective through the establishment of prices at which the government would purchase certain manufactured dairy products. The prices of the manufactured products are set at such levels that allow most processors to purchase manufacturing milk at the established support price. However, this does not mean that every processor will, or must, pay the support price for manufacturing milk. If processing costs are high, the price paid for milk will be lower. The manufacturing plant with excess capacity will usually have higher fixed costs. Variable costs must then be reduced such that total per unit costs will be in line with that of competitors. The price paid to the producer often suffers the brunt of the reduction in variable costs.

Because of the effect of seasonal production on milk prices, it seems logical that an attempt be made to encourage a more even flow of milk to the market. Most attempts along this line have been in the form of price incentives built into the pricing plan. The schedule of seasonal adjustments discussed in a later section is provided for this purpose.

Milk Prices in Surrounding Markets

With the advent of new technology in transportation, packaging, refrigeration, etc., price alignment between and among marketing areas

has come to be a major consideration in price establishment. Disruptive movements of milk from unregulated areas into order markets could result in a breakdown of the order pricing machinery. In such a case, a major objective of an order, that of retaining the proceeds of a market for those producers who regularly supply the market with milk, could not be met. This suggests the need for concern with proper inter-market price alignment as well as provisions relating to pricing milk which might come from unregulated areas.[1]

Figure 3 shows graphically the relationship of the economic formula Class I price for the Southern Michigan order to the minimum Class I price in the surrounding markets of Chicago, Toledo, and Northeastern Ohio. The Southern Michigan order price averaged slightly higher than the other market prices during the period 1952-61. However, during the years of greatest difference, 1957 to 1961, the effective prices in the surrounding markets were negotiated prices instead of the minimum Class I prices shown. If the effective prices were compared a closer relationship would have existed.

Comparison of Historical Class I Price and the Economic Formula Class I Price

A comparison of the actual Class I price with the economic formula price is interesting but relatively unimportant in evaluating a formula. The economic formula price, the minimum Class I price, and the negotiated Class I price since 1956 are shown in Figure 4. There was a wide difference between the actual and the economic formula

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[1]The provision designed for this purpose, the compensatory payment provision, has recently been questioned regarding its constitutionality. See Lehigh Valley Cooperative Farmers et al. v. United States et al., 82 S. Ct. 1168 (1962).

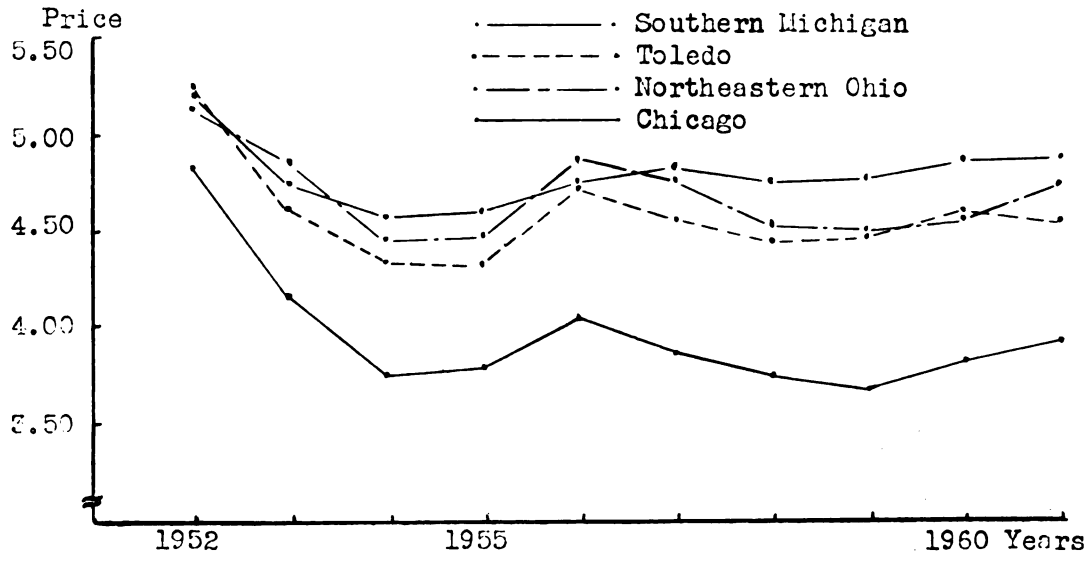

Figure 3.--A comparison of the economic formula Class I price for Southern Michigan with the minimum Class I price for Toledo, Northeastern Ohio, and Chicago Federal order markets, 1952-1961.

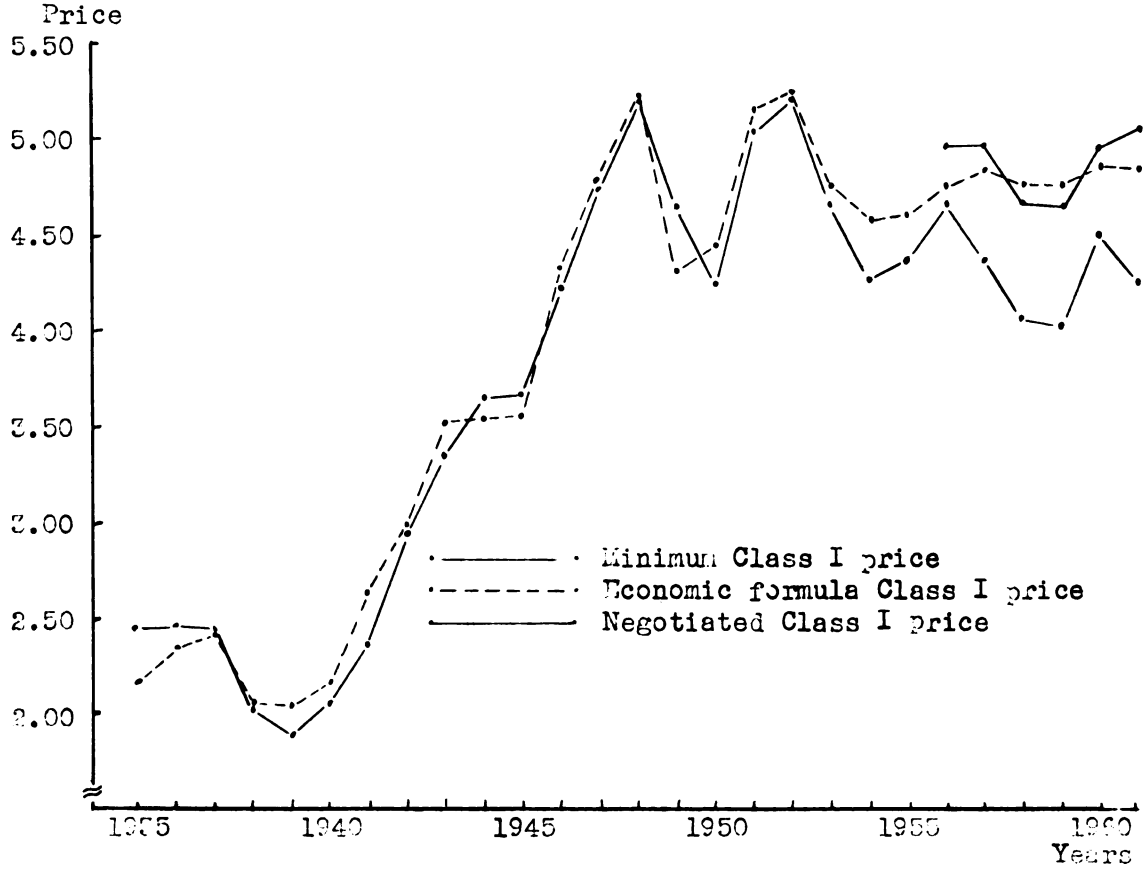

Figure 4.--Comparison of the economic formula Class I price with the minimum Class I price and the negotiated Class I price, Southern Michigan Federal order market, 1935-1961.

price during the period 1952-61. During this period, the minimum Class I price was established on the basis of a manufacturing milk formula. The economic formula price averaged higher than the minimum Class I price but slightly lower than the negotiated Class I price. A comparison for the entire period gives some indication as to how the economic formula would have performed in periods of differing levels of economic activity.

Adjustment Factors

After selecting a formula for use in establishing a Class I price, some attention should be given to adjustments which are often necessary. A formula index is useful in establishing a basing point. Adjustments may then be superimposed upon the formula price to derive a Class I price which reflects market conditions. These adjustments perform various functions in an order market. Some adjustments directly affect Class I price while others perform specific functions but indirectly influence the Class I price.

Supply-Demand Adjuster

Supply-demand adjusters are designed to effect changes based upon local supply-consumption relationship. Based upon specified receipts-Class I sales ratios, adjusters decrease or increase Class I price accordingly. The effectiveness of supply-demand adjusters is sometimes questioned on the bases of the time period required for adjusting milk production and of the elasticity of supply with respect to price. Supply response studies indicate that the elasticity of

milk supply is relatively low.[1] A low elasticity of supply suggests that farmers do respond to price changes but the degree of responsiveness is very small.

A recent study of supply-demand adjusters used in midwestern milk markets concluded that the extent to which a supply-demand adjuster affects the balance between milk receipts and Class I sales depends to a large degree on its effectiveness in shifting milk between the fluid market concerned and alternative outlets.[2] In this respect, adjusters can be quite useful in bringing about a desirable balance between the supply and demand in a market.

Part of the desired adjustment has been provided by the use of variables in the economic formula which affect the supply of and the demand for milk in the local market. An example is the index of Class I sales. The changes in the receipts-Class I sales ratio are reflected in the index and the Class I price is influenced accordingly. There is the possibility that this adjustment might not be sufficient. If, after a short time in operation, the economic formula does not provide the needed adjustment an appropriate supply-demand adjuster may be added.

Seasonal Adjustment

There are numerous methods of adjusting Class I prices for seasonal variation. The purpose of seasonal adjustment is to prevent

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[1]For a review of past studies of the elasticity of milk supply see: Marvin W. Kottke, Forces Influencing the Connecticut Supply of Milk, Agricultural Experiment Station Bulletin No. 341 (Storrs: University of Connecticut, 1959), pp. 19-20.

[2]Sheldon W. Williams et al., The Mechanics of Supply-Demand Adjusters for Midwestern Milk Markets, North Central Regional Publication 134; Agricultural Experiment Station Bulletin 684 (Urbana: University of Illinois, 1962), p. 59.

price movements contrary to the historical pattern. Fluid milk prices normally decrease in the spring and increase during the fall and winter months. Some Federal orders specify that Class I price of fluid milk during spring months cannot be higher than the preceding month and that the Class I price during certain fall months cannot be lower than the preceding month. Other Federal orders make seasonal adjustments through a variable Class I differential. During the months of historically high production, the established Class I differential is less than for months of low production. The overall objective of seasonal price adjustments is to encourage a more even flow of fluid milk to the market throughout the year.

The need for seasonal adjustment is based upon the disparity between the seasonal pattern of production and consumption. Fluid milk consumption is relatively stable throughout the year while seasonal changes in production are much greater. Much of the seasonal variation in production in Lower Michigan has been eliminated. No doubt, the use of the base-excess plan of paying producers has been helpful in this respect.

A price incentive which has indirectly affected price and encouraged greater production in the fall and winter months is the seasonal change in the class utilization of pooled milk. A higher percentage of milk used as Class I results in higher prices to the producer. A higher Class I utilization usually occurs during the fall and winter months. Another indirect price incentive is the higher Class II price resulting from seasonal change in the price of manufacturing milk. Seasonal change in the Class II price contributes favorably to the seasonal variation in Class I price.

There is need for a provision to prevent contraseasonal price movement and to keep a desirable balance between production and consumption. The provision may be one which merely prevents contraseasonal movement of prices or it may be one which builds the adjustment into each monthly price. example of the latter is to adjust the Class I price each month in accordance with a schedule based on past variation in blend prices during a period when the seasonal production and consumption patterns were similar. A schedule of monthly indexes of seasonal variation, based upon the average percentage variation in the monthly blend price over the period 1957-61 was used. Seasonal production patterns were observed during two 5-year periods starting with 1952. The results are shown in Figure 5. During the period 1957-61, seasonal variation in production was less pronounced. The blend price for milk during the same periods is shown in Figure 6. The blend prices varied from a low of 92 percent to a high of 107 percent. These percentages were based on an average for the entire period. Based on variations in the blend price for the period 1957-61, the following percentages are offered as appropriate for adjusting the Class I price seasonally.

Month	Percentage adjustment of Class I price
January	107
February	99
March	98
April	95
May	92
June	92
July	94
August	101
September	104
October	105
November	106
December	105

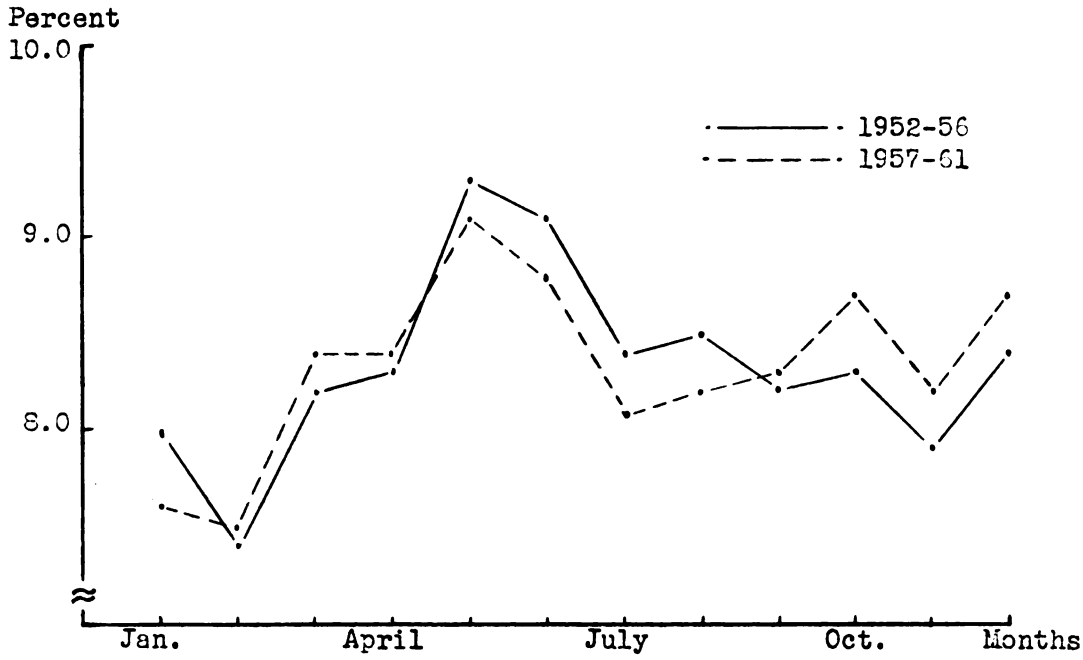

Figure 5.--Percent of total milk received each month based on average monthly receipts for two 5-year periods, Southern Michigan Federal order market.

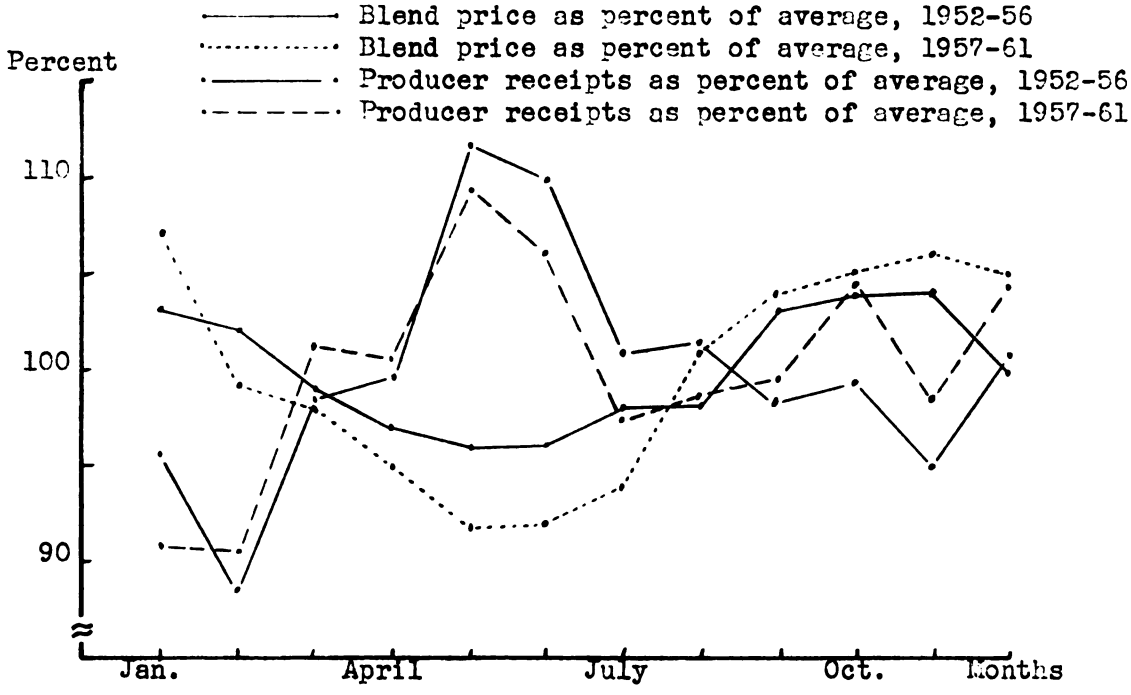

Figure 6.--Monthly average blend price and producer receipts of milk based on a percent of the 5-year average for the periods 1952-56 and 1957-61, Southern Michigan Federal order market.

The formula Class I price is adjusted according to the percentage adjustment for that particular month. In so doing, much of the arbitrary seasonal adjustment is eliminated.

Need for Re-evaluation

There are many factors that influence the price of fluid milk which cannot be included in a workable formula because of the number or because they cannot be measured. Relationships between major factors may change over time. Adjustment for unusual local conditions cannot be built into a formula. When such conditions occur, the formula can be adjusted or a new one developed to fit existing conditions.

Because of these reasons, it is necessary to re-evaluate a formula from time to time in order to keep it current.

Class II Price

While we are primarily interested in Class I prices, no pricing plan would be complete without a method of pricing Class II milk, or the amount above that used for Class I purposes. Since Class II milk is manufactured into dairy products, it seems reasonable that Class II prices should be in reasonable alignment with prices paid for manufacturing milk. This means that the Class II price is established in very close relationship to the price paid for manufacturing milk in the market area. Class II milk has been priced on this basis in the past and should continue to be so priced in the future.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Summary

The purpose of this study was to examine the changes and trends which have occurred in Michigan, within both the dairy industry and the nonfarm segment of the economy, and to relate these changes to the type of Class I pricing formula applicable to present conditions.

The basic data used in the study were from secondary sources. In most cases the data were those relating to the past decade. Occasionally, a longer series of data was used -- usually for the post World War II period. The exception to the above was the use of data for the period 1935-61 for the regression model.

The structure of the fluid milk market has evolved from that of one reflecting competitive conditions to one closely related to a bilateral monopoly. With the change in market structure, pricing practices have moved through phases which might be referred to as competitive pricing, administered pricing, authoritative pricing, and authoritative-negotiated pricing. As the pricing system became more complex and sluggish in response to changing economic conditions, formulas were designed to introduce more flexibility into the pricing mechanism.

There are basically two types of formulas used for pricing

fluid milk. A manufacturing milk formula bases the Class I price on the value of milk used for manufacturing purposes while an economic formula uses a series of economic indicators as a basis for Class I prices. In addition to the difference in basic components, the two types of formulas differ in the assumptions regarding the primary market for milk and the assumptions relative to the alternative uses for resources used in milk production. One assumption associated with the manufacturing milk formula is that the primary market for milk is for use in the manufacture of dairy products. A second assumption is that the resources used in producing milk have limited alternative uses. The use of an economic formula assumes that the primary market for milk is the fluid market and that the resources used in milk production are not faced with limited alternative uses as assumed for the manufacturing milk formula.

The production of milk for the fluid market has more than kept pace with fluid milk consumption. During the period 1952 to 1959, receipts of producer milk in the Southern Michigan Federal order market increased 43 percent and sales of whole milk increased 19.5 percent. The latter increase occurred while per capita consumption decreased 2.5 percent. During the same period, the average number of fluid milk producers decreased at an annual rate of 1.5 percent while the average daily delivery of milk per producer increased at an annual rate of 8.6 percent.

In the past decade, there have been structural changes in the organizational units of production. The number of dairy farms decreased 46 percent while the number of cows per farm increased 73 percent. The total number of farms reporting milk cows decreased.

The composition of the decrease was important since a decline occurred in the farms reporting less than 20 cows while the number of farms reporting more than 20 cows increased.

The trends in fluid milk processing have been: (1) decline in the number of plants, (2) increase in size of plant, and (3) shifts in the product line. The same movements have occurred in the manufacturing milk sector at a much more rapid rate.

Two developments in Michigan's dairy industry during the past decade have implications for the method of pricing fluid milk. First, because of the decrease in production of manufacturing milk and the increased emphasis on producing milk for the fluid market, manufacturing plants are relying more heavily on Class II milk from fluid markets as a source of supply. Second, the effective Class I price has been a negotiated price instead of the Federal order minimum price. Since 1956, negotiated premiums have increased the Class I price in the Southern Michigan order market an average of 59 cents per hundredweight.

The location of fluid milk production with respect to the consuming centers and in relation to the types of farming areas is such that milk production must compete with both farm and nonfarm uses for factors of production. The urban movement of the population puts increased pressure on the use of land for milk production. Much of this pressure has been in the form of increased taxes and the effect has been a shifting of land from agricultural to nonagricultural uses. Milk production must compete with nonfarm uses for labor. Since 1952, the total labor force in Michigan increased 6.5 percent. During the same period, the nonfarm labor force increased 7.6 percent and the

farm labor force decreased 10.7 percent. The increase in total nonfarm employment indicates that farm labor has alternative uses in nonfarm industries. Resources used in milk production also have alternative uses in other farm enterprises, primarily, fruit and truck farming, livestock, and cash crops.

In Chapter V an economic formula was developed and evaluated. The dependent variable chosen was the Class I price in the Southern Michigan Federal order market. Independent variables were chosen to reflect changes in: (1) general economic conditions, (2) supply of milk in the local market, and (3) the demand for milk in the market. To reflect these changes, the following independent variables were selected: (1) index of U. S. wholesale prices, (2) index of prices paid for manufacturing milk, (3) index of prices received by Michigan farmers for all farm products except dairy products, and (4) index of the percentage of total receipts used as Class I. Each independent variable was assigned a weight by the single equation regression model: $Y_j = \alpha + \beta_1 X_{1_j} + \beta_2 X_{2_j} + \beta_3 X_{3_j} + \beta_4 X_{4_j} + u_j$. Using annual indexes for the period 1935-61, the following coefficients were obtained:

$$\hat{Y} = - .68 + .49X_1 + .40X_2 + .07X_3 + .04X_4.$$

With this model, 98 percent of the variation in the Class I price, on an annual basis, was explained or associated with the changes in the four independent variables selected.

Conclusions

The following general conclusions may be stated on the basis of this study.

1. The declining production of manufacturing quality milk, the

increasing production of milk eligible for fluid consumption, and the resulting dependence of the manufacturing market on Class II milk as a source of supply leads to the conclusion that the primary market for milk in Michigan is the fluid market.

2. Milk production competes with nonfarm industries for labor; urban development and other nonagricultural uses for land; and alternative farm enterprises for all factors of production -- land, labor, capital, and management. Thus, the conclusion that resources used in the production of milk have alternatives and that the dairy industry must offer comparable returns to these factors in order to hold them, or attract other resources, seems justified.

3. The conclusions that milk is produced primarily for the fluid market and that the factors of production have alternatives agree with the assumptions upon which the use of an economic formula is based. Thus, there is need for an economic formula as a basis for establishing the Class I price of milk in the Lower Michigan markets.

4. This study does not support the hypothesis that existing conditions in Michigan justify the continued use of the manufacturing milk formula as a basis for establishing Class I price. On the contrary, it supports an implied alternative hypothesis that changed conditions now call for the use of an economic formula.

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APPENDIX A

SOURCES OF DATA FOR COMPUTING A FORMULA CLASS I PRICE BY THE REGRESSION METHOD

SOURCES OF DATA FOR COMPUTING A FORMULA CLASS I PRICE BY THE REGRESSION METHOD

The data used to compute the indexes used in the regression model are available from various sources. The following are suggested as readily available sources for the indexes of the variables used in the economic formula.

U. S. Wholesale Price Index

The index of U. S. wholesale prices (for all commodities) is published monthly in the Michigan Price Report, U. S. Department of Agriculture, Statistical Reporting Service, and Michigan Department of Agriculture, Lansing, Michigan. The index for the previous month is published before the 5th of each month.

Prices Paid for Manufacturing Milk

The average prices paid for milk by midwest condenseries is available from at least the following two sources: (1) Federal Milk Order No. 41 Reporter, Market Administrator, Chicago, Illinois, (2) Evaporated, Condensed and Dry Milk Report, U. S. Department of Agriculture, Statistical Reporting Service, Washington, D. C.

Prices Received for All Farm Products Except Dairy Products

This index is computed by the Department of Agricultural Economics, Michigan State University and could be published monthly in the Michigan Price Report, U. S. Department of Agriculture, Statistical

Reporting Service, and Michigan Department of Agriculture, Lansing, Michigan. The index for the previous month is available before the 5th of each month.

Percentage of Total Milk Used in Class I Sales

The percentage utilization in Class I sales is computed monthly by the Market Administrator. The percentage is converted to an index with a 1957-59 base. The base value is 66.3.

APPENDIX B

TABLES

TABLE XI.-Average monthly receipts of producer milk during two 5-year periods, Southern Michigan Federal order market[1]

Month	1952-1956		1957-1961	
	Percent of total received each month	Percent average monthly receipts are of the 5-year average	Percent of total received each month	Percent average monthly receipts are of the 5-year average
January	8.0	95.5	7.6	90.9
February	7.4	88.5	7.5	90.5
March	8.2	98.9	8.4	101.3
April	8.3	99.7	8.4	100.3
May	9.3	111.8	9.1	109.1
June	9.1	109.7	8.8	106.0
July	8.4	101.0	8.1	97.3
August	8.5	101.4	8.2	98.6
September	8.2	98.3	8.3	99.3
October	8.3	99.3	8.7	104.5
November	7.9	95.0	8.2	98.2
December	8.4	100.9	8.7	104.2

[1]Data obtained from the office of the Federal Milk Market Administrator, Detroit, Michigan.

TABLE XII.-Average uniform blend price per hundredweight during two 5-year periods, Southern Michigan Federal order market[1]

Month	1952-1956		1957-1961	
	Average uniform blend price per hundredweight (dollars)	Percent monthly average price is of the 5-year average	Average uniform blend price per hundredweight (dollars)	Percent monthly average price is of the 5-year average
January	4.42	103	4.14	107
February	4.35	102	3.84	99
March	4.25	99	3.80	98
April	4.15	97	3.67	95
May	4.12	96	3.59	92
June	4.10	96	3.56	92
July	4.19	98	3.63	94
August	4.21	98	3.93	101
September	4.41	103	4.03	104
October	4.47	104	4.08	105
November	4.46	104	4.12	106
December	4.28	100	4.07	105

[1]Data obtained from the office of the Federal Milk Market Administrator, Detroit, Michigan.

TABLE XIII.-Economic formula Class I price, Southern Michigan Federal order market and the minimum Class I price, Toledo, Northeastern Ohio, and Chicago Federal order markets, 1952-1961[1]

Year	Southern Michigan	Toledo	Northeastern Ohio	Chicago
1952	5.20	5.24	5.15	4.81
1953	4.74	4.61	4.87	4.16
1954	4.59	4.32	4.46	3.73
1955	4.60	4.31	4.48	3.80
1956	4.76	4.71	4.87	4.06
1957	4.82	4.56	4.77	3.86
1958	4.77	4.46	4.52	3.72
1959	4.77	4.48	4.50	3.68
1960	4.87	4.60	4.58	3.82
1961	4.86	4.54	4.72	3.92

[1]United States Department of Agriculture, Federal Milk Order Market Statistics, 1947-56, Statistical Bulletin No. 248 (Washington: U. S. Government Printing Office, 1959).

United States Department of Agriculture, Fluid Milk and Cream Report.

TABLE XIV.-Minimum Class I price, economic formula Class I price, and negotiated Class I price, Southern Michigan Federal order market, 1935-1961[1]

Year	Minimum Class I price	Economic formula Class I price	Negotiated Class I price
1935	2.45	2.19	
1936	2.48	2.35	
1937	2.48	2.43	
1938	2.04	2.09	
1939	1.90	2.07	
1940	2.08	2.19	
1941	2.38	2.65	
1942	3.00	2.98	
1943	3.36	3.51	
1944	3.66	3.56	
1945	3.69	3.57	
1946	4.22	4.31	
1947	4.74	4.76	
1948	5.21	5.20	
1949	4.64	4.31	
1950	4.23	4.45	
1951	5.03	5.16	
1952	5.25	5.20	
1953	4.67	4.74	
1954	4.29	4.59	
1955	4.38	4.60	
1956	4.67	4.76	4.98
1957	4.38	4.82	4.95
1958	4.08	4.77	4.69
1959	4.04	4.77	4.66
1960	4.50	4.87	4.95
1961	4.26	4.86	5.04

[1]Michigan Milk Producers Association, "History of Milk Prices, 1920-1949: Detroit, Michigan," Detroit, 1950. (Mimeographed)

The office of the Federal Milk Market Administrator, Detroit, Michigan.

United States Department of Agriculture, Fluid Milk and Cream Report.

TABLE XV.-Data used in multiple regression of minimum Class I price for milk, Southern Michigan Federal order market, 1935-1961[1] (1957-59 = 100)

Year	X_1	X_2	X_3	X_4	Y
1935	44	44	46	91	51
1936	45	51	51	82	52
1937	47	51	57	89	52
1938	43	41	46	83	43
1939	42	41	43	92	41
1940	43	45	46	93	44
1941	48	61	56	94	50
1942	54	68	70	99	63
1943	56	86	91	131	71
1944	57	87	95	128	77
1945	58	86	101	119	78
1946	66	113	110	121	89
1947	81	115	130	116	100
1948	87	130	130	121	109
1949	83	94	111	104	97
1950	87	97	107	103	89
1951	97	118	122	113	106
1952	94	124	122	112	110
1953	92	106	110	98	98
1954	93	98	106	97	90
1955	92	99	100	110	93
1956	96	103	98	108	104
1957	99	103	99	104	104
1958	100	98	106	100	98
1959	101	99	95	96	98
1960	101	104	96	96	104
1961	100	105	96	94	106

[1]Computed from data from the sources given in Appendix A.

X_1 = Index of U. S. wholesale prices (all commodities)

X_2 = Index of prices paid for manufacturing milk by midwest condenseries

X_3 = Index of prices received for all farm products except dairy products by Michigan farmers

X_4 = Index of percentage of total milk used in Class I sales in the Southern Michigan market

Y = Index of the effective Class I price for milk in the Southern Michigan Federal order market