



The development of a milk pricing formula at the processor-distributor level for Montana
by Marlow Clayton Vesterby

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of
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Abstract:

This study is an attempt to develop a formula pricing system for milk at the processor-distributor level in Montana.

Retail prices of milk in Montana have been regulated since 1939 by a system of holding hearings, the evidence of which is analyzed by the members of the Milk Control Board. Pricing orders are then promulgated whenever it is felt that prices need changing.

This study proposes that improvements in the efficiency of establishing price can be made through the use of a formula pricing system.

In brief, a formula pricing system should: 1. reduce the cost of regulation, 2. provide price changes in a more timely manner, 3. maintain a stable level of prices between areas, 4. emphasize price changes more on current economic conditions, and 5. make it easier, in terms of administration, to establish prices.

The formula is set up by using various economic indices, representing factors affecting the price of milk, to show whether the price of these factors increases or decreases in relation to a base period. These economic indices are then summed to give an overall formula index which is related to prices per hundred weight.

A revised producer formula is incorporated with the processor-distributor formulas, so that prices can be calculated at both the producer and wholesale levels for Class I, Grade A, fresh fluid milk.

The body of this thesis sets up the criteria for a pricing formula that might be used in actual practice.

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MARLOW CLAYTON VESTERBY

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Approved:

Clarence W. Jensen
Head, Major Department

Edward D. Ward
Chairman, Examining Committee

K. Goering
Graduate Dean

MONTANA STATE UNIVERSITY
Bozeman, Montana

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Of course, any errors or omissions in this study are the responsibility of the author.

M. C. V.

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ABSTRACT

This study is an attempt to develop a formula pricing system for milk at the processor-distributor level in Montana.

Retail prices of milk in Montana have been regulated since 1939 by a system of holding hearings, the evidence of which is analyzed by the members of the Milk Control Board. Pricing orders are then promulgated whenever it is felt that prices need changing.

This study proposes that improvements in the efficiency of establishing price can be made through the use of a formula pricing system.

In brief, a formula pricing system should: 1. reduce the cost of regulation, 2. provide price changes in a more timely manner, 3. maintain a stable level of prices between areas, 4. emphasize price changes more on current economic conditions, and 5. make it easier, in terms of administration, to establish prices.

The formula is set up by using various economic indices, representing factors affecting the price of milk, to show whether the price of these factors increases or decreases in relation to a base period. These economic indices are then summed to give an overall formula index which is related to prices per hundred weight.

A revised producer formula is incorporated with the processor-distributor formulas, so that prices can be calculated at both the producer and wholesale levels for Class I, Grade A, fresh fluid milk.

The body of this thesis sets up the criteria for a pricing formula that might be used in actual practice.

CHAPTER I

INTRODUCTION AND STATEMENT OF PROBLEM

The Present Situation Regarding Milk Pricing

Since 1939, the prices of fresh fluid milk have been regulated in Montana by the Montana Milk Control Board, both at the producer level and the retail level. At present, the state is divided into 12 marketing areas. Before prices can be changed, a public hearing must be called for the marketing area concerned. Evidence having a bearing on the costs of production, processing and distribution of milk is presented, as well as evidence on consumer purchasing power and other relevant information. After the Board examines and weighs all the evidence a decision is made whether or not a change in milk prices can be justified.

Problems Involved

The hearings are public and must be conducted in a legal manner, using the services of lawyers and a court recorder. They must be held in the marketing area where prices are in question, often at distances of over 400 miles from the Control Board offices at Helena. These and other factors result in a cost of \$1,000 or more per hearing.^{1/}

Often a change in milk prices cannot be made when it is justified because: first, nobody may ask for a hearing until long after the price change is due; second, it may not be practical for the Milk Control Board

^{1/} Information received from interviews with Mr. K. M. Kelly, Administrative Supervisor, Montana Milk Control Board, Helena, Montana.

to take time from a busy schedule to hold a hearing when it is needed; and third, it may be some time before the Board can evaluate the results of the hearing, decide on price changes and see that the necessary changes are promulgated. Also, new orders are often held up by court decisions.

Because of lack of sufficient information it is difficult for the Board to make objective decisions concerning price changes. Lack of information concerning processor-distributor costs, difficulties in ascertaining the factors affecting differences in prices between marketing areas, especially transportation costs, and problems of determining consumer purchasing power, all serve to present obstacles to establishing appropriate prices.

Another disadvantage of present pricing methods is the problem of determining rational patterns of price differentials between the 12 marketing areas. Since prices are presently changed in one area at a time, there is often a price differential between areas which is not always justified. If basic pricing differentials could be established between all areas and justified according to economic criteria, such as transportation costs, and other factors, then these basic differentials would remain in effect even though the formula price were applied statewide. Price differentials would not be created just because of time lags in holding hearings between areas. However, the formula system itself would not correct irrational price differentials between areas. These differentials would have to be corrected before the formula were placed into effect.

Why Price Regulation in the Dairy Industry?

The question arises whether price regulation is necessary in the dairy industry at all. Would the industry be better off without price controls?

The assumption is made in this project that price regulation is necessary at both the producer and processor-distributor levels. Certain arguments can be advanced in favor of price regulations. But they must be stated in terms of the objectives desired, which vary greatly according to the economic interests, ideas and feelings of those proposing them.

For example, it is well known that milk processor-distributors enjoy both an oligopoly and oligopsony position in the market. There are relatively few processor-distributors in relation to the number of producers and consumers. Economists have long recognized that firms in this position have a degree of control over the prices they pay for inputs and the price they receive for their products. They are thus able to enjoy profits above those which they would receive in a purely competitive situation.^{2/} In a strict economic sense these profits are not justified. The point here is that these conditions tend to cause retail prices to be higher and producer prices to be lower than would be the case in a purely competitive situation. This would be especially true with regard to "immature oligopolies".^{3/}

^{2/} If the reader wishes to obtain more information regarding the oligopolist a good source is; Boulding, K. E., Economic Analysis, pp. 638-649.

^{3/} Clark, Jr., D. A., Economic Aspects of Government Milk Price Regulation, California Agricultural Experiment Station, No. 63-4, Berkeley, Nov., 1963, p. 5. A "mature oligopoly," according to Clark, would recognize that an aggressive pricing policy would be met by retaliatory measures, and therefore it would tend to follow a policy of "live and let live".

The . . . ('immature oligopoly') exists when the individual firms take aggressive action in their eagerness to get new business and resort to destructive trade practices and price wars . . . [The long-run consequences] include the threat of an insufficient supply of safe and wholesome milk, the financial collapse of some milk producers and distributing firms, and the increase in concentration of remaining firms. ^{4/}

In order to help prevent these destructive trade practices from occurring in Montana, it is argued that appropriate price regulation is an effective tool.

Price regulation in the dairy industry also tends to stabilize the market. The production of milk is marked by seasonal fluctuations, while consumption is more constant. Demand for milk is relatively inelastic, such that in the absence of price controls a change in supply would bring about a proportionately larger change in price. ^{5/}

The following quotation by Beal and Bakken serves to strengthen the previous statements.

The natural inclination of distributors under conditions of cut-throat competition is to pass on their losses as much as possible to producers. Therefore, the price situation in many major markets of the United States was seriously demoralized. The 'all or nothing policy' of organized groups of farmers endeavoring to prevent lower prices resulted in a series of milk strikes. Thousands of gallons of milk were destroyed,

^{4/} Ibid.

^{5/} Graf, T., McBride, G., Story, R., and Jacobson, R., An Investigation of the Dairy Problem and Analysis of Selected Program Alternatives, New York State College of Agriculture, A. E. Ext. 267, Cornell University, Ithaca, Sept., 1963, p. 7. These authors state that ". . . an increase in supply of 1 percent would be expected to reduce the farm price of milk by 3 or 4 percent in clearing markets." Clark, op. cit., p. 4, states that "The demand for milk for fluid purposes is conceded to be quite 'inelastic.'"

both by farmers who deliberately 'dumped' their own product and by organized groups of farmers endeavoring to prevent independent producers from supplying the market. In some instances, there were violence and bloodshed. Because these strikes failed . . . the next step was to seek assistance through legislative controls. ^{6/}

Price regulation at the producer level is presently being used in nearly every state ^{7/} and few students of milk marketing would advocate abolishing these controls.

At the wholesale and retail levels it is difficult to determine the amount of influence over price that the processor-distributor has. The assumption is made that processor-distributors, in the absence of price controls, do have an influence on wholesale and retail prices; the basis for this assumption is the economic theory regarding the oligopolist. ^{8/}

The manner in which the processor-distributor would exert influence over prices can only be hypothesized. But it seems a reasonable hypothesis that those distributors with the greatest financial reserves and the greatest efficiency of operation would first, lower prices below costs in order to force the less efficient and those with lower financial reserves

^{6/} Beal, G. M., and Bakken, H. H., Fluid Milk Marketing, p. 189-190.

^{7/} Government's Role in Pricing Fluid Milk in the United States, U. S. Dept. of Agriculture, ERS-239, Washington D. C., May, 1965, 39 pp. Of the 48 contiguous states, 47 had some form of pricing regulations. Only North Dakota was left unmentioned. Federal Orders were used in all, or parts, of 36 states. Twenty had some form of state control and nine utilized combinations of both. Fifteen states were listed as having some type of wholesale price regulation; however, this may not be complete since not all 48 states were included in the survey at the wholesale level.

^{8/} Boulding, op. cit., pp. 638-649.

out of business. Second, they would raise prices to a level that would allow them profits above the competitive level.

This project assumes that competition is desirable in the dairy industry. Price regulation is a relatively effective method of achieving the effect of competition through the establishment of prices at those levels which more nearly approximate the levels that would occur if the industry were in a competitive situation. Regulations will not guarantee the least efficient a profit, but they will discourage the most efficient from selling under costs in order to force others out of business and capture the market. This, it would seem, is in the public interest.

Minimum price controls at the retail level also make it difficult for out-of-state processor-distributors to establish a market in Montana. Selling milk at lower than average retail prices is one of the primary methods available to a firm to introduce their product in a new area. This becomes impossible in an area with minimum retail prices established by law. When all brands must be sold at no less than the established minimum price, there is no incentive, in terms of price discounts, for consumers to purchase one brand over another. Thus, if all milk is sold at no less than the minimum price, it would be impossible for any one particular processor-distributor to sell below this price, and possibly below his costs, in order to capture a share of the market.

Federal Orders

There is reason to believe that if price regulations at the state level fails to accomplish the desired results, a movement would soon be initiated

toward Federal milk marketing orders.^{9/} In a research project conducted at Montana State University in 1963, the view was expressed that Federal Orders would be more efficient than present methods of establishing price.^{10/} However, it was also stated that ". . . revisions of the state order would, in all probability, be more readily accepted than a Federal Order by the Montana dairy industry as a whole."^{11/}

^{9/} Opinion expressed by a number of producers throughout the state.

^{10/} Litschauer, J. G., The Development of a Hypothetical Federal Milk Marketing Order for the Great Falls-Hi-Line Area and a Comparison of this Order with the Montana Milk Control Law in its Present State of Effectiveness, an unpublished thesis, Montana State University, Bozeman, Aug. 1963, p. 92.

^{11/} Ibid, p. 90.

CHAPTER II

THE CONCEPT AND OBJECTIVES OF FORMULA PRICING

The Formula Pricing Concept

The concept of formula pricing is not new. Federal milk marketing orders have been using various types of formulas for years. "In recent years, all markets under Federal milk regulation have used a 'formula' method for determining Class I prices at the producer level." ^{1/}

Presently there are two general types of Class I pricing formulas.

These are:

A. "Economic Formulas" which relate Class I milk prices to selected economic factors, and

B. "Manufacturing Milk Formulas" which relate the price of Class I milk to the value of milk used for manufacturing purposes.

The objective of this project is to devise an economic formula for determining changes in processor-distributor margins.

Basically, the pricing formula combines various index numbers, representing current economic factors that influence the price of milk, into an overall formula index which indicates whether prices should be raised or lowered when compared with a base period. There is a good deal of variation in how this can be accomplished, which will be discussed in Chapters III and IV.

^{1/} Report to the Secretary of Agriculture by the Federal Milk Order Study Committee, United States Department of Agriculture, Washington, D. C., April, 1962, p. II-1-10.

Objectives

The benefits to be derived from a formula pricing system, that cannot be obtained from the present method of setting prices through hearings, are given below.

A. A milk pricing formula would reduce the cost of establishing prices. Theoretically, hearings would be held only when considered necessary to change certain aspects of the formula itself or to change price differentials between areas, or other aspects of the Milk Control Law.

B. It would provide price changes in a more timely manner. Prices would be examined, using the formula, on a periodic basis with the most recent economic data available. A quarterly basis is proposed. Presently, the Milk Control Board cannot change prices until it has held a hearing and decided upon the results. This is often long after price changes are due, in an economic sense.

C. Prices would remain in a stable relationship between marketing areas. Once basic adjustments are made between areas, any formula price change would raise or lower prices for all areas by the same amount.

D. The pricing formula would more closely approximate current conditions through the use of indices. There would be an objective, analytic determination of prices rather than the more subjective method now used.

E. The formula would be easier to calculate and administer since its use would involve administrative procedures, rather than legal hearings. The Board members would not be required to give as much of their time to

weigh evidence of hearings.

However, there are some things that formula pricing would not do:

A. Formula pricing can go a long way in preventing processor-distributors from selling under the established price. But there is the problem of various methods of violation. Some of the more common violations are:

1. Secret rebates and discounts returned to retailers and consumers,
2. Servicing and maintenance of coolers in stores,
3. Gifts of discounted or free ice cream, butter or a few extra cartons on delivery routes,
4. Excessive prices paid to retailers for cooler rental,
5. Trading stamps, and
6. Reduction of unregulated prices while maintaining the regulated prices of fresh milk.

B. Formula pricing would probably not directly benefit or harm the less efficient processor-distributor any more than the present system.

C. The formula pricing system is not foolproof and would have to be closely watched to ensure that all the different components were up-to-date and that the calculations were correct.

D. The amount of enforcement necessary would probably not be any less than present requirements, but more resources would be available for enforcement.

CHAPTER III

THE WEIGHTS

Two Basic Assumptions

Two assumptions are made at this point that are basic to this study:

1. The assumption is made that milk is a beneficial product and that it is desirable to assure an adequate and stable supply at reasonable prices. In fact, to many people, milk is almost synonymous with mother, country and apple pie and should therefore be protected zealously. This can be clearly evidenced by the many federal, state and local regulations that exist concerning nearly every aspect of the industry.

2. The second assumption is that price regulation is necessary at the retail level to help achieve an adequate and stable supply of milk at reasonable prices. Evidence in favor of price regulation at the wholesale and retail level has already been presented, but this evidence is subject to much argument, and in the final analysis the assumption must simply be made upon subjective grounds that price regulation is necessary. Without this assumption there would be no justification for this project.

The Major Hypothesis

The major hypothesis is that a method of pricing milk in Montana at the wholesale level can be developed, which would be more efficient than the present method.

To determine just what is meant by "more efficient", one must consider the problems and objectives stated in Chapters I and II. Briefly, it would seem that a method of pricing milk would be more efficient if it:

1. Reduced the cost of establishing prices,
2. Provided price changes in a more timely manner,
3. Kept prices at a stable level between marketing areas,
4. More closely approximated current economic conditions, and
5. Were easier to calculate and administer.

More is said about efficiency in Chapter VII.

This study only concerns prices at the wholesale level for Class I homogenized fresh fluid milk in half gallon paper containers.^{1/} No attempt is made here to set up a pricing system for any other class of milk or dairy products. Formula pricing for other classes of milk products may be desirable, but that is a matter outside the realm of this study. Perhaps future research projects might study this problem.

This study is further confined to the processor-distributor level. The final retail price is derived by combining the results of the producer^{2/} and processor-distributor formulas and adding a retail margin established by the Board. Here again, some other method might be found, possibly a formula

^{1/} According to the General Official Order Regulating Transactions Involving the Purchase and Resale of Milk Within the State, Official Order # 641, Montana Milk Control Board, June 15, 1964, Helena, Montana, page 2; Class I products ". . . include all bottled or packaged milk, raw, pasteurized and homogenized, low fat, buttermilk, and chocolate milk." Class II products ". . . include whipping cream, coffee cream, half and half, and skim milk." Taking the formula price for Class I milk in half gallon containers as a starting point, the prices of the above mentioned products can be determined by using present price differentials established by the Milk Control Board.

^{2/} Ward, Edward H., Pricing Formula for Montana Milk, Montana Agricultural Experiment Station, Montana State University, Bulletin 569, May, 1962.

system, to establish the margin between wholesale and retail prices.

Thus, the project is confined to research in a specific area, which is necessary at the present stage, considering the complexity of the problem, availability of data, and time and funds available with which to work.

Now the question might be asked, "How can the major hypothesis be tested?"

The literature on milk pricing, reveals that formula pricing is used extensively at the producer level. However, at the retail level there is little price regulation and even less formula price regulation. But it seemed possible that a formula system might also be used to price milk at the retail level. Thus, the study proceeds on the assumption that a formula pricing system would be the "best" method of achieving the desired objectives.

Since few states regulate the price of milk at the wholesale level,^{3/} and only one state is known to use a pricing formula similar to that proposed in this thesis,^{4/} there are few set rules or procedures to follow in establishing a wholesale pricing formula. Even if there were, it would be unlikely that they would apply equally to Montana.

The formula system removes some of the human factors of pricing milk by automatically basing price changes upon changes in current economic

^{3/} Governments' Role in Pricing Fluid Milk in the United States, op. cit., listed 15 states as having the authority to price wholesale milk as of November, 1964.

^{4/} At the time of writing, that one state was Georgia. Refer to Purcell, J. C., Elrod, J. C., and Penny, N. M., The Formula Basis of Pricing Fluid Milk in Georgia, Evaluation and Recommendations, Georgia Agricultural Experiment Station, Mimeo Series N. S. 99, April, 1960.

factors having a relation to the price of milk.

By measuring and combining these factors in the form of indices, an overall index is developed, which indicates whether the price should be changed. This concept is easier to understand as one follows the detailed methods of constructing a formula as described in this paper.

Since economic pricing formulas use indices to represent various economic factors affecting the price of the product, the next step was to consider what factors do affect the price of milk and to weigh their effects.

There are two sides to a pricing formula and both must be considered-- supply and demand.

Deriving the Weights

Supply Side

Costs of Processing and Distributing--Several sources were used to analyze costs of processing and distributing milk. Cost studies published in several states by Agricultural Experiment Stations were compared.^{5/} A

^{5/} Some of these were: Cost of Processing and Distributing Milk in the South, Southern Cooperative Series Bulletin No. 45, June, 1955; Allred, W. M. and Ward, E. H., Costs, Quality, and Prices of Fluid Milk in Rural Areas of Utah and Montana, Utah Agricultural Experiment Station Bulletin No. 365, Dec., 1953; Bartlett, R. W. and Gothard, F. T., Measuring Efficiency of Milk Plant Operation, Illinois Agricultural Experiment Station Bulletin No. 560, No., 1952; Blanchard, W. H., McBride, G., and Rippen, A. L., A Cost Analysis of Fluid Milk Packaging Operations, Michigan Agricultural Experiment Station Technical Bulletin 285, Mar., 1962; Korzan, G. E., Costs of Distributing Milk in Montana Markets, Montana Agricultural Experiment Station Bulletin No. 462, July, 1949; Strain, J. R., Christenson, S. K., Relationships Between Plant Size and Cost of Processing Fluid Milk in Oregon, Oregon Agricultural Experiment Station Technical Bulletin No. 55, Nov., 1960.

cost study conducted by the California Bureau of Milk Stabilization to aid in price regulation in California was studied.^{6/} And most important, the costs of 11 of Montana's 34 processor-distributors were analyzed. These costs from the several different sources were used as a basis to determine how costs could be classified and weighed to represent costs of processing and distributing in the formula. The 11 cost studies of Montana's processor-distributors were obtained from the Montana Milk Control Board and represent 32.4 percent of the total processor-distributors in the state. They are assumed to represent a fair sampling as to size and location.

Grouping all the costs of processing and distributing milk necessarily involves certain subjective value judgments. For example, supply costs undoubtedly represent many items not included in the index of "chemicals and allied products" from the Survey of Current Business, which represents supplies in the formula. It is also possible that there may be some costs of processing and distributing which haven't been figured as supply costs because they were not explicitly differentiated in the cost studies. The cost studies were designed for use by the Board for their own purposes, which did not always require the same analysis needed here. If the cost studies had been broken down into more detail it would have been easier to separate them into the various cost classifications used here. Also, it might have reduced the percentages attributed to "other costs".

6/ Unit cost Reports, California Bureau of Milk Stabilization, Sacramento, California; compiled periodically, unpublished.

For formula purposes, the costs were classified into groups that could be most easily represented by various indices. The classifications used are:

1. labor,
2. containers,
3. equipment,
4. vehicles,
5. supplies, and
6. others.

The average costs of 11 Montana processor-distributors are shown in Table I. A comparison of these costs and costs of processing-distributing from two other sources are shown in Table II.

Labor

Wages and salaries are easily obtained from the Montana Milk Control Board cost studies. They represent an average of 47 percent of the costs of processing and distributing milk of the 11 cost studies analyzed.

Grouped together with wages and salaries were:

1. Employee retirement plans,
2. Health and accident insurance programs,
3. Life insurance benefits, and
4. Christmas bonuses.

This was justified due to the fact that as wages and salaries change, these items usually change in approximately the same proportion.^{1/}

^{1/} To be technical one could say that a certain amount of the increase is due to increased demands of employees for larger benefits. However, it is assumed that changes of this nature would be small over a period of a few years.

TABLE I. COSTS OF PROCESSING AND DISTRIBUTING MILK IN MONTANA*

Distributor	Cost Items					
	Labor	Containers	Equipment	Vehicles	Supplies	Other
	(Percentages of Total Costs)					
A	44.88	14.99	16.42	14.67	0.52	8.52
B	41.98	14.41	12.18	9.18	2.30	19.95
C	48.01	9.06	12.54	12.62	2.82	14.95
D	45.76	11.98	10.80	11.37	5.44	14.65
E	51.81	10.58	10.05	14.71	1.56	11.29
F	48.35	19.02	5.59	11.14	4.38	11.52
G	44.29	14.05	7.57	11.25	1.03	21.81
H	42.62	11.74	13.31	7.20	3.09	22.04
I	44.87	15.52	13.05	7.88	1.83	16.85
J	47.31	16.79	8.42	12.51	1.54	13.43
K	51.50	15.51	5.92	7.74	1.58	17.75
Average	46.48	13.96	10.53	10.93	2.37	15.70

*Calculated from 11 cost studies of Montana processor-distributors conducted by the Montana Milk Control Board, Helena.

TABLE II. AVERAGE COSTS OF PROCESSING AND DISTRIBUTING MILK IN MONTANA COMPARED WITH TWO OTHER SOURCES

Cost Item	Montana ^{a/}	Georgia ^{b/}	Nationwide ^{c/}	Average
(Percentages of Total Costs)				
Labor	46.5	41.5	51.1	46.4
Containers	14.0	15.2	15.1	14.8
Equipment	10.5	7.4	14.3	10.7
Vehicles	10.9	11.8	d/	11.4
Supplies	2.4	10.6	6.1	6.4
Other	15.7	13.5	13.4	14.2
Total	100.0	100.0	100.0	

a/ From Table I.

b/ Purcell, op. cit., p. 33.

c/ Milk Distributors' Sales and Costs, U. S. Department of Agriculture, Economic Research Service, Apr-June, 1964, MDSC No. 25, p. 3. This was the most recent of these reports available. Costs were averaged for the period of July, 1963-June, 1964.

d/ Vehicles were assumed to be included as equipment.

Container Costs

Cartons and containers are a large cost item of processing milk, comprising approximately 14 percent of the total.

Included in this category are all the different sizes and shapes of containers used to contain fluid milk products. Some inaccuracy is obviously evident here since the index used to represent container costs was "paper", from the Survey of Current Business. This index could not be expected to show changes in the costs of glass and metal containers. However, glass and metal containers comprise a small percentage of all containers used by the Montana dairy industry. More will be said about statistically fitting the index to container costs in Chapter IV.

Equipment Costs^{8/}

Equipment costs were more difficult to handle. First it had to be decided, as closely as possible, from the cost studies, just what represented equipment costs. This sometimes presented problems because equipment costs were not always differentiated, but were instead often grouped under general headings:

For this project equipment costs were grouped as follows:

1. depreciation,
2. equipment rentals,

^{8/} Although not specifically separated in the various cost studies, equipment includes such things as boilers, clarifiers, separators, water heaters, washers, conveyors, vats, homogenizers, pasteurizers, tanks, pumps, condensers, compressors, ice makers, carton and bottle filling machines, centrifuge, refrigeration machinery, valves, tools, etc.

3. repairs and maintenance, and
4. insurance on equipment.

The use of these items was justified since it was concluded that if equipment costs changed, so would depreciation, rentals, repairs and insurance by approximately proportionate amounts. Equipment costs represent approximately 11 percent of the total.

Vehicle Costs

It was also sometimes difficult to distinguish vehicle costs. Depreciation was the most common item, but one could assume that licenses, insurance and repairs might also rise and fall as the cost of trucks, delivery vans, etc., rises and falls. In the cost studies, vehicle expenses comprise about 11 percent of the total.

Supply Costs

The costs of supplies was probably the most difficult item to ascertain. These costs were often grouped under more comprehensive headings, such as "general expenses".

For purposes of this project they are considered to include:

1. cleaning compounds,
2. disinfectants,
3. pesticides,
4. washing powders,
5. oil and grease,
6. gaskets,
7. aprons, boots and gloves, etc.

It is possible that supplies actually comprise a higher percentage of total costs than is shown here. In many cases a "miscellaneous" cost was given, which may have included some of the items mentioned under supplies. Also, pesticides could not be segregated since they were included under the heading "pest control and garbage". These may be reasons why supplies comprise only about 2.4 percent of total costs.

Other Costs

"Other costs", representing about 15.6 percent of the costs of processing-distributing milk, were not represented by an index. "Other costs" include many various and miscellaneous items not adaptable to grouping into the classifications already mentioned, and thus they were not adaptable to being represented by an index. These miscellaneous costs were ignored in the formula by considering all other costs equal to 100 percent. This is not to say that they are unimportant.

Possibly some of these "other costs" could be represented by indices. But they generally included from 10 to 25 separate and distinct items, each usually comprising less than one percent of the total.

"Other costs" include such things as:

1. fuel and electricity,
2. telephone and telegraph,
3. advertising,
4. office supplies and postage,
5. realty taxes,
6. travel and entertaining,

7. accounting and legal,
8. bad debts and collection expenses,
9. director's fees (cooperatives),
10. freight,
11. bank charges,
12. bonds and licenses,
13. trash disposal,
14. laundry,
15. contributions and miscellaneous dues and fees, and
16. building rent and repairs.

Opportunity Costs

Opportunity costs should be considered in a pricing formula.

Opportunity costs, briefly stated, are the difference between the value of those investments given up for the investment incurred in a processing-distributing plant. In other words, if a processor-distributor could not obtain an interest on his investment at least equal to that which could be obtained elsewhere, he would be expected to invest his money in the more profitable pursuit. However, once funds are invested in a milk processing and distributing plant, it is difficult to get them back out. It might be possible to sell the plant but it is unlikely that it would ever be used for anything other than processing dairy products.^{9/} Even if the plant

^{9/} Some plants presently process a small quantity of orange juice, but this is the only exception known to the author.

and equipment were sold it would probably still be used for processing and distributing milk somewhere else in the state, and this would not likely affect the overall statewide picture to an appreciable degree.

In considering alternative uses for a plant processing and distributing Class I and II milk, it must be realized that it would be possible to convert to Class III and IV usage. However, at the present time, and to a large extent in the past, Class I and II usages have appeared more lucrative than Class III and IV usages. Also, a good deal of expense would be involved in the conversion since equipment necessary for processing Class I and II products is often different than that needed to process such items as butter, ice cream, cottage cheese, etc.

Finally, since processor-distributors enjoy the position of the oligopolist and oligopsonist, as explained earlier, there may be reason to believe that entry into the dairy industry would be somewhat restricted. If this were so, it would lower opportunity costs even further.

For these reasons opportunity costs are considered relatively unimportant.

Demand Side

As mentioned before, the demand side is important since different retail prices and different levels of consumer purchasing power will affect the amount of milk that consumers will buy. Prices that are too high in relation to consumer purchasing power will induce consumers to buy less fresh fluid milk and to substitute other products such as dry milk or

even orange juice or coffee.

The indices used to represent consumer purchasing power are the same as those used in the producer formula:^{10/}

1. Montana per capita income,^{11/}
2. Montana weekly wages,^{12/} and
3. Montana bank debits.^{13/}

Since there was no apparent mathematical method of deriving weights for consumer purchasing power, a subjective approach was used. It was reasoned that these indices are the most accurate available and that by using the same ones in both formulas it would make the combined formula easier to calculate and administer.

Some question might be raised as to the duplication of the consumer purchasing power indices in the two formulas. However, it would seem justified since they actually represent two different things. In the producer formula they represent willingness on the part of the consumer to purchase the product of the producer--raw milk and all the factors of production that went into making it possible--and at the retail level these indices represent willingness of the consumer to purchase the product of

^{10/} Ward, op. cit., p. 6.

^{11/} Survey of Current Business, United States Department of Commerce, Office of Business Economics.

^{12/} Montana Labor Market, Montana State Employment Service, Division of Unemployment Compensation Commission of Montana.

^{13/} This is an unpublished index compiled monthly by the Bureau of Business and Economic Research, Missoula, Montana.

the distributor--processed milk.

Formula Weights

The weights assigned each of the factors affecting price are presented in Table III. Assignment of weights to the Supply and Demand sides involves subjective judgments. Costs of processing-distributing received the heaviest weights because they could be determined by the most objective methods. Opportunity costs were weighted relatively small (five percent) since it is assumed that processor-distributors have few alternatives.

On the demand side, weekly wages received the heaviest weight, (15 percent) since they were considered most accurate of the three in representing consumer purchasing power. Per capita income received the smallest weight because it is published six months after the year's end.

Indices are assigned to the weighting factors in Chapter IV.

TABLE III. FORMULA WEIGHTS OF FACTORS AFFECTING THE PRICE OF MILK, PROCESSOR-DISTRIBUTOR LEVEL.

Factor Affecting Price	Weights Given Each Factor	
	(Percent)	
Supply side ^{a/}		
Labor	36	
Containers	11	
Equipment	8	
Vehicles	8	
Supplies	2	
Other	0	
Total Supply Side		65
Demand side		
Per capita income	10	
Weekly wages	15	
Bank debits	10	
Total Demand Side		35
Total		
	100	100

^{a/} The results of the 11 Montana cost studies are considered most accurate for a pricing formula to be used in Montana. Weights are adjusted to represent their influence on the complete formula.

CHAPTER IV

THE INDICES AND THE BASE PERIOD

Fitting Indices to Price Factors

The entire basis of a formula pricing system is to use various indices to represent different factors that influence price. These indices are combined to form an overall index which is compared with the price in a specified base period. If the index is significantly higher or lower than that of the previous period, the price is changed accordingly. The retail formula is then combined with the producer pricing formula^{1/} to give both retail and producer milk prices.

The most difficult part of compiling a pricing formula was to fit economic indices to the various pricing factors. As far as possible, objective measures and techniques were used. The idea behind the fitting of indices to the pricing factors was to compare the particular index being examined with the changes in prices that have occurred for the pricing factor over the past several years. This was attempted through statistical analysis, using correlation and regression techniques.

A major limitation here is that only the direct cost items could be compared with indices. Even in regard to the direct cost items, a weakness exists in that it was often impossible to obtain the changes in direct costs for several previous years, especially as direct costs pertain to the Montana milk processing-distributing industry. However, one should be wary

^{1/} Ward, op. cit., An up-to-date version is used. See Chapter V.

of going back too far to where the dairy industry had different characteristics. Such things as improvements in transportation, high temperature-short time pasteurizers and more efficient cooling equipment, are technological changes resulting in more efficient handling of milk. Consumer tastes and preferences also changed over the years. Increased use of powdered milk, the change in consumer preference from glass containers to paper cartons and from quarts to half-gallons, are other indications that the dairy industry had changed. Thus if one examines the dairy industry too far back, he would be looking at a different industry, the "old" industry, so to speak.

Supply Side

Cost of Processing-Distributing

Again, the major costs of processing and distributing milk are:

1. labor,
2. containers,
3. equipment,
4. vehicles,
5. supplies, and
6. others.

In fitting indices to these costs, it was considered important that the indices represent, as closely as possible, actual Montana conditions. The first step was to pick several indices which might show some relationship to a particular cost factor. Those that seemed most reasonable were

tested by statistical analysis to see how much correlation existed between the index and the individual cost factor.

Ideally, this information would have come directly from Montana's 34 processor-distributors. The distributors that were interviewed were always cooperative, but in most cases the cost information simply did not exist, or else it existed in such a form that a great deal of time and expense would have been involved to obtain it.

Instead, other sources were relied upon to give past cost information. The Milk Distributors' Sales and Costs^{2/} was used to a large extent. Data from container manufacturers and from the Teamsters Union and other sources were also used.

Labor Costs

Labor costs incurred by processor-distributors is the most important pricing factor in the entire formula, and the data for this factor is the most accurate. It was shown in Chapter III that labor represents about 47 percent of the total costs of processing and distributing milk in Montana.

The index chosen to represent this cost factor was an unpublished series, compiled monthly by the Montana State Employment Service.^{3/} In this paper it will be referred to as the Labor Index.

Labor costs for Montana processor-distributors could seldom be obtained

2/ Milk Distributors' Sales and Costs, op. cit.

3/ Monthly Employment and Wages by Quarters for Industry 202 - (Dairy Products), Montana State Employment Service, Division of Unemployment Compensation Commission of Montana, Helena.

for a series of years either because the records were unavailable for several years previous, or because the data was not available in such a form so as to be of value to this project. This was not the fault of distributors, who were generally very helpful in supplying information.

Since labor costs were not available from processor-distributors, another source was used. This was the records of the dairy industry contract wages kept by the Teamsters Union Locals in Montana.^{4/} This information was considered the most accurate available. The coefficient of correlation between this series and the Labor Index was 0.95, which was significant at the 0.01 percent significance level. Thus, the Labor Index is used to represent labor costs of Montana processor-distributors with a high degree of confidence.

Figure 1 shows how the Labor Index has reflected price changes in labor costs of the Montana dairy industry since 1955.

Container Costs

The costs of containers to package fresh fluid milk amount to about 13 percent of the total costs of processing milk in Montana. The index chosen to represent this cost in the pricing formula is the "paper" index from the Survey of Current Business.^{5/}

^{4/} There are presently five area headquarters of the Teamsters Union in Montana that cover all processor-distributor employees under union contracts. These are located at Billings, Bozeman, Butte, Great Falls, and Missoula. Two of these, Bozeman and Butte, volunteered data which covered ten plants in the above mentioned cities, back through October, 1955.

^{5/} Survey of Current Business, op. cit.

1957-59 = 100

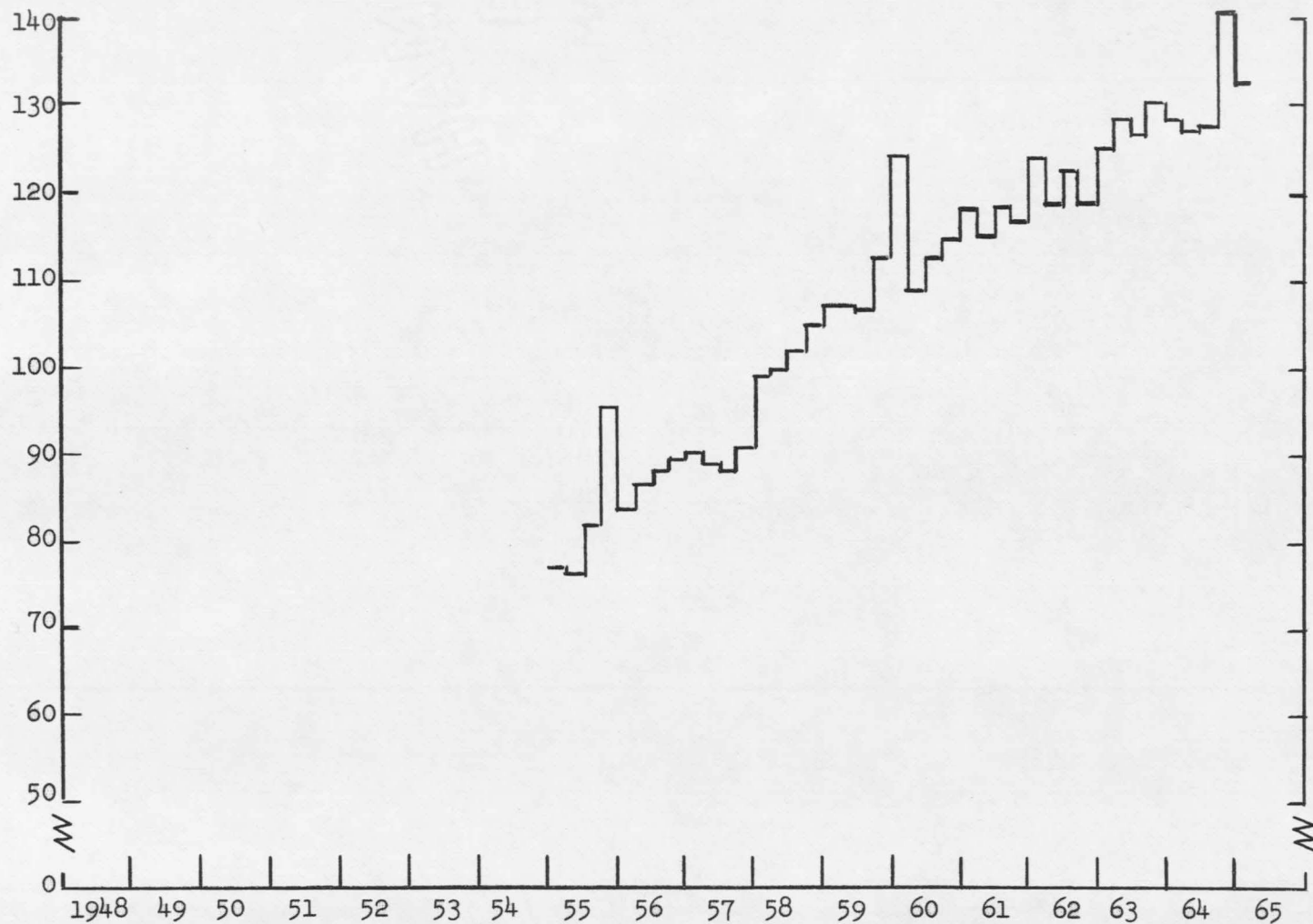


Figure 1. Quarterly Index of Average Monthly Wages Paid In Montana Dairy Industry.

Here again, it was difficult to obtain these costs directly from Montana processor-distributors for several years previous because the costs were either not recorded or else were kept in such a manner as to involve a considerable expenditure of time and money to obtain them. Thus, other sources were examined.

An analysis of the types of containers used in Montana revealed that the greatest quantities of milk are now packaged in paper cartons. For this reason letters were written to several paper carton manufacturers, who furnished prices that they charged processor-distributors since 1955.

Changes in these prices of paper cartons were compared, statistically, with changes in the index of "paper". When the paper carton series was lagged^{6/} one year, it revealed a significant correlation coefficient of 0.65 at the 0.01 percent significance level.

Figure 2 shows the "paper" index from 1947.

Equipment Costs

As mentioned in Chapter III, equipment costs are more difficult to determine. When the cost items of depreciation, rentals, and repairs were separated from the 11 Montana cost studies, it was found that they represented approximately 15 percent of the total costs of processing and distributing milk.

^{6/} This would assume that paper carton manufacturers do not immediately change the price charged to the processor-distributor when they are faced with a price change in their raw material -- "paper".

1957-59 = 100

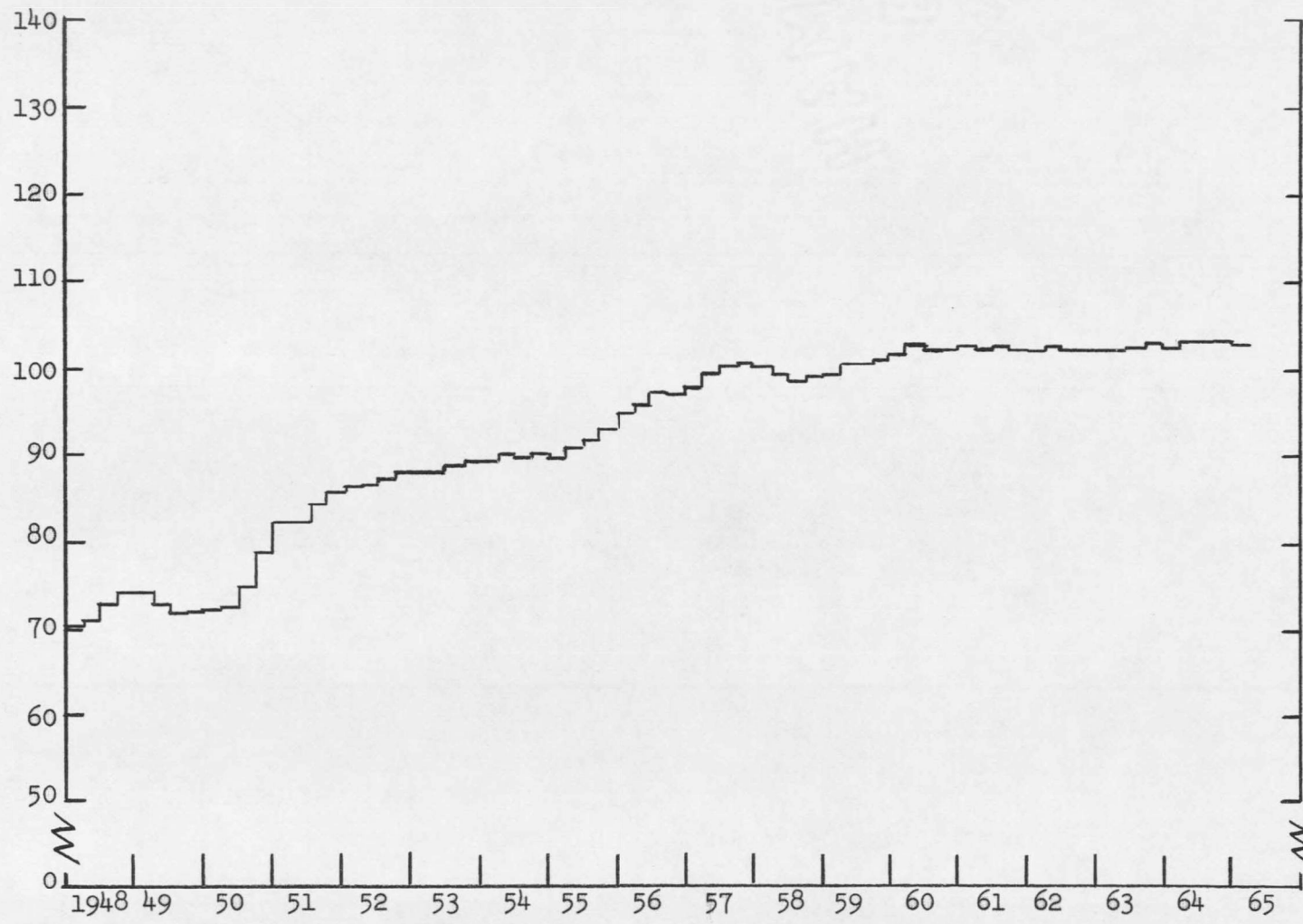


Figure 2. Quarterly Index of Paper.

Here again it was desirable to match these changes in costs for several years previous with a periodically published index that could be used to represent them in the formula. It was reasoned that changes in equipment costs would not vary to any appreciable extent in different parts of the United States. Thus, a national equipment cost series could be compared with a periodic index. The national series used was the "Repair, Rent and Depreciation" price series from the Milk Distributors' Sales and Costs.^{7/} This was correlated with the "machinery and motive products" index from the Survey of Current Business^{8/} and yielded a significant correlation coefficient of 0.70 at the 0.01 percent significance level.

Figure 3 shows the changes in price, since 1947, of machinery and motive products.

Vehicles Costs

Vehicle expenses -- depreciation, repairs, licenses, insurance -- amounted to about ten percent of total costs to the average Montana processor-distributor, as determined by the 11 cost studies mentioned earlier.

The index chosen to represent vehicle costs is the "motor vehicles" series from the Survey of Current Business.^{9/} No periodic data was found

^{7/} This index was published quarterly for 70 processor-distributors throughout the United States, starting 1952. The last quarter that an issue was compiled was for April-June, 1964.

^{8/} Op. cit.

^{9/} Ibid.

1957-59 = 100

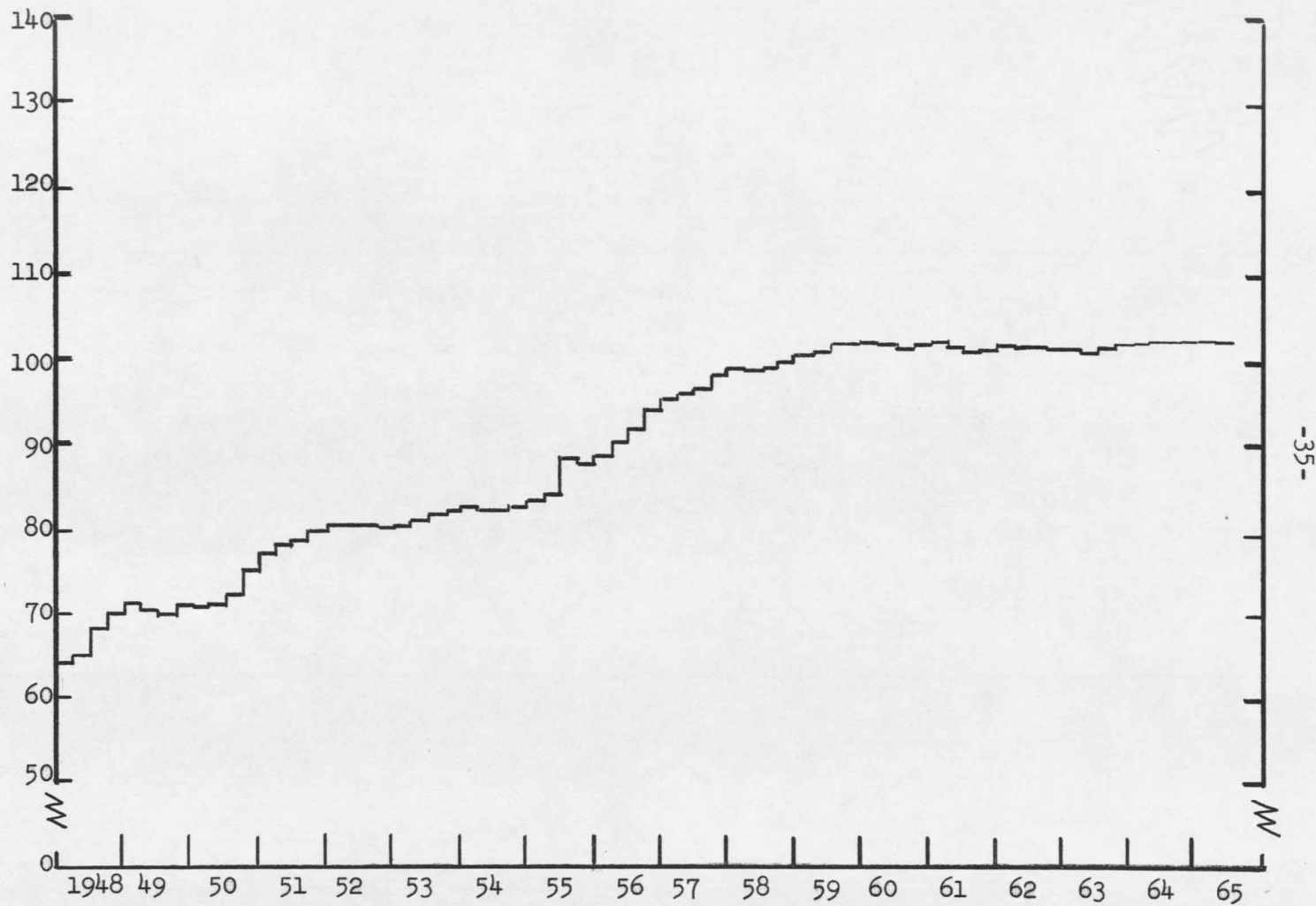


Figure 3. Quarterly Index of Machinery and Motive Products.

to compare with the index for several years previous that could be considered specific to the dairy industry. It was simply assumed in this case, that price changes of motor vehicles on a national scale, as represented by the index, would also be felt by Montana processor-distributors to a comparable degree.

Figure 4 shows the "motor vehicle" index since 1948.

Supplies Costs

As mentioned in Chapter III, supplies amount to only about $2\frac{1}{2}$ percent of the total costs.

Since the supplies classification consists mainly of items of a "chemical" nature, it seemed reasonable that an index of chemicals might bear some relationship. Again, it was assumed that the cost of supplies used in the milk processing-distributing industry in Montana would be approximately the same as for the nation. Thus the quarterly listing of "operating supplies" from the Milk Distributors' Sales and Costs^{10/} could be statistically analyzed with the index of "chemicals and allied products" from the Survey of Current Business.^{11/} When this was done, and the data for "operating supplies" was lagged^{12/} one year, a significant correlation coefficient of 0.63 was obtained at the 0.01 percent significance level.

^{10/} Op. cit.

^{11/} Op. cit.

^{12/} This assumes that changes in the costs of raw materials are not immediately passed on to the processor-distributor.

1957-59 = 100

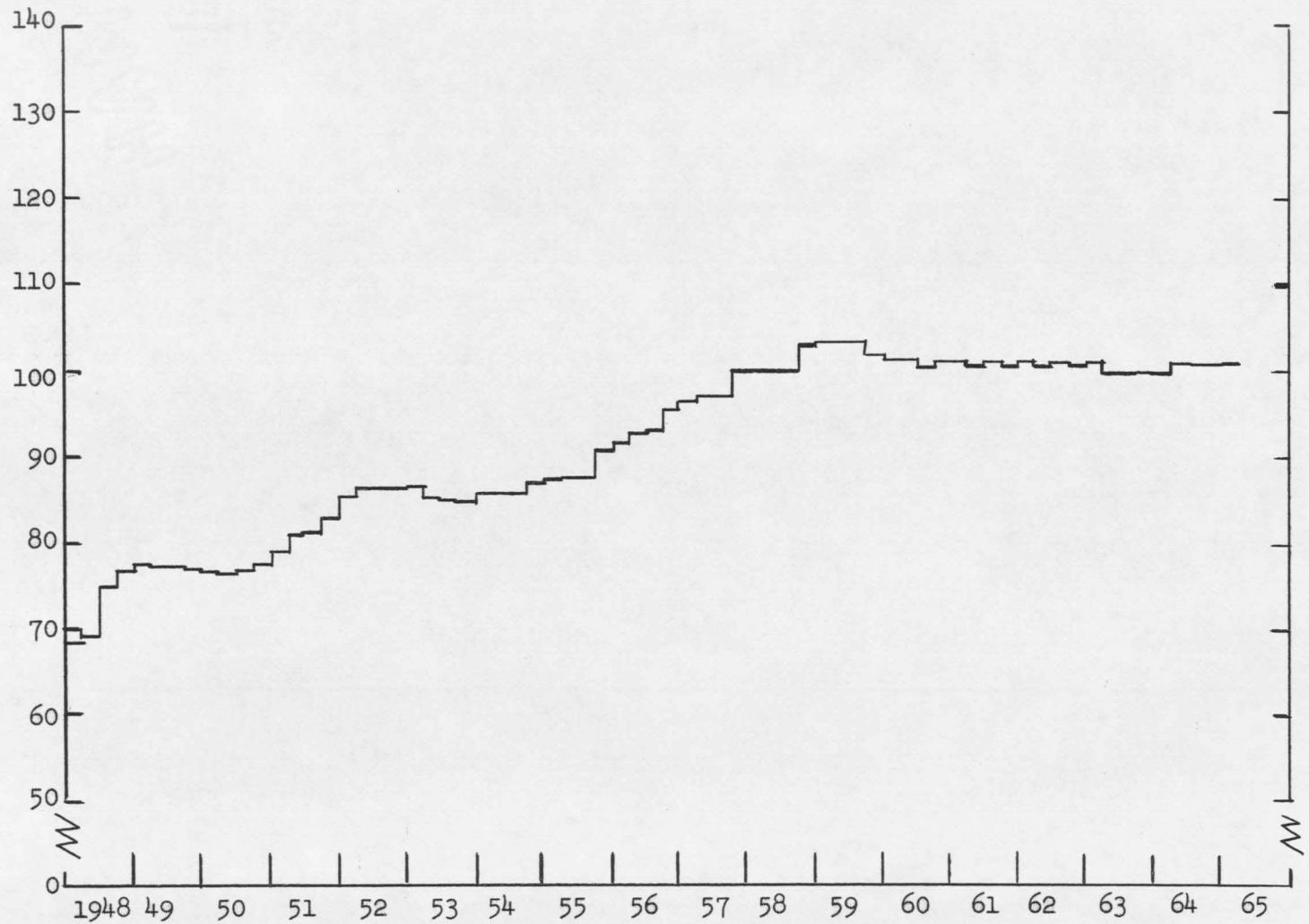


Figure 4. Quarterly Index of Motor Vehicles.

Figure 5 shows the "chemical and allied products" index from the Survey of Current Business.

Other Costs

Other costs, amounting to about $15\frac{1}{2}$ percent of total costs are omitted in the formula, as explained in Chapter III. For formula pricing purposes, labor, containers, equipment, vehicles, and supplies are assumed to equal 100 percent of the total costs to processor-distributors.

Opportunity Costs

Mention is made here of opportunity costs only for the purpose of letting the reader know that they have been considered. As mentioned in Chapter III, they are assumed to be very small to a milk processor-distributor.

If they were to be included in the formula they would have to be represented by a periodically published index. This would necessitate finding an index that would indicate profits of other industries which might constitute suitable alternatives for a processor-distributor. At this time, no indices published for Montana could be found which would accomplish this purpose.

For these reasons, opportunity costs are excluded from the formula.

Demand Side

What things influence the quantities of Class I fresh fluid milk purchased? Four things appear to have a definite influence:

1957-59 = 100

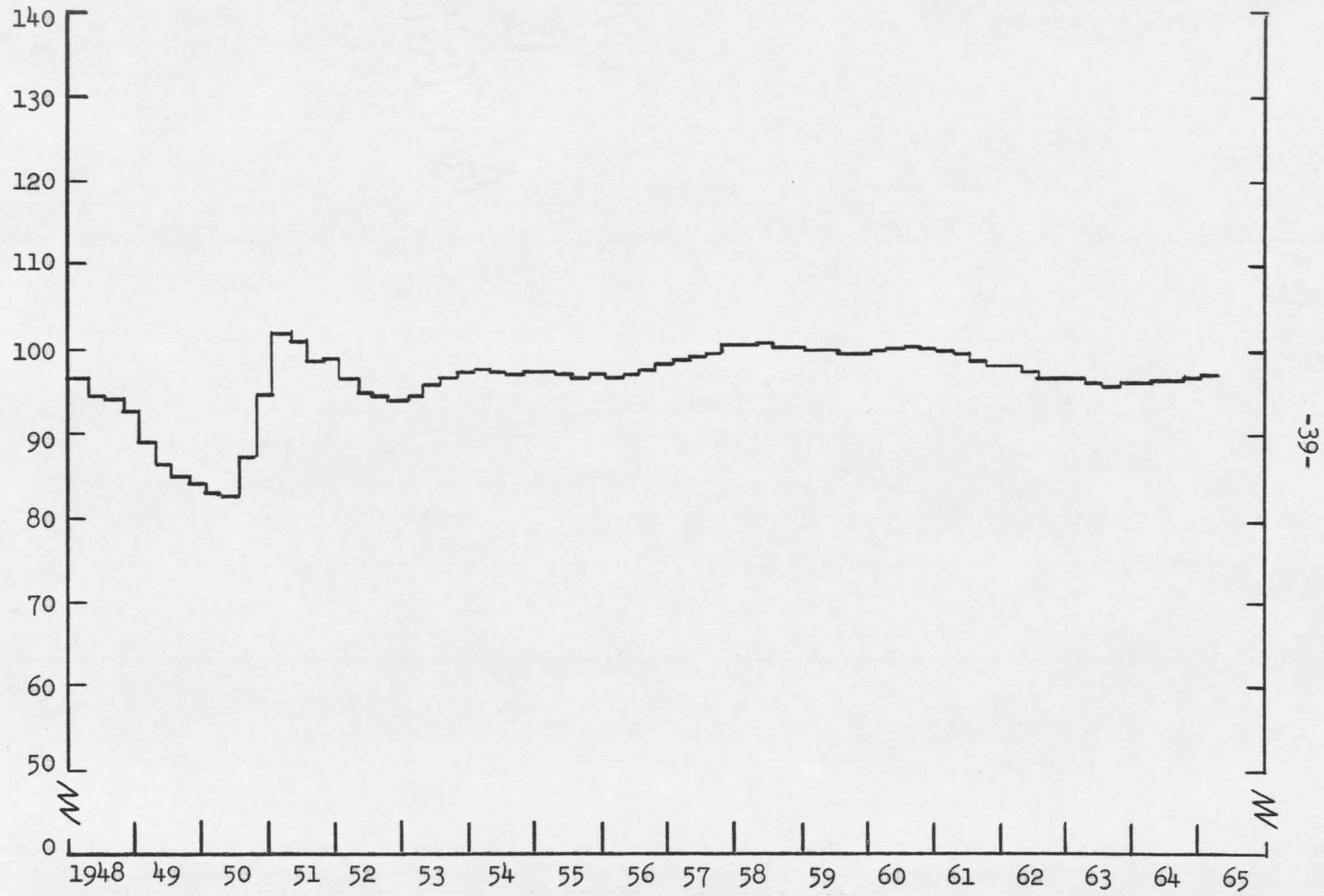


Figure 5. Quarterly Index of Chemical and Allied Products.

1. The elasticity of demand
2. income elasticity or consumer purchasing power
3. the price of milk, and
4. prices of substitute products.

The demand schedule for fresh fluid milk is generally conceded to be inelastic. Relatively large price changes are needed to appreciably affect quantities consumer. Income effects have also usually been found to be relatively inelastic, which means that changes in consumer incomes would not greatly affect amounts purchased.^{13/}

More work is needed concerning the prices of substitute products. These prices and the prices of fresh fluid milk would have to be watched closely to insure that markets for fresh fluid milk were not adversely affected by unfavorable price relationships.

Three indices were chosen to represent consumer purchasing power:

1. "per capita income for Montana" ^{14/}
2. "weekly wages of all manufacturing industries, all mining industries, and utilities and communications industries in

^{13/} Rojko, A. S., The Demand and Price Structure for Dairy Products, USDA Technical Bulletin No. 1168, May, 1957; Graf, Story and Jacobson, op. cit.; and Clark, op. cit. Demand and income elasticities are dependent upon many factors, such as the amount of price change, the length of time taken to measure responses, the amount of publicity given to price changes, and the income levels measured.

^{14/} Survey of Current Business, op. cit., usually published yearly in the July issue.

Montana" ^{15/}

3. "bank debits." ^{16/}

These three indices are combined in such a way so as to weigh the demand side of the formula. The weights assigned to the various indices of the formula are shown in Table III, Chapter III.

Figures 6, 7, and 8 show these indices.

The Base Period

The formula pricing system must have a "taking off" point. In other words, there has to be a starting price upon which to base the formula-- a base price.

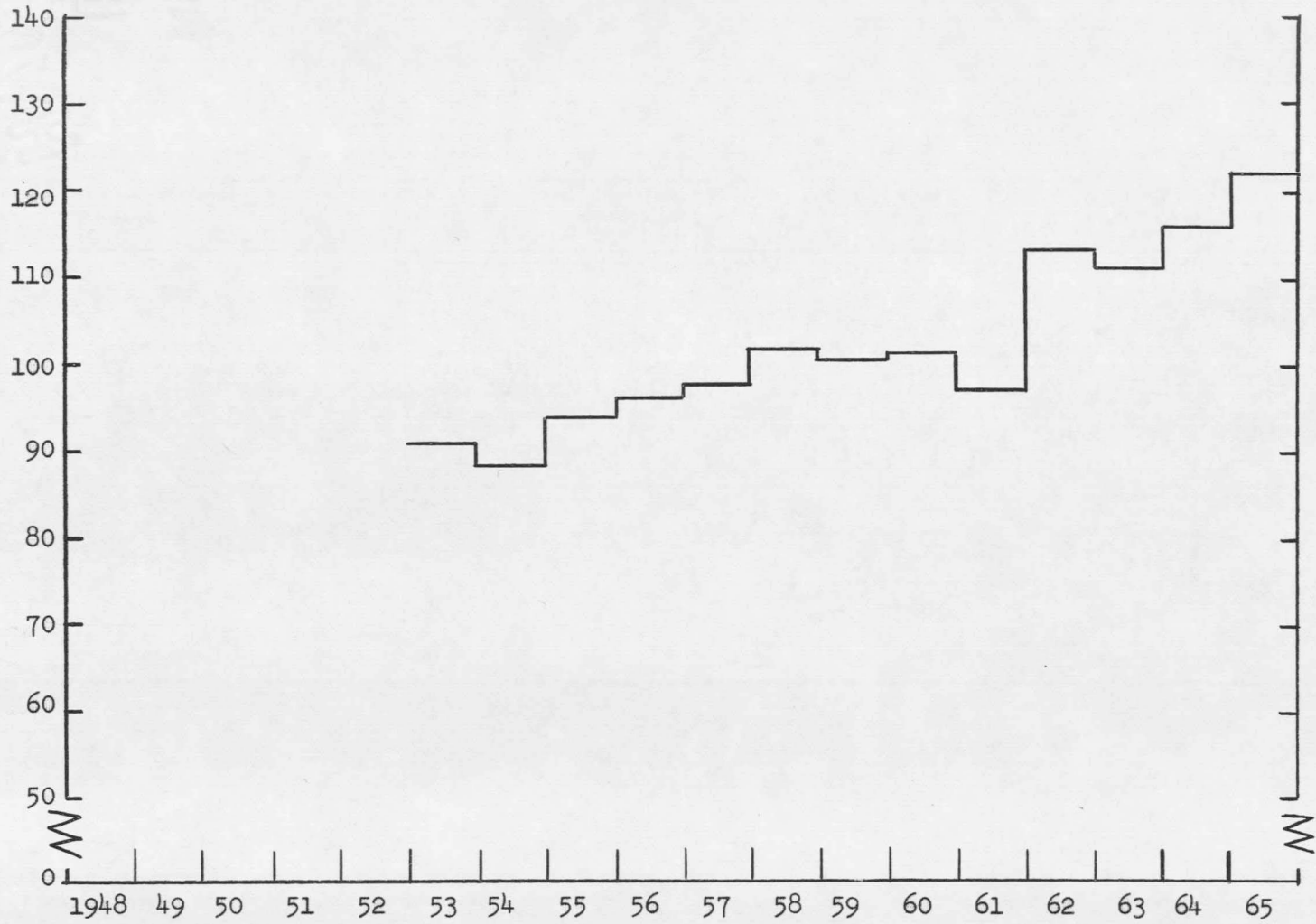
This involves a subjective judgment. It should be "fair and equitable" to processor-distributors, as well as to producers and consumers.

The years 1957-1959 are commonly used to represent base periods for various indices. Over this span of years the economy of the United States is generally considered to have been fairly stable, and the various elements of the economy in relative adjustment. It is assumed in this project that gross processor-distributor margins in Montana during this time, as established by the Milk Control Board, were also fairly stable and in

^{15/} Montana Labor Market, Montana State Employment Service, Division of Unemployment Compensation Commission of Montana, Helena.

^{16/} This is an unpublished index, compiled monthly by the Bureau of Business and Economic Research, University of Montana, Missoula, Montana.

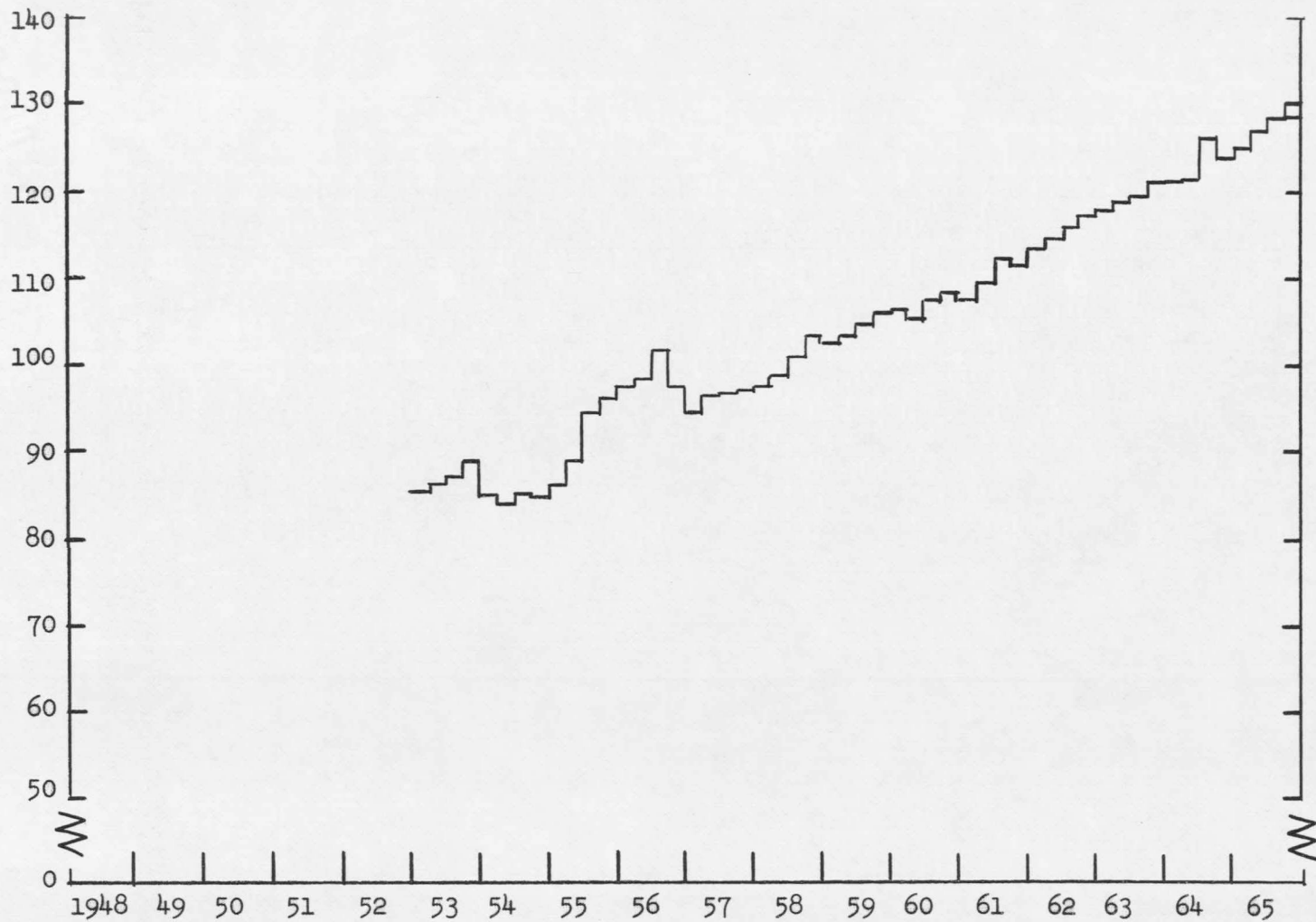
1957-59 = 100



-42-

Figure 6. Quarterly Index of Montana Per Capita Income.

1957-59 = 100



-43-

Figure 7. Quarterly Index of Weekly Wages.

1957-59 = 100

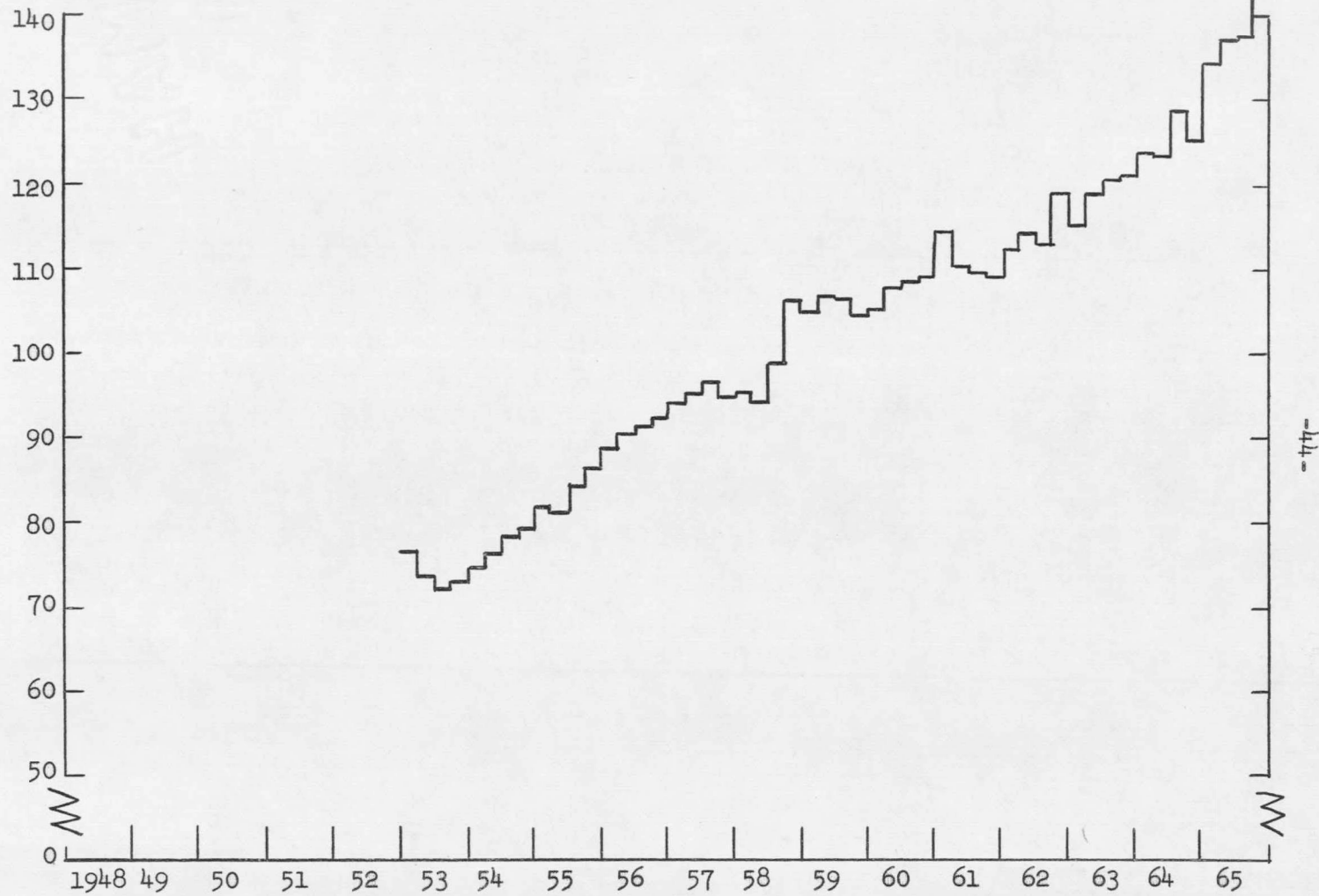


Figure 8. Quarterly Index of Bank Debits.

relative adjustment.

Proceeding on the basis of this assumption the average gross margin to processor-distributors from 1957 through 1959 was determined to be \$4.31917 per CWP. This is used as the formula base price. Figure 9 shows the average margins for each quarter for the entire state of Montana during this time.

Determination of price differentials between marketing areas will be considered later. Also postponed until later is discussion of the possibility that the formula might be used in a specific area.

The Bracketing System

Now the formula must be connected to prices. To do this, actual average statewide processor-distributor gross margins were studied from 1953 through 1965.

Two periods of time were chosen, during which gross margins were considered to be equitable. The base years, 1957-1959, were chosen for reasons already stated.^{17/} The year, 1965, was also chosen, partly for the same reasons.^{18/}

^{17/} See section on base period, in this chapter.

^{18/} Two additional arguments might be proposed for choosing 1965, 1. that margins in effect during this time were apparently sufficient to interest processor-distributors in processing and distributing quantities needed for consumption, and 2. that there was no change in the number of licensed, Grade A, processor-distributors in Montana during the year. This would indicate that established processor-distributors found it profitable to remain in business, and yet prices were not high enough to attract new firms into the industry.

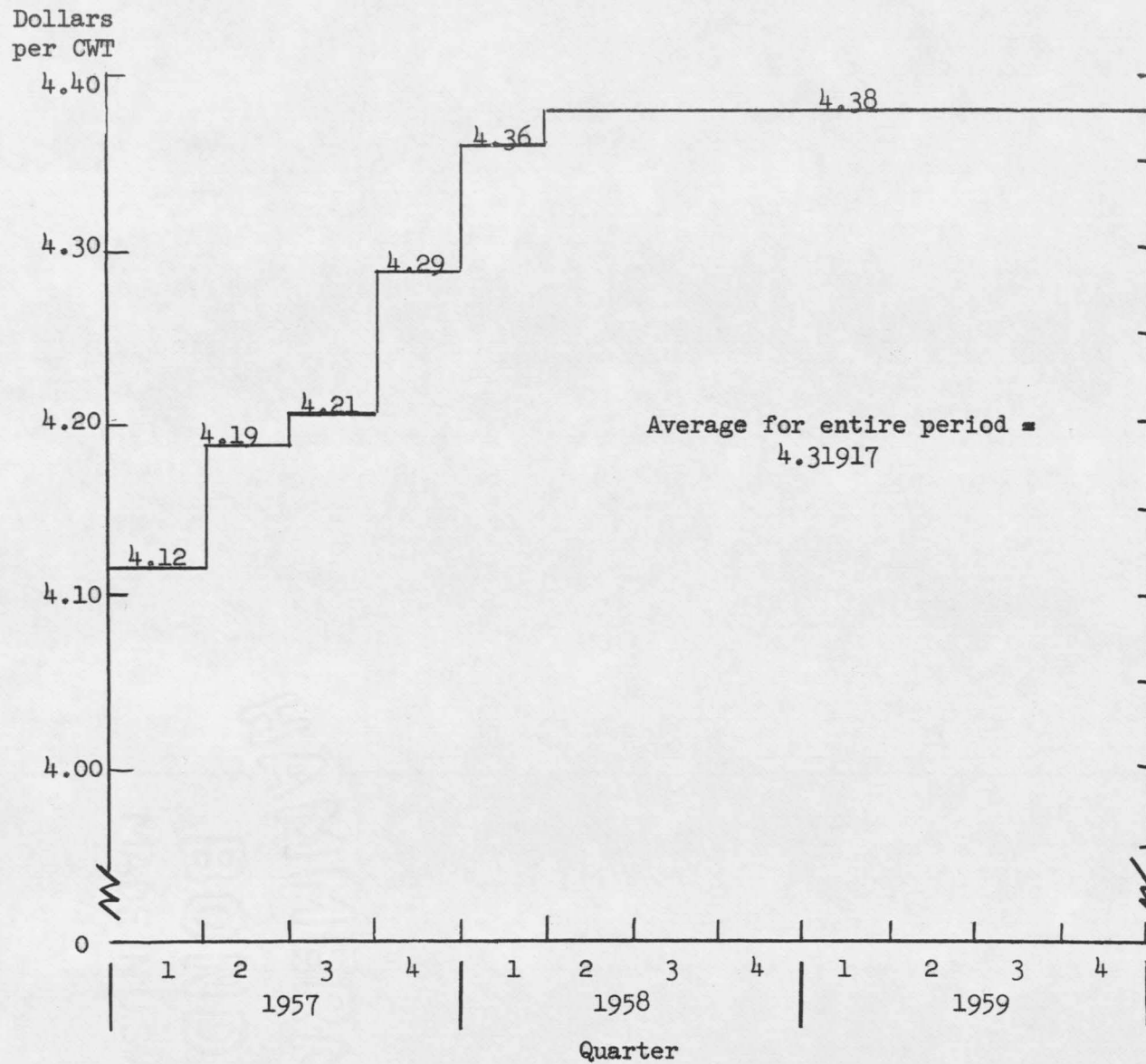


Figure 9. Average Gross Processor-Distributor Margins for Class I Milk in Montana (Calculated from Official Order Minimum Prices as Set by the Montana Milk Control Board)

There was an increase in gross margins between the averages for 1957-1959 and 1965 of 52 cents. During the same period the formula index increased 23.597 points. This amounts to a change of 23 cents in price every time the formula index changes 10.437 points. The 23 cent figure is used to take account of the fact that 46 quarts of milk equal 100 pounds. Thus margins are calculated to change at intervals of 23 cents per hundredweight, which equals one-half cent per quart. Changes any smaller than this would make the wholesale price difficult to administer.

The bracketing system has been set up, using the statewide average margin of 4.31 dollars per hundredweight as the midpoint. If the formula were used in a specific area, rather than on a statewide basis, both the base period and the bracketing system would have to be recalculated for that area.

Table IV shows the processor-distributor margin changes that would occur as a result of changes in the overall formula index.

TABLE IV. BRACKETING SYSTEM FOR PROCESSOR-DISTRIBUTOR PRICING FORMULA

<u>Total Formula Index</u>		<u>Gross Processor-Distributor Margin</u>
<u>At least</u>	<u>Not more than</u>	<u>Dollars per hundredweight</u>
146.967	157.404	5.46
136.530	146.966	5.23
126.093	136.529	5.00
115.656	126.092	4.77
105.219	115.655	4.54
94.782	105.218	4.31
84.345	94.781	4.08
73.908	84.344	3.85
63.471	73.907	3.62
53.034	63.470	3.39
42.597	53.033	3.16

CHAPTER V

THE FORMULA

Processor-Distributor Formula

Chapters I and II introduced the problems involved of pricing milk in Montana, and the objectives to be attained in this research project. Chapter III examined the various factors affecting the price of milk and established weights for these factors. Chapter IV introduced indices to represent the weights and set forth the base price and bracketing system. Now an attempt will be made to see how well the formula would work in practice.

The formula is established to work on a quarterly basis, partly because some of the indices are only available quarterly. Also the benefits derived from formula pricing on a more frequent basis probably would not justify the extra effort involved.

To calculate the formula, the following method can be used.^{1/}

1. Prepare a table with blanks beside each of the eight pricing factors (labor, containers, equipment, vehicles, supplies, per capita income, weekly wages, and bank debits), and allow space for the total index and price per hundredweight.
2. Compute the formula index weights:
 - (a) Labor: The statistics for labor are available from

^{1/} Mathematical derivation of the constants used are presented in Appendix A.

the Unemployment Compensation Commission. They will show the total number of workers employed by the dairy industry in Montana, per month, and the total wages received for each quarter. Sum the number of employees for the three months and divide the total into total wages paid. Multiply the result times 0.111686792. Enter the answer in the blank for labor.

- (b) Containers: The index of "Paper" from the Survey of Current Business must be multiplied times 0.0359106300 for each month of the quarter. Enter the sum of the products in the blank for containers.
- (c) Equipment: Multiply 0.0270745592 times the index of "Machinery and Motive Products", Survey of Current Business, for each month of the quarter, sum the products, and enter the answer in the blank for equipment.
- (d) Vehicles: Again from the Survey of Current Business, multiply the index of "Motor Vehicles" for each month of the quarter by 0.02807787168, sum the products and enter the result in the blank for vehicles.
- (e) Supplies: The "Chemicals and Allied Products" index, Survey of Current Business, is multiplied for each month of the quarter by 0.00609398670. Enter the sum of the products in the blank for supplies.

- (f) Per Capita Income: Obtain the per capita income figure for Montana for the latest year available from the Survey of Current Business. It can often be found in the July issue. Multiply this by 0.0050505051 and enter the answer in the blank for per capita income. This answer is applicable for any quarter, as long as the latest per capita income figure available is used.
- (g) Weekly Wages: Weekly wages are obtained from the Montana Labor Market published by the Unemployment Compensation Commission of Montana. Computation involves four steps:
1. Find the figures for "All Manufacturing" for the three months concerned, multiply each by 0.034753478 and sum the products;
 2. Find the figures for "All Mining" for the three months concerned, multiply each by 0.0101080461 and sum the products;
 3. Find the figures for "Utilities and Communications" for the three months concerned, multiply each by 0.0102753922 and sum the products;
 4. Add the three sums and enter the answer in the blank for weekly wages.
- (h) Bank Debits: The index of bank debits for Montana is compiled monthly by the Bureau of Business and Economic

Research, Missoula. Multiply figures for each month of the quarter by 0.0333668857, sum the products and enter in the blank for bank debits.

- (i) Sum the blanks and enter the total.
- (j) Find the price per hundredweight from Table IV and enter in the proper blank. This represents the gross processor-distributor margin for that quarter.

An Example:

Computation of the formula is made for January-March, 1965.^{2/}

1. Labor: For January, February and March, 756, 754 and 752 workers were employed, respectively, totaling 2,262 for the quarter. Total wages for the quarter equaled \$963,533.00. The average monthly wage was \$425.9650751. This figure times the constant of 0.111686792 equals 47.5746727, which is entered in the blank for labor.
2. Containers: The monthly index numbers for "Paper" are 103.7, 103.8 and 103.8. When multiplied by the constant of 0.0359106300 and the products are summed, the answer of 11.1789791 is entered in the blank for containers.
3. Equipment: The monthly index numbers for "Machinery and Motive Products" are 103.3, 103.5 and 103.5. When multiplied by constant 0.0270745592, and the products are summed, the

^{2/} A formula worksheet is presented in Appendix C.

- answer of 8.4012357 is entered in the blank for equipment.
4. Vehicles: Monthly indices equal 100.8, 100.9 and 100.8 for the quarter. Multiplied by 0.02807787168, the total of 8.4935562 is entered in the blank for vehicles.
 5. Supplies: Indices are 97.3, 97.5 and 97.5. When multiplied by constant 0.0609398670, and the products summed, the total equals 1.7812723.
 6. Per Capita Income: The per capita income figure for Montana for 1965 is \$2,409.00. When multiplied by the constant 0.0050505051, a figure of 12.1666667 is obtained and entered in the blank for per capita income.
 7. Weekly Wages: Average earnings of "All Manufacturing" for January, February and March equal 110.55, 110.84 and 110.70, respectively. Multiplied by 0.034753478, and the products summed, the total equals 11.5412825. Average earnings of "All Mining" are 117.04, 117.32 and 119.66. Multiplied by constant of 0.0101080461, the sum of the products equals 3.5784505. "Utilities and Communications" earnings are 108.70, 111.61 and 114.80. The sum of these by 0.0102753922 equals 3.4433867. The total of all three equals 18.5631197, which is entered in the blank for weekly wages.
 8. Bank Debits: Bank debits for January, February and March are 133.59, 130.75 and 138.53, respectively. When multiplied by 0.0333668857, and the products are summed, an answer of

13.4425172 is obtained which is entered in the blank for bank debits.

9. Add all the blanks and a total formula index number of 121.6020196 is obtained.
10. This corresponds to a gross processor-distributor margin of \$4.77. (Table IV)

When the average statewide producer price and the average statewide gross retailer margin is added to the formula gross processor-distributor margin for January-March, 1965, (\$5.42 plus \$1.37 plus \$4.77) the total retail price comes to \$11.56, or 50 cents per half gallon.^{3/} The actual average statewide retail price for this period was \$11.58 per hundred-weight or 50 cents per half gallon. The formula pricing system would not have changed the gross processor-distributor margin.

Processor-Distributor Formula Combined With a Revised Producer Formula

The pricing formula at the producer level was set forth by

Dr. Edward H. Ward in a bulletin entitled, Pricing Formula for Montana Milk.^{4/}

Components of the formula include direct cost items, opportunity

^{3/} There are approximately 23 half gallons per hundredweight of milk. When \$11.56 is divided by 23 the result is actually 50.261 cents per half gallon. Since it is impractical to price half gallons of milk in tenths of a cent the number is rounded to the nearest whole cent.

^{4/} Op. cit. Dr. Ward is an Agricultural Economist, Montana State University, Bozeman, Montana.

costs and consumer purchasing power. Three indices represent direct costs^{5/}: mixed dairy feeds (10%), farm labor wages (15%) and alfalfa hay (20%). The index representing opportunity costs is prices received by farmers for all farm products (20%)^{6/}. Per capita income (10%), weekly wages (15%) and bank debits (10%) represent consumer purchasing power, as in the processor-distributor formula.

The Revised Formula

Technological and structural changes that have occurred in dairy farming, plus changes in some of the indices make it desirable that the producer formula be revised slightly. The proposed revisions are shown in Table V.^{7/}

There are several reasons for making these changes. First, the dairy industry is becoming more specialized at the producer level. This means that the alternatives are becoming more limited for dairy farmers already in business with a large inventory of expensive equipment. For example, it would involve a considerable expenditure of time and money to convert a modern milking parlor over to anything that could be used in the production of beef. This reduces opportunity costs and therefore a new weight has been assigned this factor.

5/ All these indices are obtained from the Montana Crop and Livestock Reporting Service, op. cit.

6/ Ibid. Available from same source.

7/ Dr. Ward was consulted on this matter and a general agreement was reached as to changes and weights.

TABLE V. PROPOSED REVISIONS IN PRODUCER FORMULA

Original Formula			Revised Formula			
		<u>10%</u>	Mixed dairy feed		<u>10%</u>	Mixed dairy feed
All Cost Items 65%	Direct cost 45%	<u>15%</u>	Farm labor wages	All Cost Items 65%	<u>15%</u>	Farm labor wages
		<u>20%</u>	Alfalfa hay		<u>15%</u>	Alfalfa hay
	Opportunity Cost 20%	<u>20%</u>	Prices rec'd by farmers for all farm products		<u>10%</u>	Machinery costs
		<u>10%</u>	Per capita income		<u>15%</u>	Prices rec'd by farmers for all farm products
Consumer Purchasing Power 35%		<u>15%</u>	Weekly wages	Consumer Purchasing Power 35%	<u>10%</u>	Per capita income
		<u>10%</u>	Bank debits		<u>15%</u>	Weekly wages
					<u>10%</u>	Bank debits

A machinery cost index has been included in the new formula in an attempt to represent the greater specialization and increased capital investment which accompanies it.

The weight assigned to alfalfa was reduced, not so much because alfalfa is any less important, but because alfalfa prices are highly unstable, and reported prices are of questionable accuracy, causing a fluctuation in the index which is assumed to be unwarranted.

The index of prices received for all farm products is revised to represent wheat certificate payments. Since this index only reflects true market prices it would seem reasonable to account for the increased income to farmers because of these payments. The index is corrected by adding eight points to any given month.

Concerning weekly wages, the original formula used wages from "All Manufacturing", "All Mining" and "Transportation and Utilities (except railroads)". Figures for the latter have been unavailable since October, 1962. To account for this, wages for "Utilities and Communications" have been substituted and the weights changed accordingly.

The base year for bank debits has shifted from 1947-49 = 100 to 1957-59 = 100. This was also taken account of in the revised producer formula.

The revised worksheet for the producer formula computation is presented in Table VI.

Producer Base Price

The producer base price must also be changed for this project. This

TABLE VI. REVISED WORKSHEET FOR PRODUCER FORMULA COMPUTATIONS^{a/}

1. Farm wages	0.115850000 (for all quarters)			
2. Alfalfa hay				
	Quarter 1	Quarter 2	Quarter 3	Quarter 4
	Jan. 0.1630154	Apr. 0.1691546	Jul. 0.1763192	Oct. 0.1738055
	Feb. 0.1641125	May 0.1701665	Aug. 0.1773831	Nov. 0.1681547
	Mar. 0.1678241	Jun. 0.1715347	Sep. 0.1798493	Dec. 0.1681547
3. Mixed dairy feed				
	Quarter 1	Quarter 2	Quarter 3	Quarter 4
	Jan. 0.9864738	Apr. 0.9737867	Jul. 0.9786527	Oct. 1.0035860
	Feb. 0.9835404	May. 0.9689796	Aug. 0.9796376	Nov. 1.0139323
	Mar. 0.9737867	Jun. 0.9632953	Sept. 0.9835304	Dec. 0.9995165
4. Machinery costs	0.060882801 (for all quarters)			
5. Prices received for all farm products	0.057747830 (for all months)			
6. Per capita income	0.004955401 (for all quarters)			
7. Weekly wages				
	All manufacturing	0.032554179 (for all months)		
	All mining	0.009624000 (for all months)		
	Utilities & communications	0.009520728 (for all months)		
8. Bank debits	0.030963107 (for all months)			

a/ See page 16 of Ward's bulletin for original worksheet.

is because prices here are figured on a statewide average, whereas in Dr. Ward's formula the base was calculated specifically for marketing area number ten. Also, in Ward's bulletin the price was quoted at 3.7 percent butterfat. Here all prices are calculated for 3.5 butterfat. The average statewide producer price in 1960 for milk testing 3.5 percent butterfat was 5.2425 dollars per hundredweight. This changes the producer formula bracketing system to that shown in Table VII.

Using the revised producer formula for the first quarter of 1965, a price of \$5.93 per cwt is arrived at. This, added to the processor-distributor formula price of \$4.77, brings the total wholesale price to \$10.70 per cwt. If a retail gross margin of 13.8^{8/} percent of the wholesale price is added, the total retail price comes to \$12.18 per cwt. This amounts to 53 cents per half gallon. Actual average statewide prices during this period were: producer - \$5.42, distributor margin - \$4.79, and retailer margin - \$1.37, for a total of \$11.58 per cwt, or 50 cents per half gallon.

Table VIII also gives a comparison of formula prices and actual average statewide prices, as well as wholesale formula (two formulas combined) prices and actual average statewide wholesale prices.

8/ A retail gross margin of 13.8 percent of the wholesale price is used here for illustrative purposes only. This is the average statewide margin for six quarters, January, 1965, through June, 1966. It is quite possible that a better system could be found, possibly formula pricing. No attempt is made to do that here.

TABLE VII. PRODUCER FORMULA PRICE DETERMINATION

Formula Index		Milk Price Per CWT
<u>at least</u>	<u>less than</u>	<u>dollars</u>
118.217	121.528	6.62
114.905	118.216	6.39
111.593	114.904	6.16
108.281	111.592	5.93
104.969	108.280	5.70
101.657	104.968	5.47
98.345	101.656	5.24
95.033	98.344	5.01
91.721	95.032	4.78
88.409	91.720	4.55
85.097	88.408	4.32
81.785	85.096	4.09

Formula Prices Compared with Actual Prices

To compile this table it was necessary to obtain prices of milk in Montana for several years previous. The series begins in 1953 and shows average statewide prices by quarters through June, 1966. It was not felt to be advantageous to go back any farther than 1953 since an earlier series would involve difficulties in differentiating between price changes and changes in technology. For example, before 1953 glass containers were more and more prevalent as one goes further back. Since conversion from glass to paper containers is considered a major technological change in the dairy industry and since this conversion was approximately complete by this time, the series does not go any further back than 1953. Even with the series used here some technological change is inevitable.

It must be remembered that the actual prices shown are averages of

minimum prices established by the Milk Control Board for the 12 marketing areas. Although it was possible for higher prices to be established by the individual firms concerned, there is little evidence that this was actually the case. Rather the minimum price tended to be the price used.

Perhaps a more satisfactory comparison could have been made if formula prices could have been compared with free market prices. But the milk market has been regulated in Montana since 1939 at the producer, wholesale and consumer levels, and so the only comparison possible was with controlled prices. In some respects, this is probably the more proper comparison. Any pricing system is meant to accomplish certain objectives -- in this case, to see that prices are maintained in such a manner so as to assure adequate supplies of fresh fluid milk at reasonable prices, and to see that producers, processor-distributors, retailers, and consumers are dealt with fairly and that they pay and receive equitable prices for their product. That this would have happened in a free market situation is questionable. Therefore, a justification can be made for comparing formula prices with regulated prices in this project.

TABLE VIII. FORMULA PRICES COMPARED WITH ACTUAL AVERAGE STATEWIDE PRICES ^{a/}

Year	Quarter							
	1		2		3		4	
	Formula	Actual	Formula	Actual	Formula	Actual	Formula	Actual
1953 P	5.01	5.05	4.78	5.06	4.55	5.06	4.55	5.06
P/D	3.85	4.15	3.85	4.15	3.85	4.15	3.85	4.15
W	8.86	9.20	8.63	9.21	8.40	9.21	8.40	9.21
1954 P	4.55	5.06	4.55	5.05	4.55	5.02	4.78	5.00
P/D	4.08	4.14	3.85	4.12	3.85	4.10	3.85	4.10
W	8.63	9.20	8.40	9.17	8.40	9.12	8.63	9.10
1955 P	4.55	4.98	4.78	4.98	4.78	4.96	4.55	4.96
P/D	3.85	4.10	3.85	4.09	4.08	4.10	4.08	4.10
W	8.40	9.08	8.63	9.07	8.86	9.06	8.63	9.06
1956 P	4.55	4.96	4.78	4.96	4.78	4.97	4.78	4.98
P/D	4.08	4.10	4.08	4.07	4.08	3.98	4.08	3.99
W	8.63	9.06	8.86	9.03	8.86	8.95	8.86	8.97
1957 P	4.78	5.06	4.78	5.08	4.78	5.10	4.55	5.15
P/D	4.08	4.11	4.08	4.23	4.08	4.23	4.31	4.29
W	8.86	9.17	8.86	9.31	8.86	9.33	8.86	9.44
1958 P	4.55	5.17	4.78	5.17	4.78	5.17	4.78	5.17
P/D	4.31	4.35	4.31	4.35	4.31	4.35	4.31	4.35
W	8.86	9.52	9.09	9.52	9.09	9.52	9.09	9.52
1959 P	4.78	5.17	5.01	5.17	5.01	5.17	5.24	5.17
P/D	4.31	4.35	4.31	4.35	4.31	4.35	4.54	4.35
W	9.09	9.52	9.32	9.52	9.32	9.52	9.78	9.52
1960 P	5.24	5.17	5.24	5.23	5.24	5.23	5.24	5.34
P/D	4.54	4.35	4.54	4.39	4.54	4.39	4.54	4.39
W	9.78	9.52	9.78	9.62	9.78	9.62	9.78	9.73
1961 P	5.01	5.33	5.01	5.33	5.24	5.31	5.24	5.29
P/D	4.54	4.46	4.54	4.40	4.54	4.44	4.54	4.48
W	9.55	9.73	9.55	9.73	9.78	9.75	9.78	9.77
1962 P ^{b/}	5.47	5.28	5.47	5.28	5.47	5.28	5.47	5.28
P/D	4.54	4.49	4.54	4.49	4.54	4.49	4.54	4.49
W	10.01	9.77	10.01	9.77	10.01	9.77	10.01	9.77
1963 P	5.47	5.30	5.47	5.33	5.47	5.34	5.47	5.34
P/D	4.54	4.47	4.77	4.44	4.77	4.43	4.77	4.43
W	10.01	9.77	10.24	9.77	10.24	9.77	10.24	9.77
1964 P	5.47	5.34	5.47	5.36	5.47	5.42	5.47	5.42
P/D	4.77	4.44	4.77	4.48	4.77	4.78	4.77	4.78
W	10.24	9.78	10.24	9.84	10.24	10.20	10.24	10.20
1965 P	5.93	5.42	5.93	5.41	5.93	5.41	5.93	5.41
P/D	4.77	4.79	4.77	4.83	4.77	4.84	5.00	4.84
W	10.70	10.21	10.70	10.24	10.70	10.25	10.93	10.25

TABLE VIII. (Continued)

- a/ "Actual" prices are statewide averages as determined from Milk Control Board Official Orders, which establishes minimum prices by marketing areas. The fact that they are minimum prices is not considered to affect true conditions to any great extent, since there is little evidence that true prices differed appreciably from those set by the Board. Producer formula prices from 1953 through 1961 were calculated by using the formula indices found on page 20 of Dr. Ward's bulletin (op. cit.) and Table VII of this paper. From 1962, through 1965, the revised producer formula is used--P = Producer price, P/D = Processor-Distributor margin, W = Wholesale price.
- b/ Marketing areas were not placed into effect until approximately 1960. Marketing orders before that time were promulgated for specific towns. For purposes of this study, actual average prices were extended to include entire marketing areas for all years, as presently set up. Any error in this procedure should be relatively small.

CHAPTER VI

OUT-OF-STATE COMPETITION

It is conceivable that producer prices in Montana could get high enough, in comparison to prices in out-of-state surplus areas, to encourage imports of bulk milk from these areas. If this were to happen it would have damaging effects on Montana producers due to no fault of their own. Since the proposed formula is not meant to have damaging effects on the Montana dairy industry, an upper price limit is incorporated. This limit would be the price at which it would be unprofitable for milk to be shipped into the state.

How then, should this limit be established?

Before attempting to answer this question, it seems appropriate to consider producers and processor-distributors separately. In order to establish the upper price limit of bulk milk at the producer level it is necessary to know two things -- 1. The price of bulk milk in areas surrounding Montana, and 2. The costs of transporting this milk into Montana. As long as Montana producer prices were kept below producer prices in surrounding, surplus areas, plus transportation charges, it would be unprofitable for Montana processor-distributors to purchase milk out of state.

In order to establish the upper limit on the wholesale price it is again necessary to know two things -- 1. The prices of wholesale processed and packaged milk in surrounding surplus areas, and 2. The costs of transportation. As long as the Montana wholesale price were maintained

below the price of wholesale milk in other areas, plus transportation costs, it would be unprofitable for Montana retailers and jobbers to buy wholesale milk out of state.

Thus, in order to set upper price limits, four things must be known:

1. The producer prices in surrounding surplus areas,
2. The wholesale prices in surrounding surplus areas,
3. Transportation costs of bulk milk, and
4. Transportation costs of processed and packaged milk.

Producer and wholesale prices in surrounding surplus areas are relatively easy to obtain. They can be found in the monthly issues of the Fluid Milk and Cream Report, published by the U. S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board, Washington, D. C.^{1/}

Transportation charges are a different matter. This author knows of no periodically published price series which provides hauling rates of milk, either bulk or processed.

Figure 10 shows approximate transportation charges, per hundredweight, for bulk milk.^{2/} The solid line shows the approximate transportation

^{1/} Concerning the producer and wholesale prices in surrounding states, it must be assumed that these are correct and true prices. However, this in fact may not be the case. Prices quoted in the Fluid Milk and Cream Report are wholesale prices charged to retail outlets. It may well be that discounts could be offered for larger volumes to be shipped into Montana. Whatever the true conditions may be would be difficult to find out, so prices from the above publication must be used.

^{2/} This information was received through telephone conversations with several Montana processor-distributors.

dollars per
hundredweight

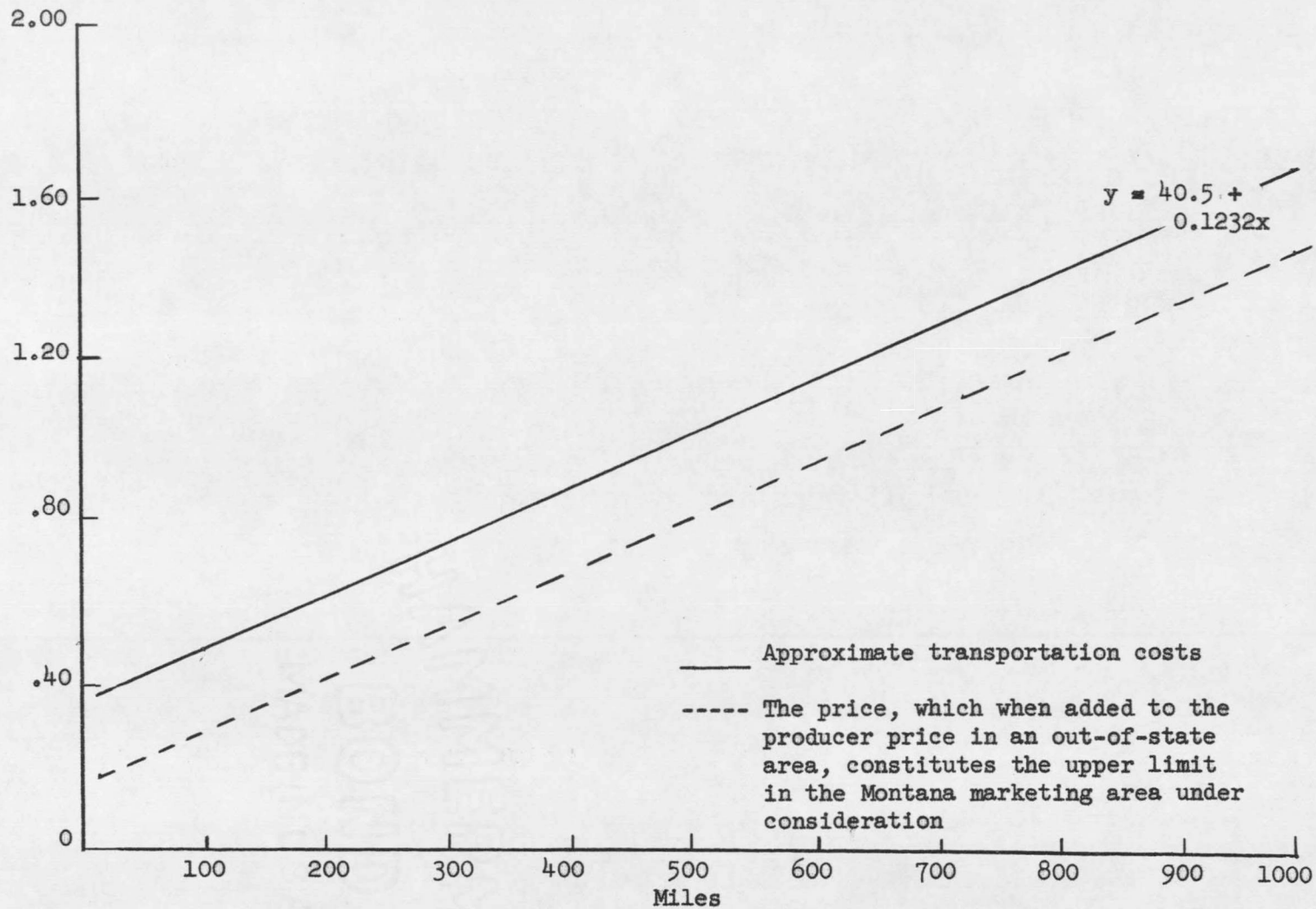


Figure 10. Hauling Rates for Bulk Milk.

charges for bulk milk at various distances. The dashed line is considered to represent a price, that when combined with the out-of-state producer price, will be sufficiently low to discourage imports of milk.

The Montana producer price for any marketing area may be figured by using Table IX.^{3/}

First, prices in the out-of-state marketing areas must be obtained and averaged for the quarter.^{4/} These averages are then added to the prices from Table IX for the Montana marketing area concerned. The resulting totals set the upper limit for the price for that area; if the formula price is higher, it cannot be used.

At the processor-distributor level, it would seem that slightly different problems are involved. First, there are two methods for an out-of-state distributor to take advantage of a favorable wholesale price differential between marketing areas. He may sell the packaged product in Montana under his own brand name, or he may package milk for Montana distributors to be shipped and sold in the state under the Montana distributor's brand name. The former method is discouraged simply due to the fact that with price controls the out-of-state distributor must sell his milk at the same price as all other milk, and thus it would be difficult for him to establish a market. The latter method would also

^{3/} Table IX was compiled by using distances from the major town or city in each Montana marketing area, to the out-of-state marketing area indicated. Prices were obtained from the dashed line in figure 10, using the above mileages.

^{4/} Fluid Milk and Cream Report, Op. Cit.

TABLE IX. FIGURES TO AID IN THE CALCULATION OF THE MONTANA
PRODUCER PRICE a/

Montana Marketing Area	Out-of-State Marketing Area				
	Minneapolis- St. Paul	Fargo- Moorhead	Bismark- Mandan	Idaho Falls	Spokane
I	1.38	1.11	.88	.45	.72
II	1.20	.96	.72	.60	.86
III	1.02	.78	.54	---	---
IV	1.06	.77	.62	---	---
V	.98	.69	.45	---	---
VI	1.25	.96	.72	---	.90
VII	1.28	.98	.74	.64	.79
VIII	1.40	1.12	.88	.66	.64
IX	----	----	---	.88	.60
X	----	----	---	.60	.45
XI	----	----	---	.47	.60
XII	1.44	1.20	.93	.56	.60

a/ For explanation, see text.

be discouraged, provided Montana producer prices were not allowed to get too high in comparison to producer prices in out-of-state surplus areas. This is due to the fact that it costs more to haul packaged milk, than it does to haul the same quantity of bulk milk.^{5/} The assumption is made that the costs of processing and distributing milk in out-of-state areas are similar to those in Montana. For these reasons, out-of-state competition is assumed to be of a relatively minor scale at the processor-distributor level, and no formula limits are therefore imposed.

^{5/} A tank truck can haul approximately 40,000 to 42,000 pounds of milk, while a 35-foot refrigerated trailer rig hauls only about 30,000 to 35,000 pounds. The cost of transporting 420 CWT of milk by tanker comes to about \$1.25 per CWT, when figured at 760 miles. A trailer loaded at 32,500 pounds will hold about 615 quart cases. At 24 quarts to the case, this comes to about 320 CWT of milk. A trip of 760 miles would cost about \$615.00 or \$1.91 per CWT.

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

The formula has been presented. There is no doubt that parts of it could be questioned. However, it is contended that it would be more efficient than the present method of establishing prices.

Nothing has been mentioned about prices of Class II, III, and IV milk or about blend prices. Government support prices also have been omitted. Producer base pools, both market pools and individual handler pools have been ignored. These items, and others, naturally add complications to formula pricing.

There is the additional problem of determining pricing differentials between marketing areas. Price differentials in effect at the time the formula is instigated are used here. However, a careful study might reveal justifications for changing these differentials. Costs of producing and processing and distributing milk would have to be examined, as well as transportation costs between areas. This again is a difficult area in which to obtain information.

Another area that has been treated briefly is the elasticity of consumer income and price elasticity. Here again is an important subject, deserving of careful study and attention. It was assumed in this project that price changes would not appreciably change consumer buying habits. However, increases in the price of fresh fluid milk may induce consumers to substitute more dry milk powders or even orange juice or coffee. The main reason this area was side-stepped was due to lack of information on

elasticities. To obtain this information would involve considerable time and money conducting market surveys.

Also by-passed is the effect of economies of scale and possible economies from producing other products, such as cottage cheese and ice cream.

Conclusions

The ultimate test of a milk pricing formula is the job it does when put to actual use. Its effectiveness must be determined by the degree to which it accomplishes the task it was meant to do.

So what was it meant to do?

The formula is meant to change gross distributor margins to reflect changes in the prices of factors having an influence on the supply and demand of milk at the processor-distributor level.

At this point a distinction should be made between the formula itself and the base price. Neither the formula nor the base price is meant to deal with problems of establishing "fair and equitable" margins. The formula is simply meant to see that some previously determined margin rises and falls with increases and decreases of the prices of factors affecting the margin. It is assumed that existing margins would be "fair and equitable" when the formula is placed into operation. The formula would then aim at keeping this margin in a "fair and equitable" range.

The base price is another problem. The entire formula pricing system is dependent upon the base price. For example, if the base price is too

high, then all prices for succeeding quarters will be too high. The base price must be "correct" at the outset.

Then the question is, what constitutes a fair and equitable base price? An assumption was made that the average statewide price during the years 1957 through 1959 was fair to everyone concerned. This then becomes the base price.

In actuality, this may not have been a fair price. Maybe a better base price could have been found. But to the author's knowledge, this is the best method of establishing a base price known at this time. Any measure of the efficiency of the base price is going to necessarily involve a good deal of subjective judgment. Some idea of efficiency of the base price could be determined by comparing the supply and demand of milk. To do this several things would have to be examined, such as quantities needed and quantities supplied for all classes of dairy products. Also, the amount of milk imported and exported to and from Montana would have to be looked at.

Measuring efficiency of the formula itself is a different matter. Subjective judgments will still be involved, but if one accepts the assumptions and objectives already set forth, then relative effectiveness and efficiency of the formula can be measured to some degree.

The purpose of the formula is to accomplish pricing more efficiently than present methods. Will it actually reduce the costs of establishing price? Will it provide price regulation that is more up-to-date? Will it be easier to calculate and administer? Would the formula method more

closely approximate economic conditions through the use of indices? Would it reduce the number of hearings? These things will only be determined after the formula is put to practical use.

Another measure of effectiveness is whether the formula pricing system would balance supply and demand of Class I products. But this could be as much a test of the correctness of the base price as of the formula.

It might be possible that someone in proper authority would deem it necessary to increase or decrease the base price on equity or value judgments in order to stimulate technological innovations or to cut out some unfair trade practices. These considerations are by-passed here.

Recommendations on Administration of the Formula

The formula should be placed into effect for the entire state at the same time. Deviation from this rule could well result in unwarranted price differentials between marketing areas.

Before the formula is placed into effect, the price differentials between marketing areas should be studied, and changed, if necessary, to insure that they are justified. The marketing areas themselves should be analyzed, for that matter, to determine whether or not there is justification for concluding that economic conditions differ in different areas. It is possible that boundaries might be changed or that entire areas could be eliminated or new areas defined.

Once the formula is placed into effect, it must be watched closely. First, formula prices should be calculated every quarter by at least two different agencies and the results compared and corrected, if necessary.

Second, at least one a year the entire formula should be reviewed. The indices should be checked to see that they continue to represent the economic factors they were originally meant to reflect. The weights of the various pricing factors should be examined in light of up-to-date cost studies and other criteria to ensure that they are correct. Third, the supplies of milk and the amounts consumed would have to be watched closely. If they did not balance out within some reasonable range then the formula might be changed, possibly in regard to the base price, to correct the situation.

APPENDICES

APPENDIX A

STATISTICAL METHODS AND RESULTS

Computation of Processor-Distributor Formula Constants

As mentioned in the text, 11 cost studies were utilized to obtain the basic direct cost information for the constants. Results of the cost studies were presented in Table I of Chapter III. To show how the constants are derived, results of the cost studies are presented in more detail.

Average costs as percentages of total costs:

Labor	46.48803648
Containers	13.96938379
Equipment	10.53123879
Vehicles	10.93183408
Supplies	2.37078331
Other	15.70872355
Total	100.00000000

Excluding "other" costs, the total comes to 84.29127645. Allowing labor, containers, equipment, vehicles, and supplies to represent 100 percent of the direct costs, percentages attributed to each can be found by dividing 84.29127645 into each of the above numbers.

Labor	55.15165796
Containers	16.57275151
Equipment	12.49386559
Vehicles	12.96911679
Supplies	2.81260815
Total	100.00000000

By taking 65 percent of each of these values (this allows a weight of 65 percent on the supply side, as explained in Chapter III), the following weights are arrived at. Weights for the demand side are also incorporated

at this stage.

Labor	35.84857767
Containers	10.77228848
Equipment	8.12101263
Vehicles	8.42992592
Supplies	1.82819530
Per capita income	10.00000000
Weekly wages	15.00000000
Bank debits	10.00000000
Total	100.00000000

Constants can then be derived as follows:

Labor \$320.9742 = average wages for the base period, 1957-59.

x_i = average wages for any particular quarter.

k_i = formula weight for any particular quarter.

$$k_i = \frac{35.84857767 \cdot x_i}{320.9742} = 0.11168679 x_i$$

Containers 99.9916 = average monthly index for "paper", 1957-59.

x_i = index for "paper" for any particular quarter.

k_i = formula weight for any particular quarter.

$$k_i = \frac{10.77228848 \cdot x_i}{99.9916} = 0.1077319$$

To facilitate computation on a calculating machine, 0.1077319 is divided by 3 to arrive at 0.0359106. This number can then be taken times the index for each month of the quarter and the sum of the products are easily accumulated on the machine.

Equipment 99.9833 = average monthly index for "machinery and motive products", 1957-59.

x_i = index for "machinery and motive product",
for any particular quarter.

k_i = formula weight for any particular quarter.

$$k_i = \frac{8.12101263 x_i}{99.9833} = 0.08122369 x_i$$

$$k_i/3 = 0.02707456$$

Vehicles 100.078 = average monthly index for "motor vehicles",
1957-59.

x_i = index for "motor vehicles" for any particular
quarter.

k_i = formula weight for any particular quarter.

$$k_i = \frac{8.42992592 x_i}{100.078} = 0.0842336 x_i$$

$$k_i/3 = 0.02807787$$

Supplies 100.000 = average monthly index for "chemicals and
allied products", for 1957-59

x_i = index for "chemicals and allied products",
for any particular quarter.

k_i = formula weight for any particular quarter.

$$k_i = \frac{1.82819530 x_i}{100} = 0.0182819530 x_i$$

$$k_i/3 = 0.00609398$$

Per capita
income 1,980.00 = average yearly per capita income for Montana,
1957-59.

x_i = average yearly per capita income for any particular year.

k_i = formula weight for any particular quarter.

$$k_i = \frac{10 x_i}{1980} = 0.0050505051 x_i$$

Weekly wages \$90.21444 = average weekly wages of "all manufacturing", 1957-59.

99.88694 = average weekly wages of "all mining", 1957-59

83.21555 = average weekly wages of "utilities and communications", 1957-59.

In order to arrive at correct weights for weekly wages it is necessary to consider the number of people employed in these industries. To do this the averages of 1961-1963 were calculated.

	<u>Manufacturing</u>	<u>Mining</u>	<u>Communications & Utilities</u>
1961	20,400	7,100	6,000
1962	22,000	6,800	5,900
1963	22,500	7,000	5,800
Average	21,633.333	6,966.667	5,900.000

The total average numbers employed for these years was 34,500. Average percent employment in each industry was:

<u>Manufacturing</u>	<u>Mining</u>	<u>Communications & Utilities</u>
62.7053140%	20.19323671%	17.10144927%

Since weekly wages account for .15 percent of the total formula, 0.15 is taken times each of the above.

Manufacturing

Mining

Communications & Utilities

9.4057971

3.0289855

2.5652174

x_{ij} = wages for any particular quarter.

k_{ij} = formula weight for any particular quarter.

$$k_{1j} = \frac{9.4057971 x_{1j}}{90.21444} = 0.1042604387 x_{1j}$$

$$k_{1j/3} = 0.034753479$$

$$k_{2j} = \frac{3.0289855 x_{2j}}{99.88694} = 0.0303241394 x_{2j}$$

$$k_{2j/3} = 0.010108046$$

$$k_{3j} = \frac{2.5652174 x_{3j}}{83.21555} = 0.0308261785 x_{3j}$$

$$k_{3j/3} = 0.010275392$$

Bank debits 99.89944 = average monthly index for bank debits, 1957-59.

x_i = index for bank debits for any particular quarter.

k_i = formula weight for any particular quarter.

$$k_i = \frac{10 x_i}{99.89944} = 0.100100661$$

$$k_{i/3} = 0.03336688$$

Computation of Producer Formula Constants

Farm labor The constant of 0.11585, as found in Dr. Ward's bulletin, remains effective.

Alfalfa hay Since the formula weight for alfalfa was changed from 20 percent to 15 percent, the constants in the bulletin were all reduced by three-fourths.

Mixed dairy feed Constants remain unchanged.

Machinery 164.25 = average quarterly index for machinery, 1960.

x_i = index number for any particular quarter.

k_i = formula weight for any particular quarter.

$$k_i = \frac{10 x_i}{164.25} = 0.060882801 x_i$$

Prices received Formula weight was reduced from 20% to 15%. The new constant was arrived at by taking three-fourths of the old one.

Per capita income-Constant remains unchanged.

Weekly wages As already mentioned, "utilities and communications" were substituted for "transportation and utilities (except railroads)".

\$96.30916 = average weekly wages of "all manufacturing", 1960.

104.91083 = average weekly wages of "all mining", 1960.

89.81166 = average weekly wages of "utilities and communications", 1960.

For the weights of each of these industries, the same figures are used as in the processor-distributor formula.

Manufacturing

Mining

Communications & Utilities

9.4057971

3.0289855

2.5652174

x_{ij} = wages for any particular quarter

k_{ij} = formula weight for any particular quarter.

$$k_{ij} = \frac{9.4057971 x_{ij}}{96.30916} = 0.097662539 x_{ij}$$

$$k_{ij/3} = 0.0325541797$$

$$k_{2j} = \frac{3.0289855 x_{2j}}{104.91083} = 0.02887200015 x_{2j}$$

$$k_{2j/3} = 0.0096240001$$

$$k_{3j} = \frac{2.5652174 x_{3j}}{89.81166} = 0.0285621866 x_{3j}$$

$$k_{3j/3} = 0.0095207289$$

Bank debits 107.655 = average monthly index for bank debits, 1960.

x_i = index number for any particular quarter.

k_i = formula weight for any particular quarter.

$$k_i = \frac{10 x_i}{107.655} = 0.0928893223 x_i$$

$$k_{i/3} = 0.0309631075$$

Correlation Procedures Used in Matching Indices with Cost Factors in
Processor-Distributor Formula 1/

Labor The figures obtained from Teamsters Unions were converted to a 1957-59 = 100 index and matched, quarterly, with an average wage index as calculated from data received from the Unemployment Compensation Commission. Results were as follows:

1/ Mills, C. M., Statistical Methods, 3rd edition; and Steel, G. D. and Torrie, J. H., Principles and Procedures of Statistics were utilized as reference texts for statistical procedures used in this section.

$$Y = a + b X$$

Y = index of wages -- Unemployment Compensation
Commission.

X = index of wages -- Teamsters Unions.

$$\begin{aligned}\sum Y &= 3876 & \sum X &= 3771.6 \\ \sum Y^2 &= 448,452.82 & \sum X^2 &= 422,202.28 \\ \sum XY &= 434,738.70 \\ \sum y^2 &= 6,588.82 \\ \sum x^2 &= 3,820.911 \\ \sum xy &= 4,776.3 & r &= 0.9519\end{aligned}$$

For a sample size of 30 and a probability level of 0.01, the value of a significant correlation is 0.4487. Thus, there is a highly significant correlation between the two indices.

Containers

Here the "paper" index was compared with an index calculated from prices charged for paper cartons by an independent paper carton manufacturer. When the latter was lagged one year the following results were obtained.

Y = index of "paper" from the Survey of Current Business.

X = index of prices charged for paper cartons.

$$\begin{aligned}Y &= 3380.9 & \sum X &= 4344.7 \\ \sum Y^2 &= 336,641.15 & \sum X^2 &= 467,688.25 \\ \sum XY &= 392,951.78\end{aligned}$$

$$\sum y^2 = 450.42$$

$$\sum x^2 = 11,876.28$$

$$\sum xy = 1,493.28$$

$$r = 0.6456$$

With a sample size of 30 and a probability level of 0.01, the value of a significant correlation is again 0.4487.

Equipment

Values obtained from "repairs, rent, and depreciation," Milk Distributors' Sales and Costs, were compared with the index of "machinery and motive products", Survey of Current Business.

Y = index of "machinery and motive products".

X = costs of "repairs, rent and depreciation".

$$\sum Y = 3349.1$$

$$\sum X = 22.47$$

$$\sum Y^2 = 330,944.59$$

$$\sum X^2 = 14.8821$$

$$\sum XY = 2217.433$$

$$\sum y^2 = 1,048.39$$

$$\sum x^2 = 0.0321$$

$$\sum xy = 4.072$$

$$r = 0.7019$$

Significance level remains the same as before, and the correlation coefficient obtained is significant.

Vehicles

No series was found which could be used to represent changes in the costs of vehicles of Montana processor-distributors. It was simply assumed that the "motor vehicles" index from the Survey of Current Business

would be adequate.

Supplies

Here the prices of "supplies", Milk Distributors' Sales and Costs were compared with the index of "chemicals and allied products", Survey of Current Business. When the former was lagged one year the following results were obtained.

Y = index of "chemicals and allied products".

X = index of "supplies".

$$\sum Y = 2965.4$$

$$\sum X = 2995.4$$

$$\sum Y^2 = 293,190.26$$

$$\sum X^2 = 299,253.72$$

$$\sum y^2 = 70.3547$$

$$\sum x^2 = 173.0147$$

$$\sum xy = 69.3147$$

$$r = 0.62826$$

Again, this is significant, using sample size and probability level of 0.01, as for labor, containers and equipment.

APPENDIX B

TABLES OF INDICES

TABLE I. QUARTERLY INDEX OF DAIRY INDUSTRY WAGES (1957-59 = 100)

Year	Quarter			
	1	2	3	4
1953.	75.31	73.18	78.01	80.97
1954.	84.63	69.83	77.33	81.16
1955.	77.37	76.50	82.29	96.14
1956.	83.88	86.62	88.24	90.11
1957.	90.37	89.31	88.14	91.09
1958.	99.45	100.08	102.09	105.05
1959.	107.30	107.27	106.98	112.88
1960.	124.33	109.44	112.38	114.90
1961.	118.27	115.32	118.92	117.10
1962.	124.33	118.88	123.29	119.92
1963.	125.37	129.08	127.24	130.37
1964.	128.70	127.34	127.93	141.01
1965.	132.71	134.00	133.80	142.16
1966.				

TABLE II. QUARTERLY INDEX OF PAPER (1957-59 = 100)

Year	Quarter			
	1	2	3	4
1953.	87.6	87.6	88.3	88.9
1954.	89.0	88.9	88.8	88.9
1955.	89.7	90.3	91.7	92.5
1956.	94.9	95.8	97.2	97.7
1957.	97.9	99.5	100.4	100.5
1958.	100.4	99.8	99.5	99.7
1959.	99.7	100.5	100.8	101.2
1960.	101.5	102.2	102.1	102.2
1961.	102.2	102.1	102.3	102.0
1962.	102.4	103.1	102.5	102.2
1963.	102.2	102.2	102.2	102.9
1964.	103.2	103.7	103.7	103.9
1965.	103.8	104.0	104.1	104.7
1966.	105.3			

TABLE III. QUARTERLY INDEX OF MACHINERY AND MOTIVE PRODUCTS (1957-59 = 100)

Year	Quarter			
	1	2	3	4
1953.	81.3	81.8	82.7	83.0
1954.	83.2	83.1	83.1	83.6
1955.	84.2	84.7	87.3	88.4
1956.	89.5	91.6	92.3	95.4
1957.	96.5	97.0	97.8	99.4
1958.	99.8	99.8	99.9	100.8
1959.	101.6	101.9	102.7	102.7
1960.	102.8	102.7	102.1	102.3
1961.	102.5	102.3	102.1	102.2
1962.	102.3	102.3	102.3	102.2
1963.	102.2	102.0	102.1	102.5
1964.	102.6	103.0	103.0	103.1
1965.	103.4	103.7	103.8	104.1
1966.	104.7			

TABLE IV. QUARTERLY INDEX OF MOTOR VEHICLES (1957-59 = 100)

Year	Quarter			
	1	2	3	4
1953.	86.1	85.2	85.1	85.0
1954.	85.3	85.3	85.3	86.4
1955.	87.2	87.6	87.6	90.4
1956.	91.7	92.7	92.8	95.5
1957.	96.5	96.7	96.7	98.8
1958.	99.8	99.8	99.8	102.7
1959.	102.8	102.8	102.8	101.7
1960.	101.6	101.6	100.1	100.8
1961.	100.8	100.7	100.8	100.4
1962.	100.2	100.4	100.9	100.7
1963.	100.8	99.8	99.5	99.9
1964.	99.8	100.7	100.7	100.7
1965.	100.8	100.8	100.6	100.5
1966.	100.4			

TABLE V. QUARTERLY INDEX OF CHEMICALS AND ALLIED PRODUCTS (1957-59 = 100)

Year	Quarter			
	1	2	3	4
1953.	94.4	95.9	96.8	97.3
1954.	97.7	97.3	97.1	97.3
1955.	97.3	97.2	96.4	96.9
1956.	96.7	97.3	97.5	98.3
1957.	98.9	99.3	99.9	100.4
1958.	100.7	100.8	100.1	100.1
1959.	100.0	100.0	99.9	100.0
1960.	100.0	100.2	100.4	100.2
1961.	100.0	99.8	98.6	98.1
1962.	98.2	97.7	97.0	97.0
1963.	96.8	96.3	96.0	96.2
1964.	96.4	96.6	96.6	97.0
1965.	97.4	97.5	97.2	97.6
1966.	97.6			

TABLE VI. QUARTERLY INDEX OF MONTANA PER CAPITA INCOME (1957-59 = 100)

Year	Quarter			
	1	2	3	4
1953.	90.8	90.8	90.8	90.8
1954.	88.2	88.2	88.2	88.2
1955.	94.0	94.0	94.0	94.0
1956.	96.1	96.1	96.1	96.1
1957.	97.7	97.7	97.7	97.7
1958.	101.8	101.8	101.8	101.8
1959.	100.6	100.6	100.6	100.6
1960.	101.2	101.2	101.2	101.2
1961.	97.2	97.2	97.2	97.2
1962.	112.9	112.9	112.9	112.9
1963.	111.0	111.0	111.0	111.0
1964.	115.9	115.9	115.9	115.9
1965.	121.7	121.7	121.7	121.7
1966				

TABLE VII. QUARTERLY INDEX OF WEEKLY WAGES (1957-59 = 100)

Year	Quarter			
	1	2	3	4
1953.	95.04	96.13	87.91	89.13
1954.	84.44	83.69	85.32	84.48
1955.	86.44	88.07	94.46	96.05
1956.	97.64	98.29	101.48	97.60
1957.	94.31	96.30	96.83	97.73
1958.	97.06	98.77	100.63	103.13
1959.	102.17	102.99	104.27	105.91
1960.	105.98	104.82	107.09	108.07
1961.	107.18	109.10	111.73	110.82
1962.	112.86	113.96	115.39	116.51
1963.	117.68	118.28	119.01	120.47
1964.	120.45	120.68	125.77	123.53
1965.	124.56	126.52	128.24	128.16
1966.				

TABLE VIII. QUARTERLY INDEX OF BANK DEBITS (1957-59 = 100)

Year	Quarter			
	1	2	3	4
1953.	76.72	73.68	72.44	73.53
1954.	74.92	76.46	78.57	79.65
1955.	82.04	81.39	84.38	86.39
1956.	89.59	90.71	91.69	92.62
1957.	94.24	95.46	96.77	95.22
1958.	95.68	94.53	98.76	106.21
1959.	104.07	106.76	106.60	104.48
1960.	105.22	107.85	108.51	109.04
1961.	114.54	110.14	109.67	109.10
1962.	112.13	114.11	112.86	118.54
1963.	115.60	118.66	120.29	121.19
1964.	123.89	123.51	128.75	125.10
1965.	134.29	137.77	137.86	144.79
1966.	149.79			

TABLE IX. QUARTERLY INDEX OF FARM WAGES PAID (1960 = 100)

Year	Quarter			
	1	2	3	4
1953.	91.9	91.9	88.8	92.6
1954.	91.9	88.8	86.5	89.6
1955.	91.9	88.8	88.8	93.4
1956.	90.3	89.6	91.9	97.3
1957.	97.3	92.6	94.2	97.3
1958.	95.0	96.5	95.7	95.7
1959.	98.8	96.5	97.3	98.0
1960.	101.1	101.1	98.0	99.6
1961.	101.18	102.70	101.93	101.16
1962.	101.93	104.25	105.02	105.79
1963.	103.48	105.79	108.88	108.88
1964.	104.25	105.02	108.88	111.97
1965.	108.11	110.43	114.29	111.97
1966.				

TABLE X. QUARTERLY INDEX OF PRICES PAID FOR ALFALFA HAY (1960 = 100)

Year	Quarter			
	1	2	3	4
1953.	100.03	93.09	83.57	79.32
1954.	85.23	84.03	88.90	89.56
1955.	85.23	88.55	88.86	86.68
1956.	93.52	94.21	97.24	95.77
1957.	89.04	82.28	76.64	68.58
1958.	67.65	66.98	75.34	76.48
1959.	74.22	74.35	80.09	98.01
1960.	91.82	97.06	108.51	102.60
1961.	85.21	80.59	99.61	93.54
1962.	94.11	89.00	69.73	72.56
1963.	74.26	71.43	74.26	74.83
1964.	73.13	73.13	71.43	75.96
1965.	101.47	89.57	77.10	81.63
1966.	81.07			

TABLE XI. QUARTERLY INDEX OF PRICES PAID FOR DAIRY MIX FEEDS (1960 = 100)

Year	Quarter			
	1	2	3	4
1953.	135.53	130.88	128.73	125.89
1954.	124.72	122.18	118.41	119.87
1955.	115.88	112.87	113.50	112.35
1956.	110.48	110.38	108.59	108.33
1957.	109.50	106.09	108.59	104.83
1958.	101.16	99.80	98.76	99.31
1959.	100.17	100.76	101.71	101.31
1960.	100.17	99.31	98.76	101.81
1961.	98.62	98.81	102.97	105.60
1962.	106.61	106.10	105.10	104.59
1963.	104.59	104.59	102.08	102.08
1964.	102.58	102.08	101.07	99.06
1965.	102.58	104.59	105.10	107.11
1966.	108.11			

TABLE XII. QUARTERLY INDEX OF MACHINERY (1960 = 100)

Year	Quarter			
	1	2	3	4
1953.	80.36	80.97	80.97	80.97
1954.	80.97	80.36	80.36	80.36
1955.	80.97	80.97	82.19	82.19
1956.	82.19	82.80	82.80	82.80
1957.	82.80	85.24	85.85	86.45
1958.	87.06	89.50	90.11	90.11
1959.	91.93	96.19	97.41	97.41
1960.	98.02	98.63	101.67	101.67
1961.	102.28	104.11	101.67	101.67
1962.	104.11	106.54	107.76	107.76
1963.	106.54	107.15	106.54	106.54
1964.	106.54	108.37	108.98	108.98
1965.	110.81	110.81	113.24	113.24
1966.				

TABLE XIII. QUARTERLY INDEX OF PRICES RECEIVED (1960 = 100)

Year	Quarter			
	1	2	3	4
1953.	107.8	105.5	97.8	97.8
1954.	100.9	102.4	100.9	101.2
1955.	102.0	104.4	98.6	91.2
1956.	88.9	93.2	94.3	94.0
1957.	95.1	98.2	98.9	100.1
1958.	104.7	107.8	104.0	105.5
1959.	104.0	107.0	105.9	104.7
1960.	100.9	103.6	98.2	97.4
1961.	98.56	99.33	101.64	103.18
1962.	107.03	107.42	110.50	110.50
1963.	108.96	107.42	103.18	102.80
1964.	99.72	98.56	97.41	96.64
1965.	98.56	91.00	91.67	88.67
1966.	95.33			

TABLE XIV. QUARTERLY INDEX OF MONTANA PER CAPITA INCOME (1960 = 100)

Year	Quarter			
	1	2	3	4
1953.	89.72	89.72	89.72	89.72
1954.	87.18	87.18	87.18	87.18
1955.	92.91	92.91	92.91	92.91
1956.	94.91	94.91	94.91	94.91
1957.	96.51	96.51	96.51	96.51
1958.	100.55	100.55	100.55	100.55
1959.	99.35	99.35	99.35	99.35
1960.	100.00	100.00	100.00	100.00
1961.	96.01	96.01	96.01	96.01
1962.	111.53	111.53	111.53	111.53
1963.	109.63	109.63	109.63	109.63
1964.	114.52	114.52	114.52	114.52
1965.	120.21	120.21	120.21	120.21
1966.				

TABLE XV. QUARTERLY INDEX OF WEEKLY WAGES (1960 = 100)

Year	Quarter			
	1	2	3	4
1953.	78.28	79.81	81.63	81.74
1954.	79.10	78.78	81.22	80.64
1955.	81.75	82.53	88.02	88.18
1956.	89.41	90.74	93.79	91.50
1957.	87.68	90.82	91.37	91.69
1958.	91.89	94.97	96.47	97.44
1959.	97.74	98.24	99.81	99.16
1960.	99.52	98.43	100.57	101.48
1961.	100.65	102.45	104.92	104.06
1962.	105.98	107.02	108.36	109.41
1963.	110.50	111.07	111.75	113.13
1964.	113.11	113.32	118.11	116.00
1965.	116.97	118.81	120.42	120.35
1966.				

TABLE XVI. QUARTERLY INDEX OF BANK DEBITS (1960 = 100)

Year	Quarter			
	1	2	3	4
1953.	70.92	67.10	66.97	67.97
1954.	69.26	70.68	72.63	73.63
1955.	76.20	75.60	78.38	80.24
1956.	83.22	84.26	85.17	86.04
1957.	87.54	88.68	89.89	88.45
1958.	88.88	87.81	91.74	98.66
1959.	96.67	99.17	99.02	97.05
1960.	97.74	100.18	100.79	101.28
1961.	106.40	102.31	101.87	101.35
1962.	104.16	106.00	104.84	110.11
1963.	107.38	110.22	111.74	112.57
1964.	115.08	114.73	119.59	116.20
1965.	124.74	127.93	128.05	134.49
1966.				

APPENDIX C

MILK PROCESSOR-DISTRIBUTOR PRICING FORMULA
WORKSHEET

Price per hundredweight represents the processor-distributor gross margin.

PRICING FACTOR

Years _____	QUARTER			
	1	2	3	4
Labor				
Containers				
Equipment				
Vehicles				
Supplies				
Per Capita Income				
Weekly Wages				
Bank Debits				
TOTAL				
Price Per CWT				

Year _____	1	2	3	4
Labor				
Containers				
Equipment				
Vehicles				
Supplies				

Per Capita
Income _____

Weekly Wages _____

Bank Debits _____

TOTAL _____

Price per CWT _____

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