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RETURNS TO DAIRY PRODUCERS UNDER DIFFERENT SEASONAL PRODUCTION PATTERNS

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Preface

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INTRODUCTION

An unfavorable seasonal production pattern has long been recognized as one of the important problems confronting the dairy industry in the Northeast. There is reason for renewed concern today in light of the dramatic regional expansion of Italian cheese and soft product manufacturing operations. During periods of tight milk supplies, these plants are frequently unable to obtain enough milk to operate efficiently. Another factor that is likely to have an impact on Northeast cheese plants in the future is the tremendous growth of milk production in California and the desert Southwest. Cheese manufacturers in the Northeast will likely begin to feel competitive pressure from the Upper Midwest as California cheese begins to displace Midwestern cheese in California markets, and Midwesterners, in turn, look to the populated Northeast to sell their cheese. In the event that handlers operating manufacturing plants in the Northeast find themselves to be at a real competitive disadvantage with respect to operating costs vis-a-vis the Upper Midwest, they will leave the Northeast--not today or tomorrow, but 5 or 10 years from now--for milk supply areas that promise lower operating costs and greater long-run profitability. As manufacturing plants grow larger and larger, the issue of plant operating efficiency becomes increasingly important.

Seasonality has been a fact of life in the Northeast dairy industry for many years. Rapid increases in milk production during the spring, followed by declining production through the summer and fall months inevitably result in higher operating costs and reduced efficiency in plant operations. A measure of the seasonality in Order No. 2 relative to the rest of the country is shown in Figure 1. Order No. 2 daily deliveries[1] peak in May when they are 17 percent above the lowest average daily delivery (November). The spread between the peak and the low in the rest of the United States is 10.7 percent. Within the Northeast, Order No. 2 is noticeably more seasonal than either the New England market where the difference between the high and the low is about 9 percent, or the Middle Atlantic market where the difference is approximately 8 percent[2] as shown in Figure 2. (Federal Milk Order Market Statistics, 1981-85 Annual Summaries.)

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[1] Average daily delivery for each month.

[2] An alternative measure of seasonality is to compute the average deviation of daily deliveries from the index value of 100.0 (the 12-month average) for each market or group of markets. These values are as follows:

Market	Average Deviation (percent)
New York-New Jersey	4.5
United States without NY-NJ	3.1
Middle Atlantic	2.1
New England	2.6

FIGURE 1. SEASONAL VARIATION IN DAILY PRODUCER RECEIPTS (1981-85 AVERAGE) FOR ORDER NO. 2 AND THE U.S. WITHOUT ORDER NO. 2, (12-MONTH AVERAGE = 100)

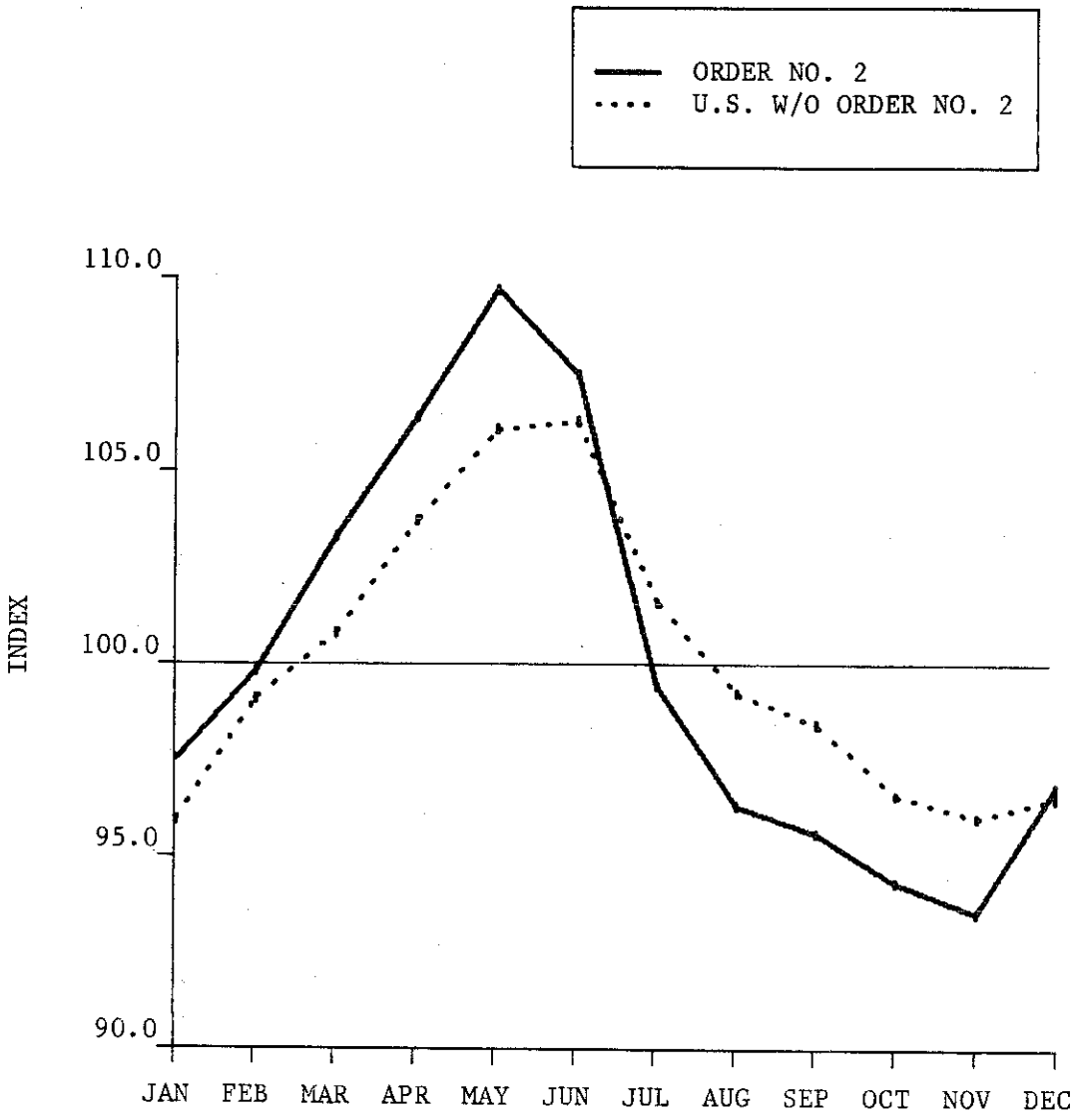
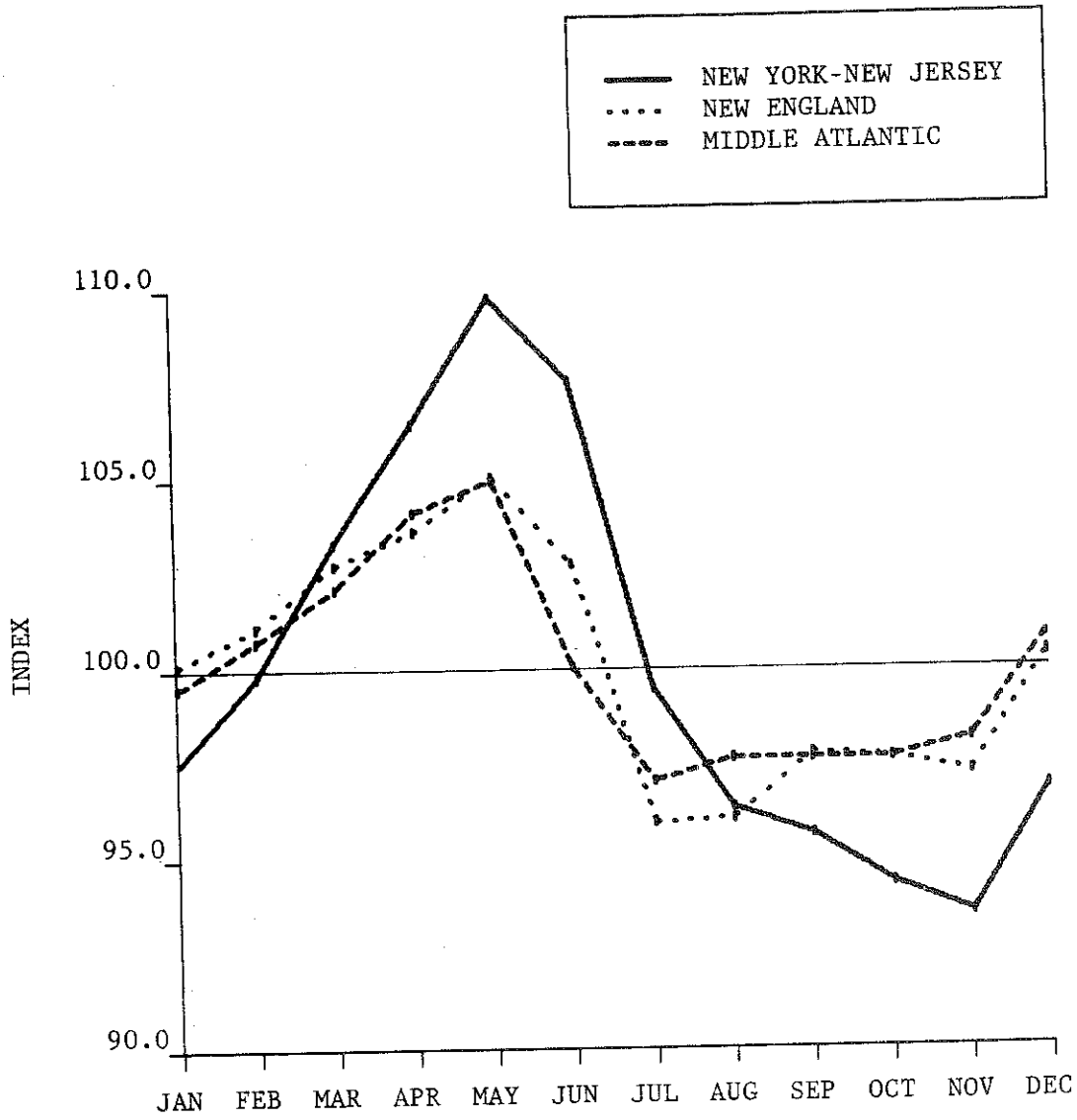


FIGURE 2. SEASONAL VARIATION IN DAILY PRODUCER RECEIPTS (1981-85 AVERAGE) FOR THE THREE NORTHEAST FEDERAL ORDERS, (12-MONTH AVERAGE = 100)



Class II balancing plants experience far greater seasonality in average daily receipts than these numbers would suggest because they are residual users of milk. In 1985, daily receipts at three large Order No. 2 manufacturing plants were more than 38 percent higher in May than in November (unpublished data--New York-New Jersey Market Administrator's Office).

The problem of seasonality has led to the development of several pricing plans (most notably the Louisville and base-excess plans) designed to encourage farmers to produce milk more evenly throughout the year. A key factor which has not been considered previously is the magnitude of the differences in net returns to producers who produce milk under different patterns of production. Prindle and Livesey used a linear programming approach to calculate a freshening pattern that would maximize net return to a dairy farm; however, they did not report net return as a function of production pattern. A prerequisite to the implementation of any successful seasonal incentive plan is an understanding of the variation in returns to individual producers caused solely by seasonal factors. It was hypothesized that one explanation for the spring flush is that producers find it more profitable to produce milk in the spring than during other times of the year. If this is true, then it should be verified by higher levels of profitability for lactations commencing in the winter and early spring, and by higher income levels for seasonal and highly seasonal dairy herds. The objective of this research is to gain an understanding of the impacts of month of freshening and seasonal variation of feed and milk prices on returns to dairy farmers.

METHODOLOGY

The initial step in the analysis was to model the 12-month milk production cycle for a herd in which all cows freshen at the same time since both total milk production and the shape of the milk production curve over the lactation are influenced by the month, or "season" in which freshening occurs. This modeling process was repeated for each of the 12 months in order to gain a complete picture of how milk yield, milk receipts, feed cost and return over feed cost vary by freshening month.

In the second phase of the study, individual freshening month results were combined in five different weighted combinations to simulate five typical herd milk production patterns. The five patterns are contra-seasonal, even, average, seasonal and highly seasonal. They represent a continuous progression in the seasonality of milk production ranging from relatively higher production in the fall months (contra-seasonal) to significantly greater production in the spring (highly seasonal). This portion of the analysis was designed to facilitate a profitability comparison between herds with different milk production patterns.

The final stage of the study was designed to test the validity of the model by comparing the model results with actual 1984 operating results for a sample of dairy farms located in New York, New Jersey and New England. These farms were grouped based on their 1984 milk production pattern and average income and expenses were calculated for the farms in each group.[3]

The Model

The simulation model employed in the study estimated monthly milk production, milk income, feed consumption and feed cost based on a set of parameters that define the herd. These parameters include freshening month(s), average milk yield, average calving interval, milk price and feed prices. (See Oltenacu et al., 1980 for a description of the basic mathematical model. A herd-level application of the model is described in Oltenacu et al., 1981.)

A series of 36 lactation adjustment factors (12 freshening months with three age groups for each month) is incorporated into the model to reflect seasonal changes in total milk production and the shape of the lactation curve. These adjustment factors were formulated based on research conducted by Keown et al., and Keown and Everett. Lactation records of cows on DHI test in New York and New Jersey were the basis for this earlier research. Lactation curves for an average production month (March) and a low production month (July) illustrate the nature of these seasonal differences (Figure 3), as well as the 4-6 week lag between freshening and peak milk production in the lactation.

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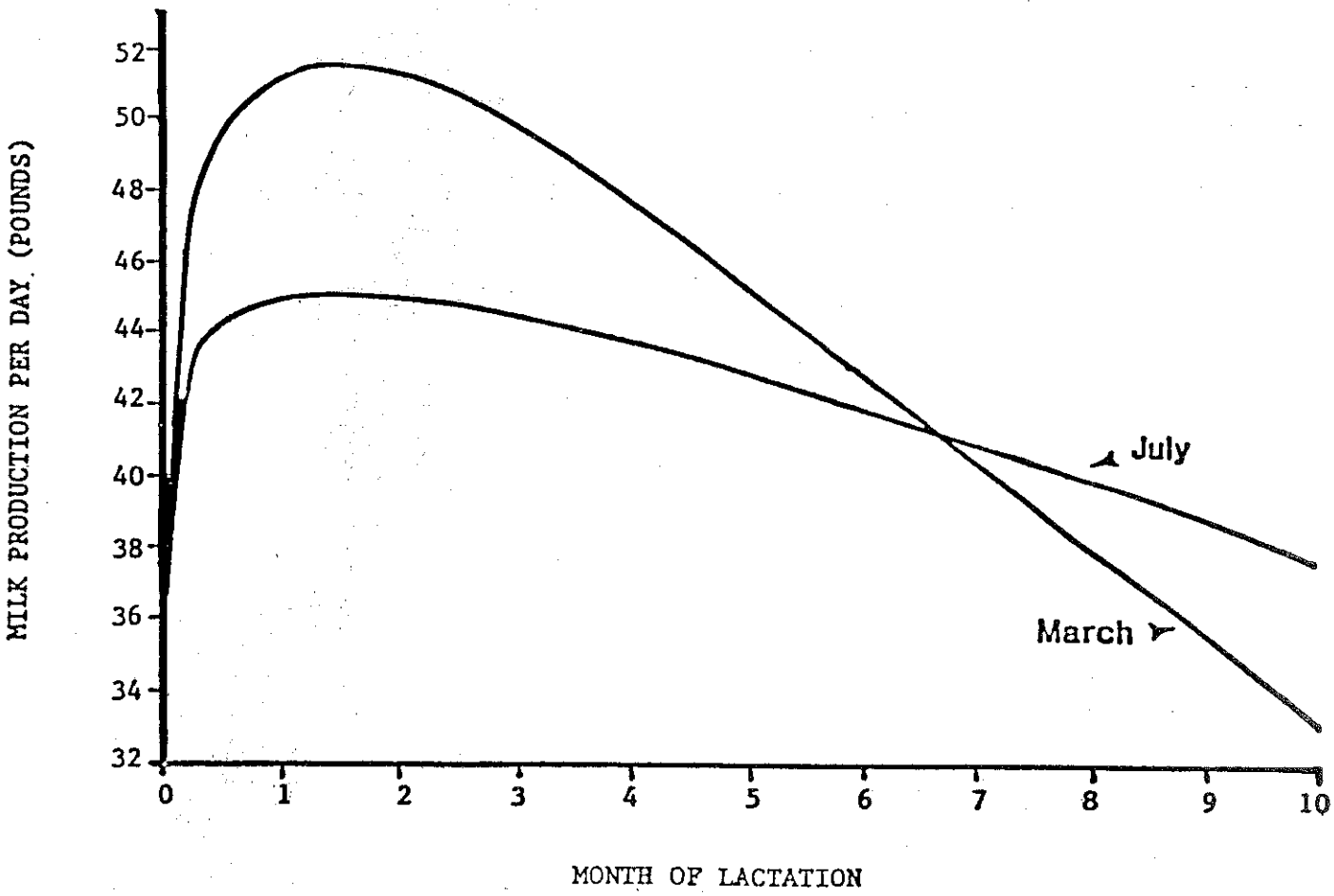
[3] Financial information for sample farms was provided by the Farm Credit Banks of Springfield.

FIGURE 3. EFFECT OF MONTH OF FRESHENING ON MILK PRODUCTION AND SHAPE OF LACTATION CURVE FOR A COW IN THIRD LACTATION



For the purposes of this study, the modeled dairy herd was formulated to represent a typical New York herd with respect to production level and age composition. The herd consisted of 30 percent first-lactation cows, 20 percent second-lactation cows and 50 percent third or greater lactation cows. Additional assumptions included a 15,250-pound mature equivalent (M.E.) herd average and a 13-month calving interval. The 15,250 pounds M.E. translates into an actual herd average of 14,183 pounds per cow, since DHI records show that first-lactation cows produce milk at 80 percent of the mature equivalent rate and second-lactation cows produce milk at 95 percent of the mature equivalent rate.[4] Milking cows are fed one of three totally mixed rations (feeding groups are based on the level of milk production) with a fourth ration for dry cows (Milligan et al.). These rations are formulated to minimize feed cost while satisfying all of the nutritional requirements of the dairy herd.

[4] Calculation of Actual Herd Average.

Lactation	% of herd	x	% of M.E. rate	x	M.E. production level	=	Weighted contribution
					pounds		
First	30		80		15,250		3,660
Second	20		95		15,250		2,898
Third	50		100		15,250		7,625
							Actual Herd Average = 14,183

SEASONAL ADJUSTMENT OF PRICES

The primary source of income and expense price data for the model was the New York Crop Reporting Service publication New York Agricultural Statistics. This publication is the best source of monthly prices for items whose price is subject to seasonal variation or variation due to changes in the general price level. Since the method of gathering data employed by the New York Crop Reporting Service (now known as the New York Agricultural Statistics Service) is consistent and the most thorough available, it provides the best means for detecting seasonality effects. Monthly prices received by farmers for hay, slaughter cows, calves, and milk cows for replacement, and prices paid for corn meal and 44 percent protein soybean meal were obtained from this publication.

Milk prices were gathered from annual reports of The Market Administrator's Bulletin for the New York-New Jersey Milk Marketing Area. Prices used were the uniform price for bulk tank milk testing 3.5 percent butterfat at the 201-210 mile zone. These prices were adjusted to remove seasonal deductions and additions under the Louisville Plan. No adjustment was made for seasonal variation in milk butterfat content because normal changes in butterfat content were found to have an insignificant impact on milk income. Butterfat adjustments would have increased milk income between $25 and $35 per cow, depending on the freshening month.

A difficulty presented by the use of monthly prices in this analysis is that price changes are caused by a combination of seasonal variation and general trends in prices. The general trend is a result of inflation and long-term supply-demand adjustments. In order to meet the objective of this study, it was necessary to remove the effect of the general trend in prices. If this were not done and prices were left as reported, then the economic impact of seasonal milk production patterns could not be evaluated correctly. For example, if the general price trend is upward (as is the normal case with inflation), monthly prices late in the year will be relatively greater than prices for months earlier in the year.

The following procedure was developed to remove the within-year price increases (or decreases) due to the general trend in prices, leaving monthly prices that vary only due to seasonal factors.

1. The simple average of the 12 monthly prices was calculated for each of the 10 years 1975-84.

2. These 10 averages were used to calculate 9 ratios of each year's average price to the previous year's average price (1976 average/1975 average, ..., 1984 average/1983 average).

3. The nine ratios of current to preceding year were averaged to determine the average annual ratio of prices. If this ratio exceeded 1.0, the price trend was upward.

4. The average ratio minus 1.0 gives the average annual proportional increase or decrease in prices. Dividing this average by 12 provides an estimate of the monthly proportional increase or decrease due to the general price trend. This procedure implicitly assumes that the annual increase or decrease is spread evenly throughout the year.

5. The 12 monthly average prices for 1975-84 and the annual average price were calculated. The ratio of each monthly average to the overall annual average was calculated.

6. These ratios are adjusted using the monthly change due to the general price change (step 4). The adjustment is made to center the price ratio at mid-year (July 1). If the general price level has been increasing, the monthly ratios (step 5) are increased for January-June and decreased for July-December.

7. Finally, these ratios are multiplied by the 1984 average price to obtain seasonal prices for the model in 1984 dollars.

The seasonal monthly prices calculated are contained in Table 1 and graphed in Appendix Figures 1-5. The effectiveness of the above procedure is apparent in these figures, as the December-January price change is an integral part of the normal seasonal change in prices. The presence of inflation would result in a sharp price break between December and January.

A different methodology was used to calculate the price of corn silage because reliable corn silage price data is not available. Monthly corn silage prices were calculated based on the cost of growing and harvesting corn for silage, plus an imputed interest charge of 12 percent of this cost for the period when the silage was stored in the silo.

TABLE 1.

COMMODITY PRICES*

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Milk ($/cwt.)	13.17	13.06	12.93	12.77	12.70	12.69	12.85	13.03	13.13	13.24	13.29	13.22
Corn Meal** ($/cwt.)	8.61	8.63	8.55	8.71	8.75	8.88	8.95	9.04	9.05	8.99	8.58	8.57
Corn Silage ($/ton)	25.76	26.04	26.31	26.58	26.76	27.03	27.31	27.58	25.04	25.04	25.22	25.49
Soybean Meal ($/cwt.) 44% Protein	13.94	13.69	13.56	13.69	13.82	13.92	13.88	13.62	13.74	13.48	13.70	13.75
Hay ($/ton) 90% dry matter	85.30	86.20	86.70	85.90	84.70	81.30	80.10	81.00	82.30	83.20	83.60	84.60
Dairy Replacements ($/head)	818	820	819	818	823	830	830	829	821	822	820	818
Calves ($/cwt.)	68.00	71.60	68.40	71.70	80.60	77.30	69.50	65.50	67.40	67.70	64.50	63.80

*All prices, except corn silage, were calculated based on seasonal price changes over the preceding 10 years, and have been adjusted to remove intra-year inflation.
**Derived from 16 percent dairy ration and soybean meal prices.

DATA SOURCES: New York Agricultural Statistics
The Market Administrator's Bulletin

RESULTS

Milk Income and Feed Cost by Freshening Month

The individual-cow results are presented on a freshening month basis, i.e., they reflect 12-month total milk income, feed expense and return over feed cost (Table 2). For example, a cow freshening in January generates $1,848 in milk income and consumes feed which costs $871 during the 12-month period following freshening, leaving a return over feed cost (ROFC) of $977. If one were to expand this analysis to include all 12 freshening months, the need for a standard of comparison immediately becomes apparent. The basis of comparison selected for this study is the average of all 12 freshening months, e.g., average milk income, feed cost, etc.

While it is clear that milk income, feed expense and ROFC vary significantly between freshening months, it is necessary to look at changes in their underlying determinants--price and quantity--in order to better understand the dynamics behind the observed variation. Turning first to milk income, Figure 4 illustrates the changes in milk prices, production and income by freshening month. For example, the average price received for milk produced by a January-freshening cow is slightly below average, while milk production is above average, resulting in milk income that is just above average. Overall, there is appreciably more variation in milk production per cow than in the average milk price received. The combined effect of these two components together translates into variation in milk income. Milk income shows little deviation from the average during the first four freshening months, followed by a sharp rise in May and June, and an even steeper decline in July and August. Income is somewhat higher--though still below average--for September freshening cows and continues rising to a second peak in November.

On the expense side (Figure 5) average feed cost[5] is subject to noticeably greater volatility than feed consumption per cow. This variation in feed cost per ton is due to the seasonality of prices and differences in the length of time that cows remain in the top production group. Because cows freshening in January, February, and December are in the top group longer, they are fed a more costly (higher concentrate) ration for a longer period of time. The result is a higher average feed cost over the entire lactation for these cows. Feed cost is below average for cows freshening in July, August, and September because cows freshening in late summer are in the top production group for a relatively short period of time. The variation in feed consumption per cow tends to offset the effect of changes in feed cost per ton. Consequently, feed costs on a per-cow basis exhibit less variation than feed cost per ton.

[5] This is the cost of the totally mixed ration. Concentrate and hay prices were taken from New York Agricultural Statistics and corn silage prices were based on the cost of production, plus the interest cost of holding corn silage inventory as described in the previous section.

TABLE 2. SELECTED DATA ON MILK PRODUCTION AND MILK INCOME ACCORDING TO FRESHENING MONTH

12-month total	Freshening month*					
	Jan	Feb	Mar	Apr	May	Jun
Milk production per cow (pounds)	14,290	14,176	14,246	14,162	14,567	14,608
Month of peak milk production	March	March	April	May	June	July
Milk income per cow	$ 1,848	$ 1,830	$ 1,840	$ 1,832	$ 1,892	$ 1,904
Feed cost per cow	871	869	859	858	866	863
Return over feed cost	$ 977	$ 961	$ 981	$ 974	$ 1,026	$ 1,041

	Jul	Aug	Sep	Oct	Nov	Dec
Milk production per cow (pounds)	13,643	13,551	13,797	14,247	14,507	14,397
Month of peak milk production	August	September	October	November	December	January
Milk income per cow	$ 1,783	$ 1,773	$ 1,804	$ 1,859	$ 1,887	$ 1,867
Feed cost per cow	831	821	831	854	855	872
Return over feed cost	$ 952	$ 952	$ 973	$ 1,005	$ 1,032	$ 995

*For purposes of comparison, it is useful to compute an average of the data for all twelve freshening months. Calculation of the average is based on the assumption that an equal number of cows freshen each month.

	Average
Milk production per cow (pounds)	14,183
Milk income per cow	$1,843
Feed cost per cow	854
Return over feed cost	$ 989

FIGURE 4. DEVIATIONS FROM AVERAGE MILK PRICE, MILK PRODUCTION PER COW AND MILK INCOME PER COW, BY FRESHENING MONTH

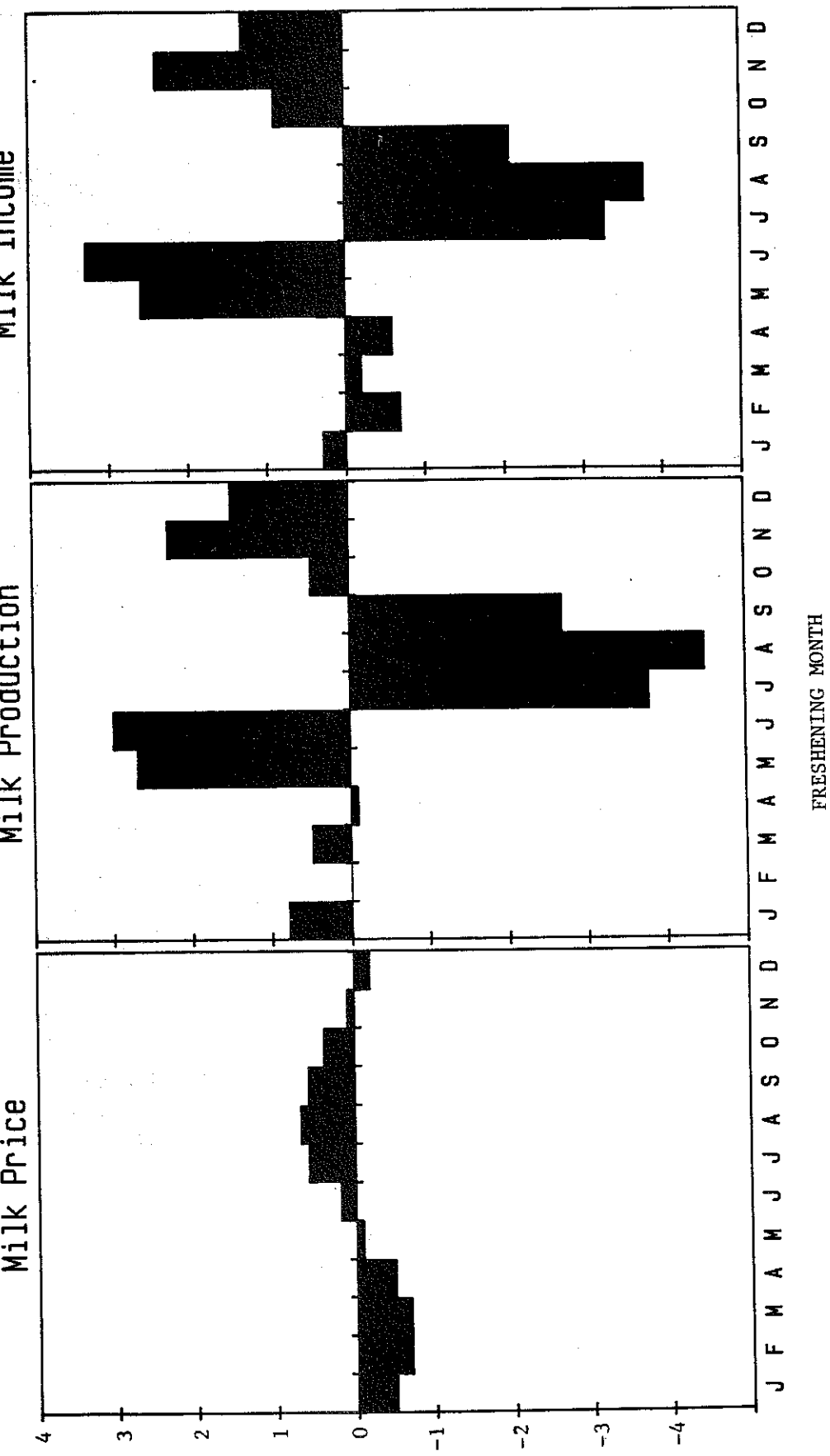
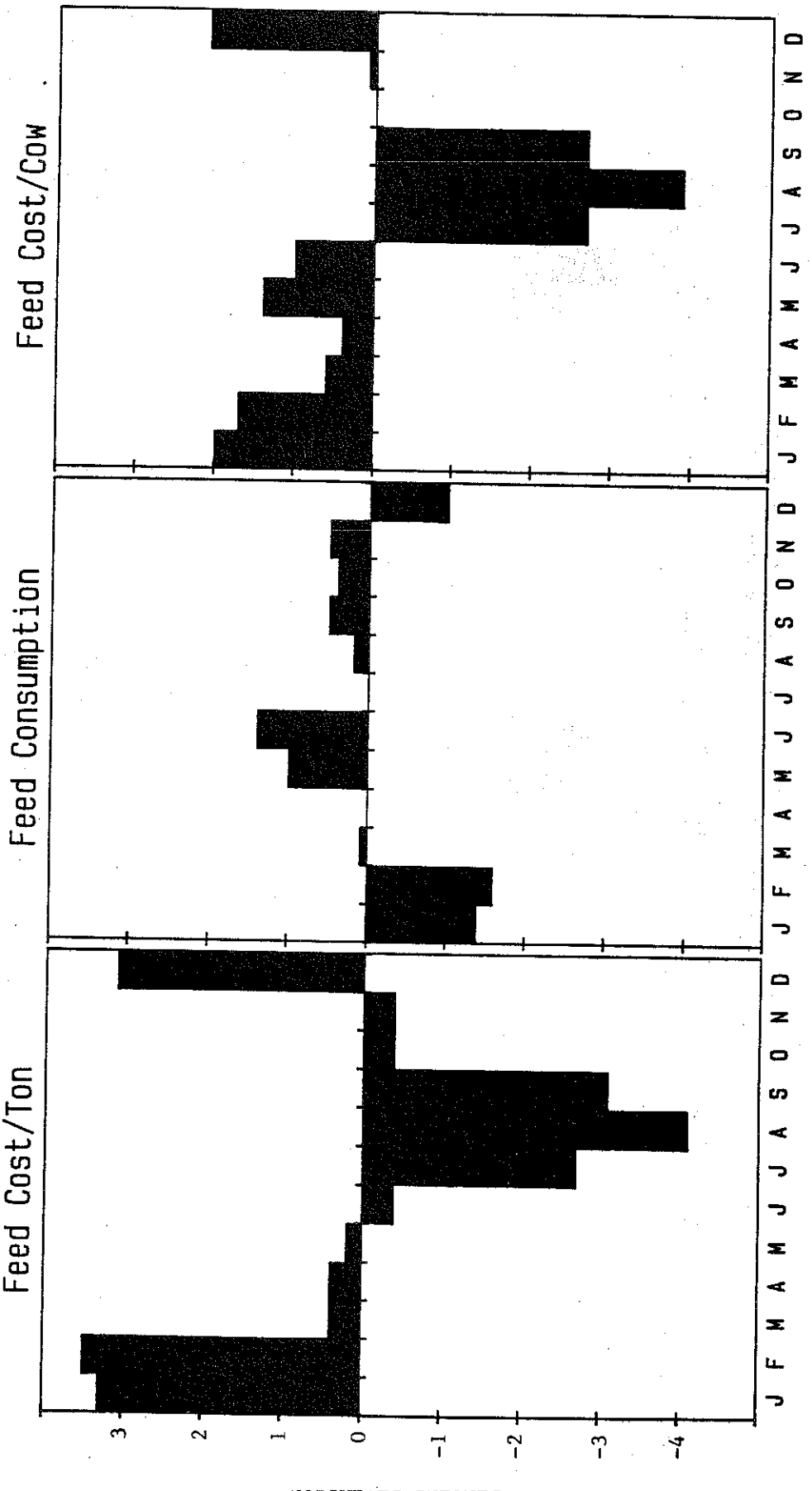


FIGURE 5. DEVIATIONS FROM AVERAGE FEED COST PER TON, FEED CONSUMPTION PER COW AND FEED COST PER COW, BY FRESHENING MONTH



Combining milk receipts and feed cost, we find that the pattern of return over feed cost by freshening month closely tracks milk income (Figure 6). The most profitable freshening months are May, June, October and November, with a trough in returns for cows freshening in July and August. Returns for cows freshening during the January-April period are below average due to above-average feed costs.

Analysis

These results demonstrate that the volume of milk produced during a lactation is the single most important factor in determining return over feed cost (Figure 7). Above-average milk production is largely responsible for the higher level of profits generated by cows freshening in May, June, October, and November. Likewise, below-average milk production accounts for the lackluster returns to cows freshening in July, August, and September.

The existence of these profitability differences between freshening months presents dairy farmers with an incentive to time the breeding of their cows in order to take advantage of the more profitable freshening months.

Of the four high-profit freshening months, producers would most likely choose to emphasize fall freshening for several reasons. May and June are less desirable from the standpoint of labor utilization because summer is a period of peak labor demand for fieldwork on most farms. Another important factor which mitigates against striving for freshening dates in May and June (especially for first calf heifers) is the risk that a cow will not conceive in the targeted month and end up freshening in the low-profit months of July or August. This problem would arise in any case within a year or two in most herds because the typical calving interval is 13 months. In view of the risks associated with targeting May and June freshening months, the ideal month for freshening first calf heifers would appear to be September. These cows would freshen during high production freshening months in their second and third lactations (assuming a 13-month calving interval), with no significantly below-average freshening months before February.

The Impact of the Louisville Plan

The preceding analysis is based on milk prices which are not adjusted by a seasonal incentive plan. Since Order No. 2 has a Louisville Plan in effect, the return over feed cost analysis was repeated with milk prices adjusted to reflect the deductions and additions under the Louisville Plan. A comparison of return over feed cost with and without the Louisville Plan is shown in Figure 8. The Louisville Plan increases returns for cows freshening between May and September and reduces returns for November through April freshening cows.

FIGURE 6. DEVIATIONS FROM AVERAGE MILK INCOME PER COW, FEED COST PER COW AND RETURN OVER FEED COST, BY FRESHENING MONTH

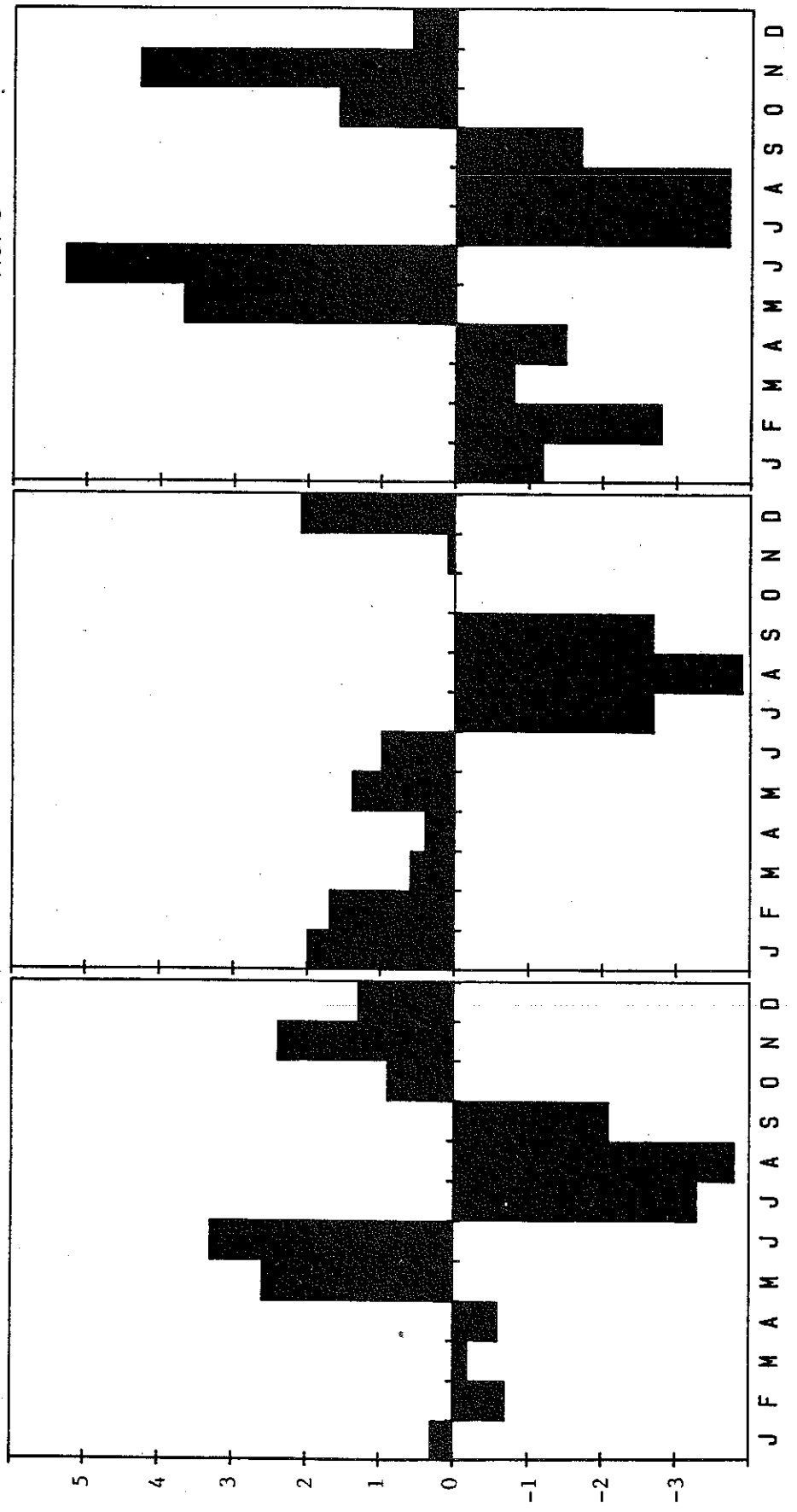


FIGURE 7. MILK PRODUCTION AND RETURN OVER FEED COST BY FRESHENING MONTH

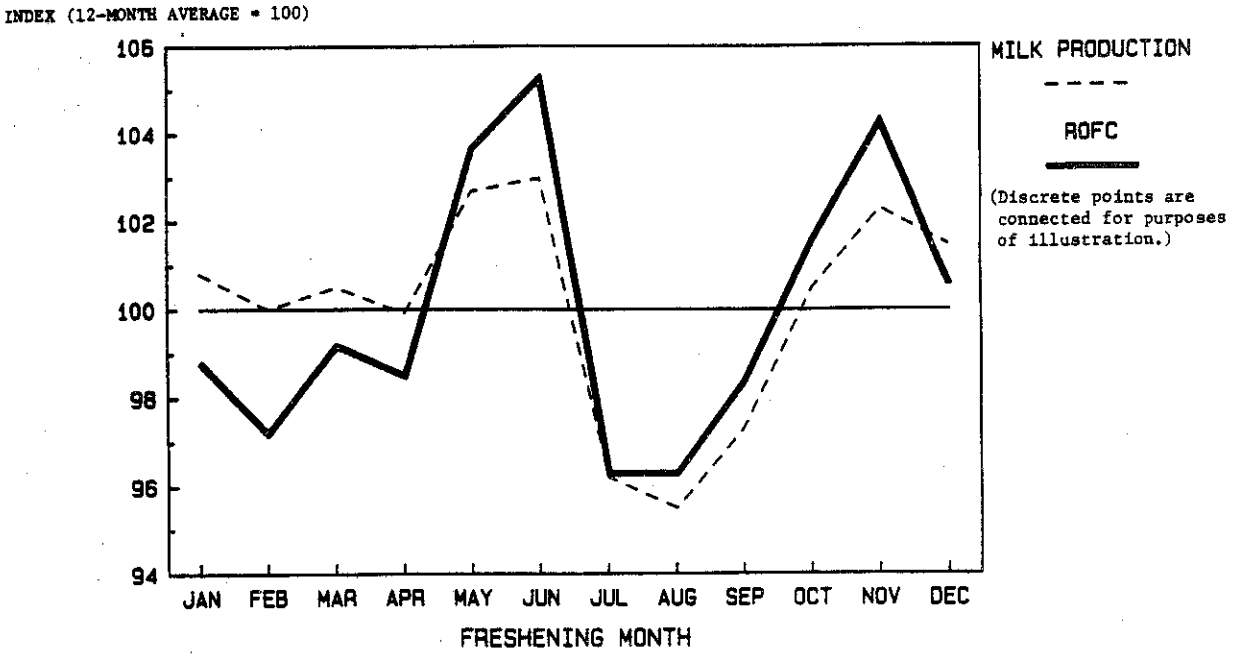
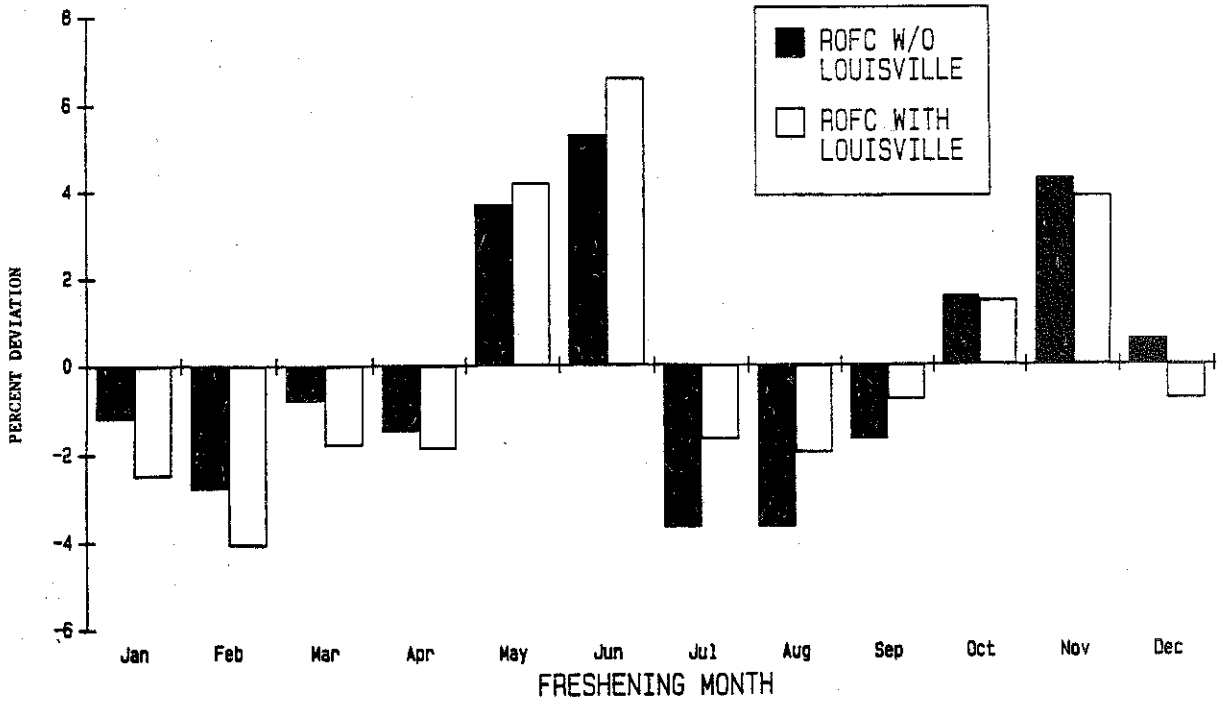


FIGURE 8. IMPACT OF LOUISVILLE PLAN ON RETURN OVER FEED COST, BY FRESHENING MONTH



The Effect of Seasonality on Returns to Dairy Herds

The existence of significant season-related differences in returns to individual cows immediately raises the question of whether there is also a correlation between herd production patterns and profitability. In order to answer this question, the individual-cow results of the previous section were combined in five different weighted combinations designed to replicate herd production patterns observed in Order No. 2.[6] These production patterns range from herds with far greater milk production in the spring than in the fall to contra-seasonal herds in which the opposite production pattern prevails (Figure 9).

The results of the herd-level analysis (Table 3) were unexpected in that they revealed essentially no difference in profitability between the five production patterns. These findings disproved our initial hypothesis that seasonal herds are more profitable than even or contra-seasonal herds.[7] The similarity of annual milk production, milk income, feed cost, and return over feed cost is explained by the fact that during approximately 6 months of the year there are few differences between the calving patterns across the five herds. Where there were dramatic differences, they tended to be offsetting so that by year end each herd had produced roughly the same amount of milk and generated the same level of income.

The range of returns to herds in the five groups is also a matter of interest. A more general analysis was performed to look at return over feed cost over a range of freshening patterns that still satisfy the criteria for each production pattern. A random sampling procedure was used to generate 25,000 different freshening patterns.[8] (Note that the total number of possible freshening combinations is much larger than this.) ROFC was calculated for each of the 25,000 herds and the herds were grouped according to production pattern. The range of ROFC within each production pattern is shown in Table 4 and Figure 10. Average return over feed cost varied between $987 and $991 per cow across the five production patterns. While this sampling procedure highlights the extent to which ROFC can vary within production patterns, it also confirms the validity of the results obtained using the five weighted average milk production patterns derived from Order No. 2 production data.

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[6] These patterns are based on the work of Mary-Patricia Gallagher, in which she classified Order No. 2 producers in five seasonal groups. Each curve in Figure 9 represents the weighted average seasonal distribution of total milk production for all of the farms in the group. Individual farms in each group undoubtedly deviate from the average to some extent.

[7] These results should not be interpreted to mean that seasonal factors do not account for some of the income differences between specific herds. They do show, however, that seasonal farms as a group are not inherently more profitable than any other group of farms. As indicated by the individual-cow results, this does not preclude the possibility of season-related differences in total herd incomes.

[8] Constraints in formulating the freshening patterns were that no more than 20 cows could freshen in any 1 month--assuming a 60-cow herd--and there could be no more than 3 months in which no cows freshened.

FIGURE 9. SEASONAL VARIATION OF DAILY MILK PRODUCTION PATTERN
(12-MONTH AVERAGE = 100)

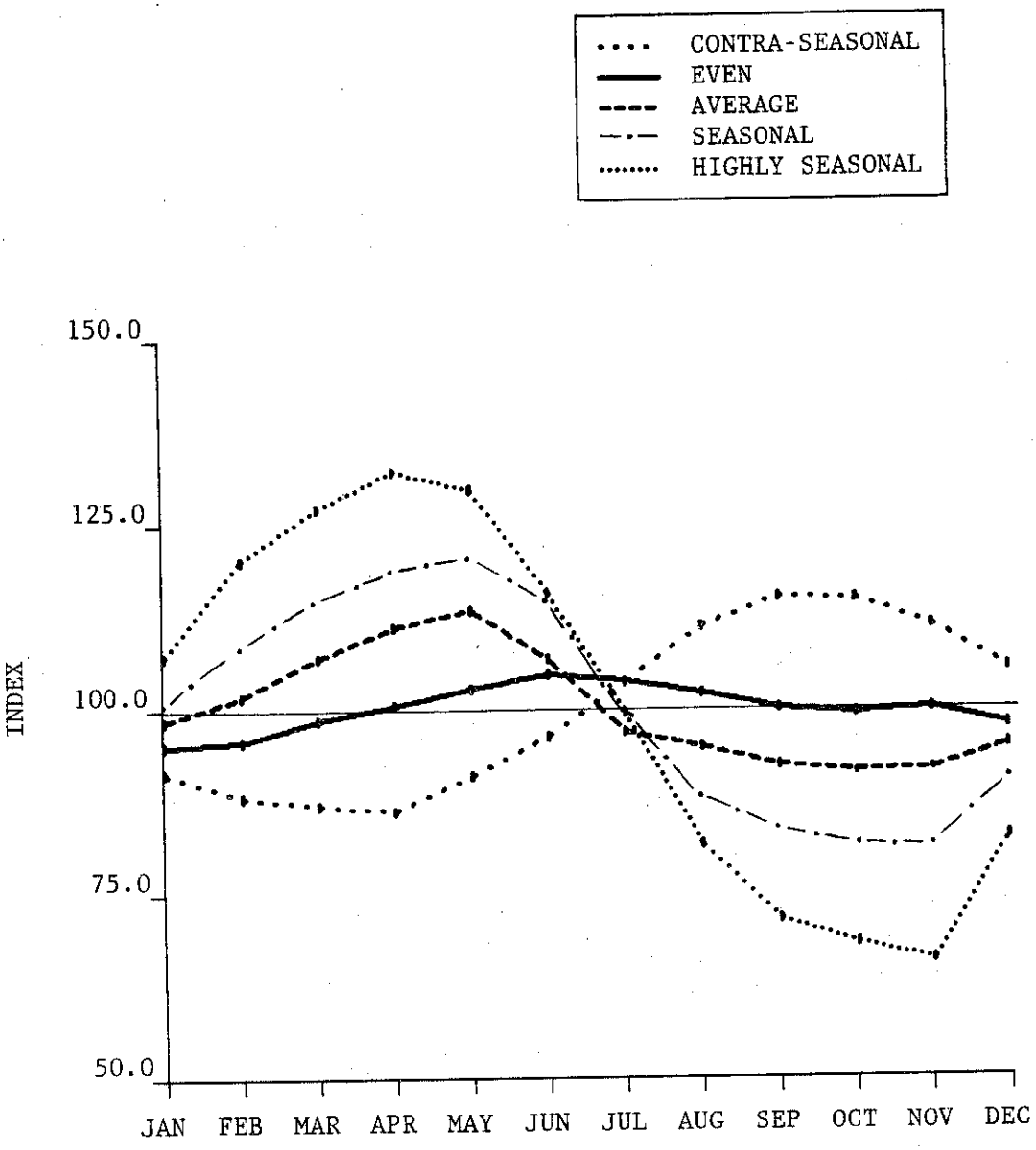


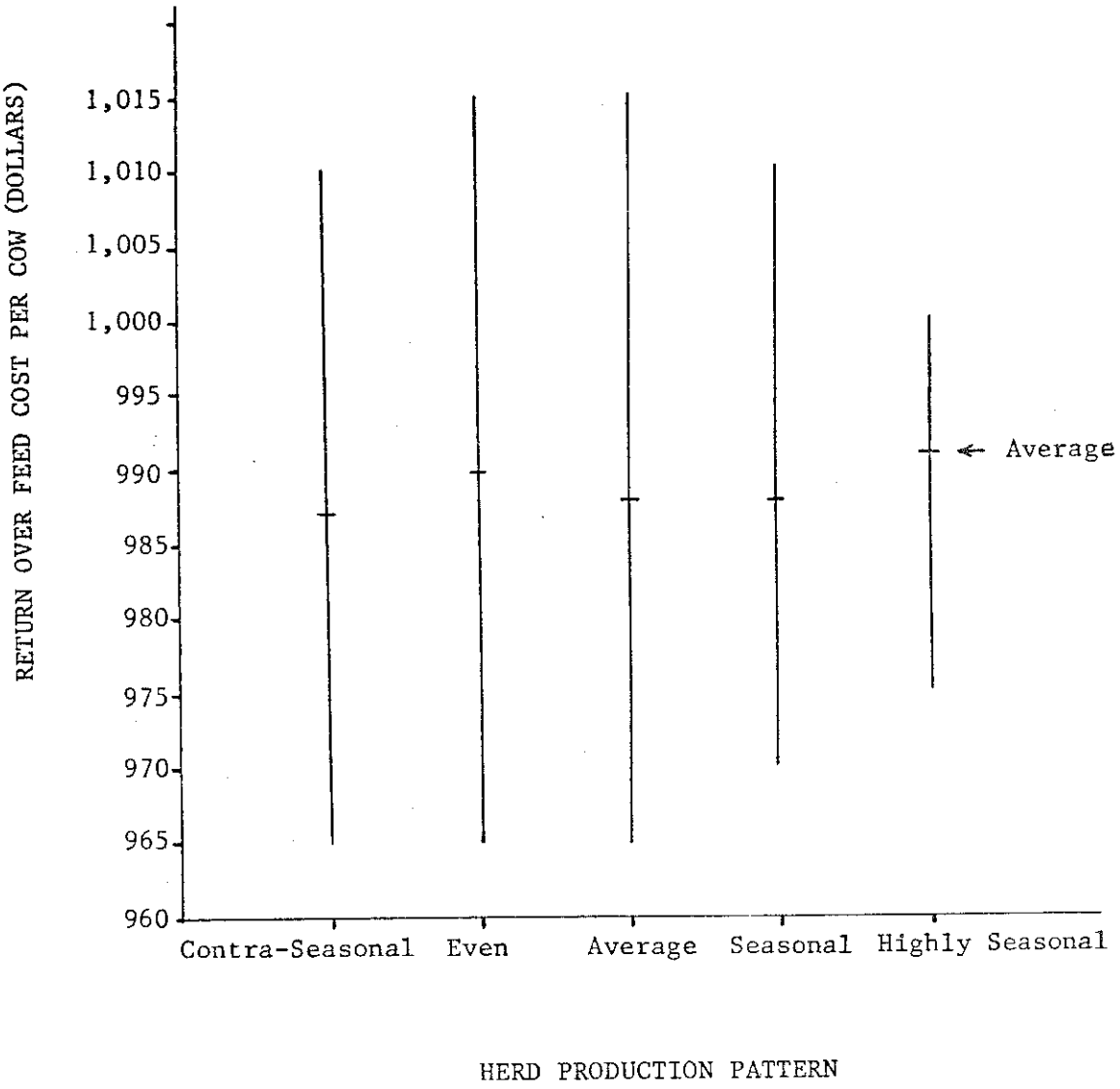
TABLE 3. ANNUAL MILK INCOME, FEED COST AND RETURN OVER FEED COST BY PRODUCTION PATTERN

	Contra-Seasonal	Even	Average	Seasonal	Highly Seasonal
Milk Production Per Cow (pounds)	14,073	14,173	14,149	14,239	14,269
	dollars per cow				
Milk Income	1,832	1,839	1,838	1,845	1,846
Feed Cost	846	853	855	859	863
Return Over Feed Cost	986	986	983	986	983

TABLE 4. RETURN OVER FEED COST BY HERD PRODUCTION PATTERN--RANGE ANALYSIS

	Contra-Seasonal	Even	Average	Seasonal	Highly Seasonal
Number of Herds	5,646	9,771	6,437	2,717	429
	dollars per cow				
Return Over Feed Cost Range:					
High Value	1,010	1,015	1,015	1,010	1,000
Low Value	965	965	965	970	975
Average Return Over Feed Cost	987	990	988	988	991

FIGURE 10. RANGE OF RETURN OVER FEED COST BY HERD PRODUCTION PATTERN



This section has relied solely on an economic engineering approach to analyze the relationship between the seasonality of milk production and returns to dairy farmers. The engineering model is desirable because it facilitates analysis of the effects of seasonality ceteris paribus, i.e., all other factors being the same. The drawback with this approach is that findings are not based on the operating results of actual dairy farms. Consequently, the results may fail to capture all of the factors relevant to the determination of farm income. An analysis of actual farm data is presented in the next section.

SEASONALITY VS. RETURNS ON OPERATING DAIRY FARMS

An alternative method for determining the relationship between the seasonality of milk production and farm profitability is to examine the operating statements of actual dairy farms. In this section of the study, the financial records of 214 dairy farms located in New England, New York and New Jersey were analyzed, as detailed below. The primary analytical problem associated with actual farm data is that the differences which exist between farms in terms of their human and physical resources make it difficult to isolate the impact of a single factor (in this case seasonality) on the profitability of milk production. The data was analyzed in a variety of ways in an attempt to separate the effects of this noise from the impact of seasonality.

The Sample

The 214 farms selected for this study were drawn from a list of dairy farms participating in the Agrifax®[9] farm records program and marketing their milk to handlers regulated under either Federal Order No. 1 (New England Marketing Area) or Federal Order No. 2 (New York-New Jersey Milk Marketing Area) during 1984.[10] The sample farms were generally much larger than the average farm in the two federal order markets. Order No. 1 sample farms marketed an average of 1,367,000 pounds per farm in 1984 (vs. 790,000 pounds for all farms in the order), and Order No. 2 sample farms sold an average of 1,301,000 pounds per farm (compared to the market-wide average of 700,000 pounds per farm). Farms with major enterprises unrelated to dairying were not included in the sample. The geographic distribution of farms in the study is shown in Figure 11. Sample farms ranged in size from 24 to 316 cows.

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[9] Agrifax® is a financial record-keeping service offered to farmers in the Northeast on a fee basis by local Production Credit Associations. All financial data used in this section of the study was provided by the Farm Credit Banks of Springfield.

[10] Milk production data for Order No. 1 producers was provided by the Order No. 1 Market Administrator's Office.

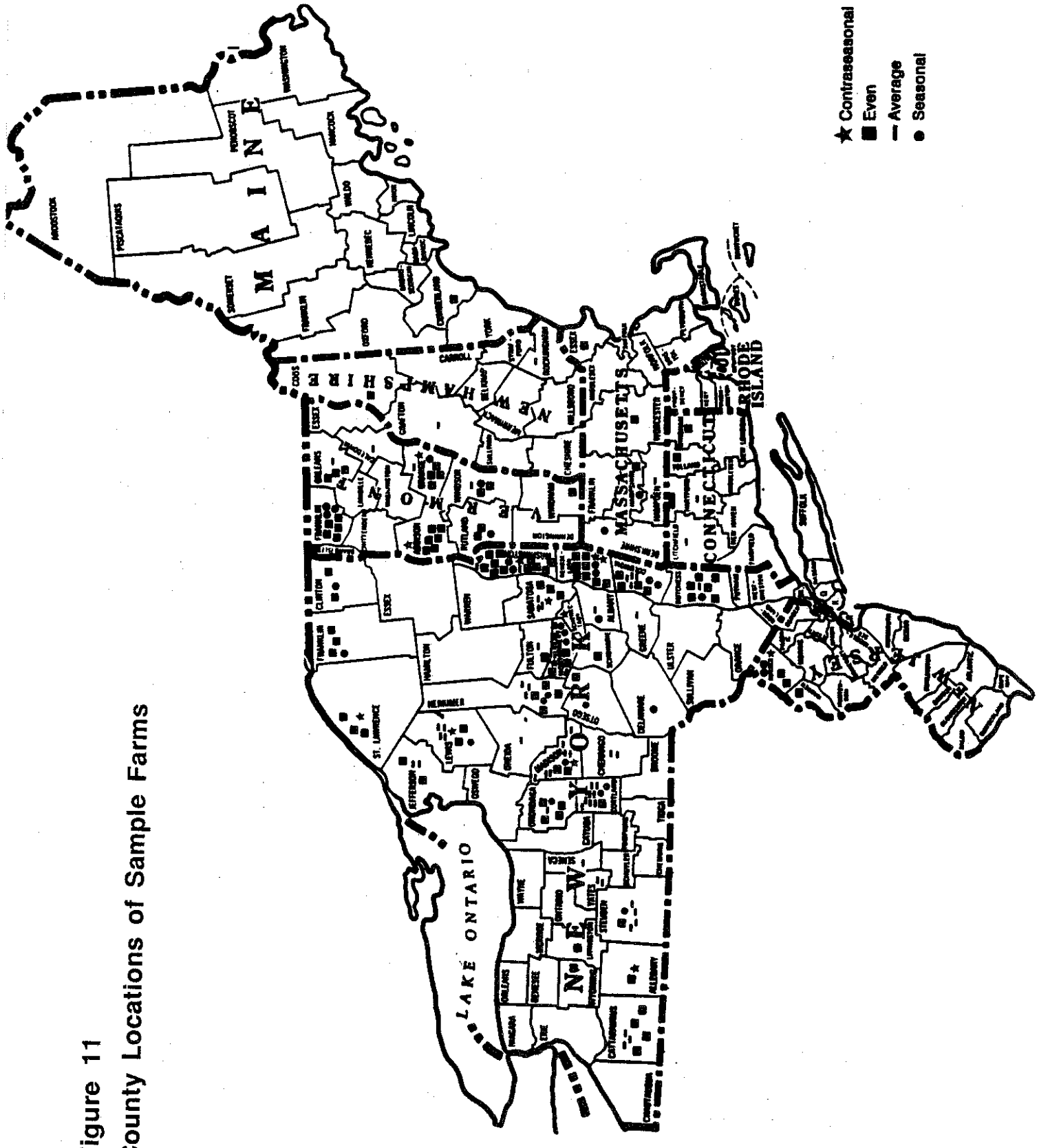


Figure 11
County Locations of Sample Farms

Farms were placed in one of four seasonal groups on the basis of the seasonality coefficient[11] calculated for each farm. The five seasonal groups used in the engineering model were reduced to four due to the small number of highly seasonal farms in the sample. Highly seasonal farms were included with the seasonal farms. The distribution of sample farms across seasonal groups is shown in Table 5.

TABLE 5. DISTRIBUTION OF FARMS, BY SEASONAL GROUP

	Contra-Seasonal	Even	Average	Seasonal	Total
Number of farms	13	103	65	33	214
Percent of farms	6.1	48.1	30.4	15.4	100.0

Analysis of Operating Results

A common measure of farm income is the difference between gross farm income and total farm expenses, herein referred to as net returns. A more meaningful measure for the purposes of this analysis is net returns before labor and interest expenses. Both labor and interest expenses frequently vary from one farm to another, and their inclusion would tend to obscure the presence of any correlation which may exist between seasonality and dairy farm profitability. Interest expenses are determined by the level and structure of farm debt. In any given year, interest expenses are more directly related to the operator's debt position than they are to the earning capacity of the business. Labor expenses vary between farms for at least two reasons. The first is that the amount of unpaid family labor varies significantly between farms. The other important factor with respect to labor expenses is that some farmers are simply willing to pay more for labor than others.

[11] The seasonality coefficient was developed by Mary-Patricia Gallagher as a criterion for classifying farms based on the relative seasonality of milk production. It is defined by the following formula:

$$\text{Seasonality Coefficient} = \frac{(\text{Spring production} - \text{Fall production})}{\text{Fall production}}$$

where spring production is the total milk sold from March through June, and fall production is the total milk sold from August through November. The seasonal groups are defined as follows:

Seasonal group	Seasonality coefficient
Contra-seasonal	$x < -.10$
Even	$-.10 \leq x < .10$
Moderately seasonal	$.10 \leq x < .30$
Seasonal	$.30 \leq x$

Earnings by Seasonal Group

Gross income per cow exhibited little variation between seasonal groups, with the exception of the seasonal farms which generated significantly less income than farms in the other three groups[12] (see Figure 12 and Table 6). Two groups stood out in terms of their net returns before labor and interest expenses. Average farms were more profitable than the others, with net returns per cow of $646 (vs. $595 for all farms in the study). At $503, net returns per cow were lowest on seasonal farms. Contra-seasonal and even farms' income-earning ability was approximately equal to the average for all farms in the study. A detailed income statement for the four seasonal groups is included in Appendix Table A1.

The underlying explanation for these income differences seems to be unrelated to the seasonality of milk production. Seasonal farms generated below-average milk sales per cow and showed little or no increase in livestock and feed and crop inventories. This low output resulted in net returns per cow before labor and interest expenses that were nearly $100 less than the average for all farms in the sample. The average group was more profitable than the others due to high milk production per cow combined with relatively low feed and crop expenses.

Figure 13 presents the range of net returns per cow for 80 percent of the farms in each group (i.e., excluding the 10 percent of farms with the highest earnings and the 10 percent of farms with the lowest earnings).

This further confirms the conclusions that: a) there is no significant difference in profitability (expressed on a per-cow basis) between contra-seasonal and even farms; b) average farms are somewhat more profitable than the first two groups; and, c) seasonal farms are significantly less profitable than the other groups of farms.

A more detailed picture of the relationship between profitability and seasonality is shown in Figure 14. This diagram illustrates the absence of any meaningful correlation between seasonality and profitability.

[12] Note that operating farms were subject to the Louisville Plan in effect under Federal Orders 1 and 2. This creates a slight problem when comparing model results with actual farm data, since the Louisville Plan was not included in the model.

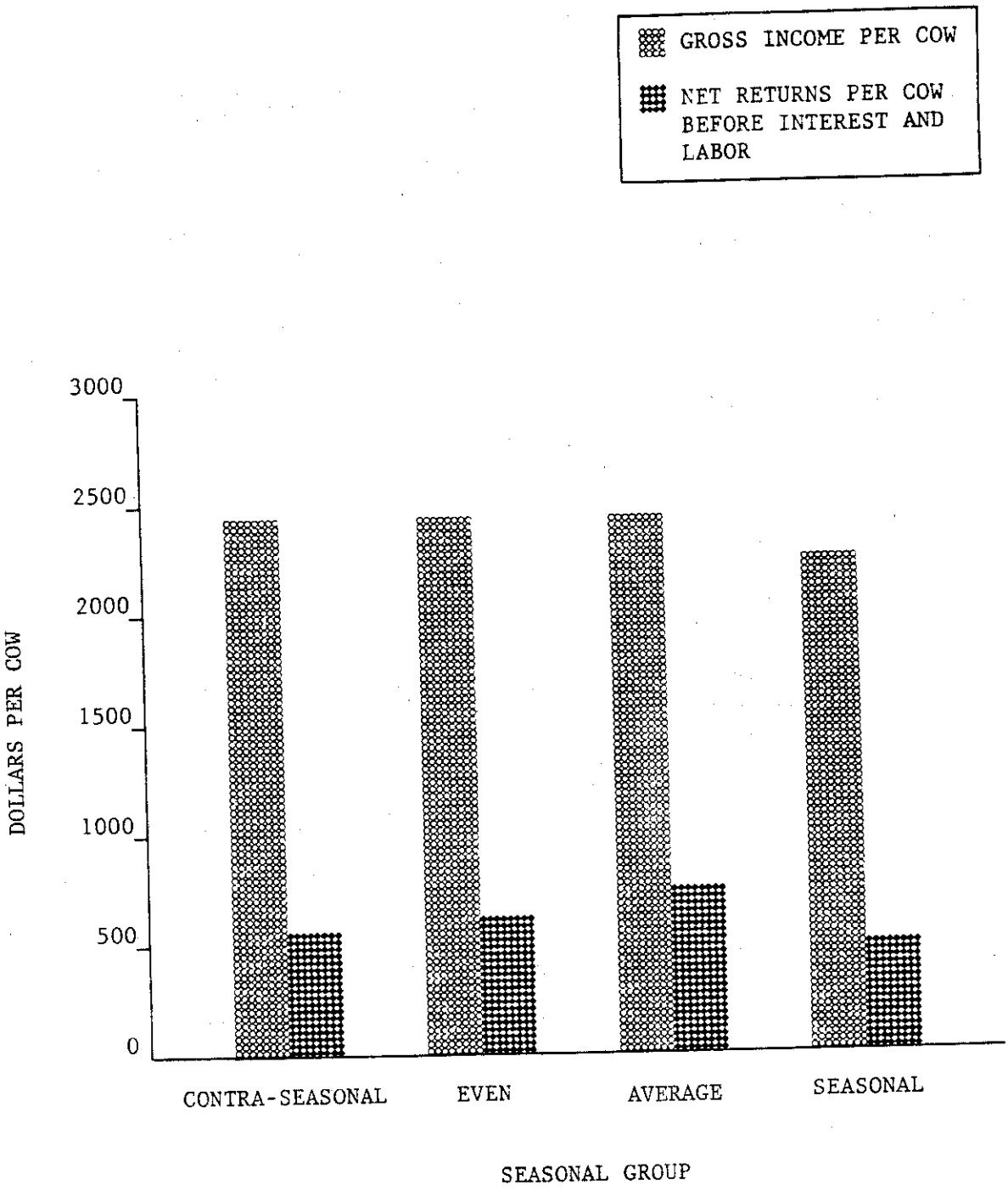


FIGURE 12. GROSS INCOME AND NET RETURNS PER COW, BY SEASONAL GROUP

TABLE 6. SELECTED BUSINESS FACTORS, BY SEASONAL GROUP

	Seasonal Group				
	Contra-seasonal	Even	Average	Seasonal	All farms
NUMBER OF FARMS	13	103	65	33	214
AVERAGE NUMBER OF COWS	79	100	77	73	88
Milk Sold per Cow (pounds)	14,685	15,159	15,721	14,637	15,216
Milk Price per hundredweight ($)	14.15	13.94	13.52	13.72	13.81
Milk Income per Cow ($)	2,083	2,119	2,132	2,018	2,097
Change in Livestock Inventory ($ per cow)	81	29	13	2	24
Change in Feed & Crop Inventory ($ per cow)	61	20	33	0	23
Purchased Feed Cost as a Percentage of Milk Income	28.1	27.0	22.8	28.2	26.1
Feed Cost per Cow ($)	585	573	486	570	547
Feed & Crop Expense per Cow ($)	769	729	646	700	705
Feed Cost per hundredweight ($)	3.98	3.78	3.09	3.89	3.59
Feed & Crop Expense per hundredweight ($)	5.24	4.81	4.11	4.78	4.63
	dollars per cow				
GROSS INCOME	2,433	2,409	2,435	2,235	2,384
TOTAL EXPENSES B/F LABOR & INTEREST	1,854	1,811	1,789	1,732	1,789
NET RETURNS B/F LABOR & INTEREST	579	598	646	503	595

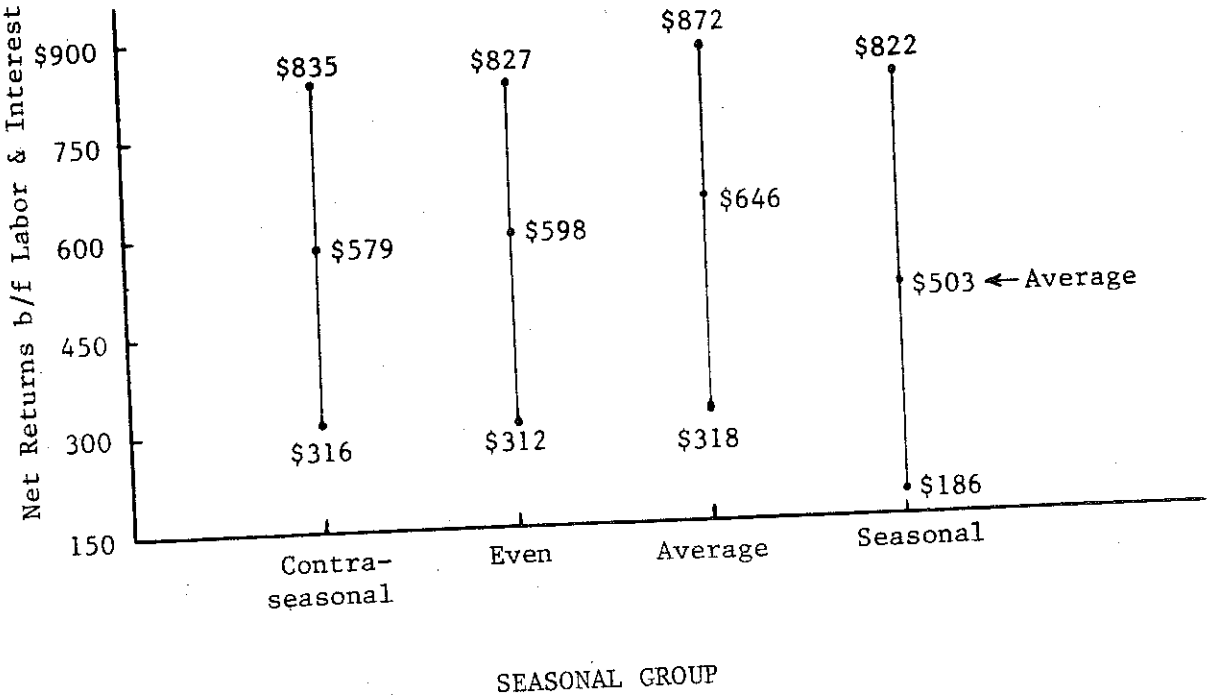
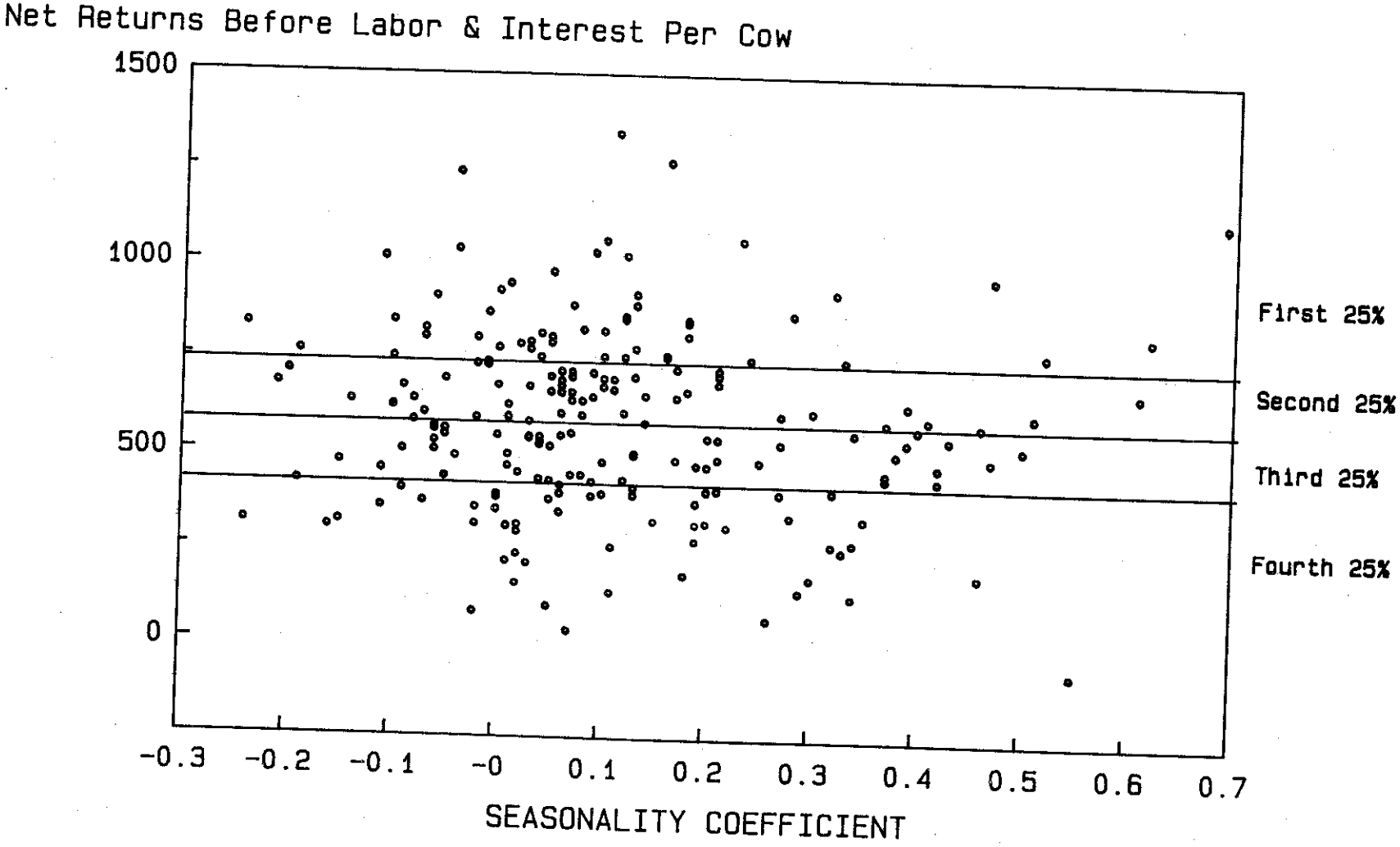


FIGURE 13. 80 PERCENT RANGE OF NET RETURNS PER COW BEFORE INTEREST & LABOR, BY SEASONAL GROUP

FIGURE 14. NET RETURNS BEFORE LABOR & INTEREST VERSUS SEASONALITY COEFFICIENT



An alternative approach to this analysis is to look first at farm profitability and then to consider the seasonality of milk production. Sample farms were ranked on the basis of net returns per cow before labor and interest, and then divided into four profit groups. The average return for farms in each quartile is shown below. It is interesting to note that within each profit group there are farms ranging across the entire seasonality spectrum.

Quartile	Average Net Returns B/F Labor & Interest
	dollars per cow
First	883
Second	657
Third	500
Fourth	285

The proportional composition of each seasonal group by profit quartile is shown in Figure 15. (Note that by definition, each quartile contains 25 percent of the farms in the entire sample.) There are relatively more third and fourth quartile farms in the seasonal group, while the most profitable farms are somewhat more concentrated in the moderately seasonal group.

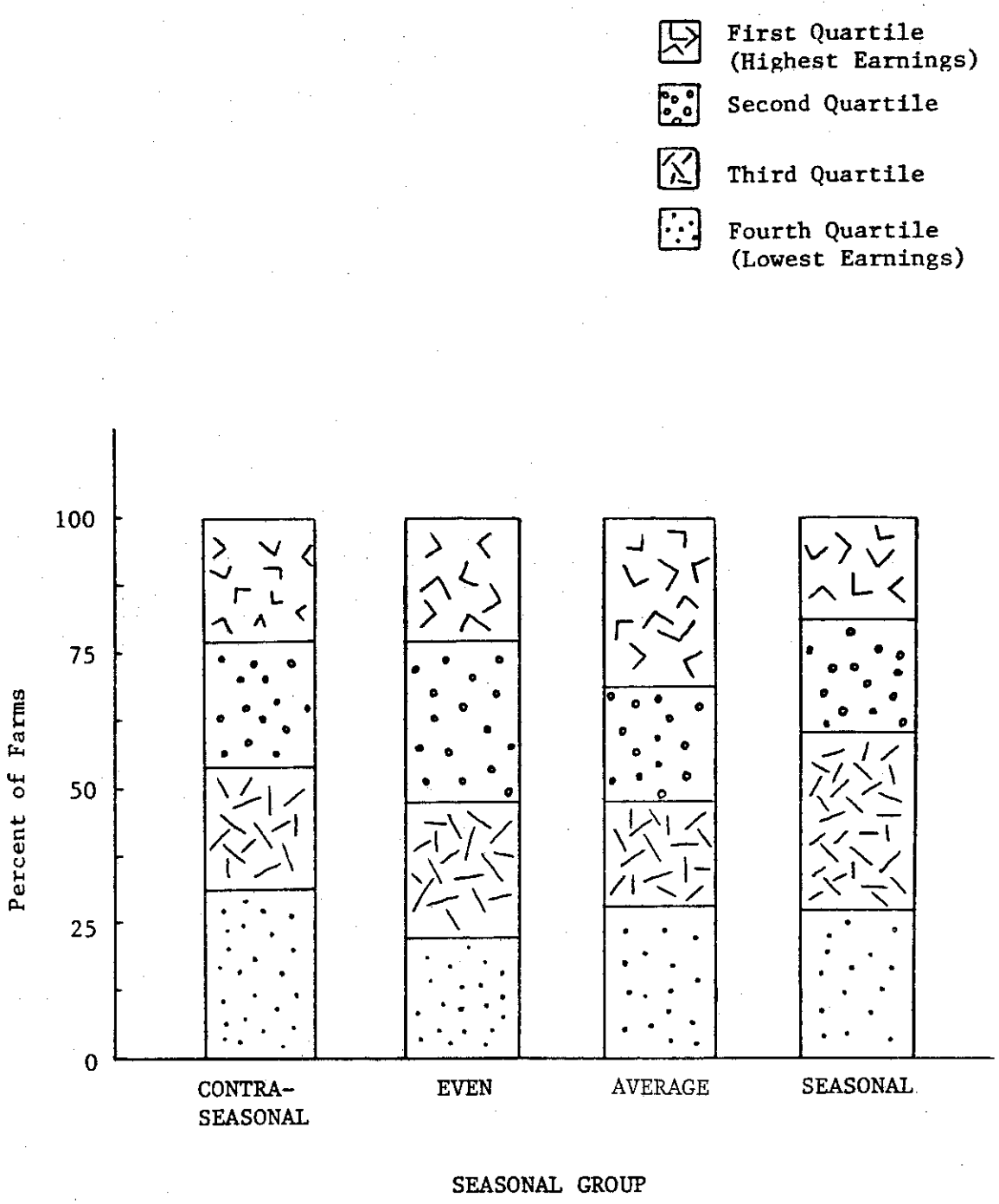


FIGURE 15. DISTRIBUTION OF FARMS BY SEASONAL GROUP AND PROFIT QUARTILE

SUMMARY AND CONCLUSIONS

This study has utilized an economic engineering model supplemented with actual farm operating data to examine the impact of seasonality on returns to dairy producers. The model was ideally suited to this task because it made it possible to isolate the impact of seasonality on profitability. Return over feed cost (ROFC) was used as a measure of profitability for evaluating the model results. While many other factors affect overall dairy farm profitability, they were excluded from the model because they are relatively constant over a wide range of milk production patterns.

Analysis of individual freshening month results revealed substantial ROFC differences between cows freshening in different months. The 12-month ROFC for cows freshening in June (the peak month) was $52 above average, while the return to cows freshening in July and August (the lowest months) was $37 below average. This presents a real opportunity for astute managers to enhance the profitability of their operations.

When individual freshening month results were combined to generate herd results, there was essentially no difference in ROFC between herds producing milk under a variety of production patterns. The primary reason for this is that the freshening patterns of all herds were similar during approximately 6 months of the year. For the balance of the year the differences tended to cancel each other out, resulting in nearly identical total production and return over feed cost for all herds.

In the farm sample, there were no income differences between farms grouped according to production pattern that could be attributed to seasonal factors. The differences in income that were found (especially the low income for seasonal farms) appeared to be caused by differences in productivity levels. A number of other possible explanations for the observed income differences were investigated, including the relationship between geographic location and income, the impact of the Agri-Mark base-excess plan, and the average price received for milk by different groups of farms, however, none was found to be significant.

This research has shown that seasonal factors do have an impact on returns to producers at the individual-cow level. When the same evaluation was made at the herd level (both for modeled and actual herds) no season-related impact was found. It is important to note that this inability to correlate differences in income for entire herds with seasonal factors does not necessarily preclude the existence of a relationship between seasonality and herd income. Further research is needed to clarify the relationship between production patterns and profitability at the herd level.

A P P E N D I X

FIGURE A1.

MONTHLY MILK PRICES

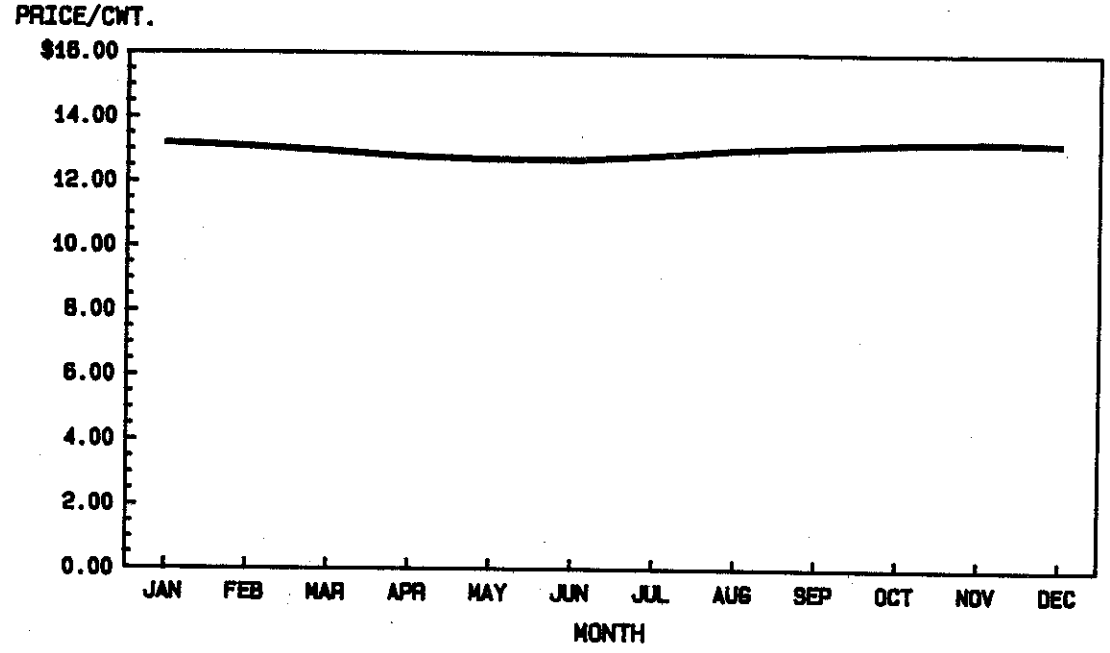


FIGURE A2.

MONTHLY CORN MEAL AND
SOYBEAN (44% PROTEIN) PRICES

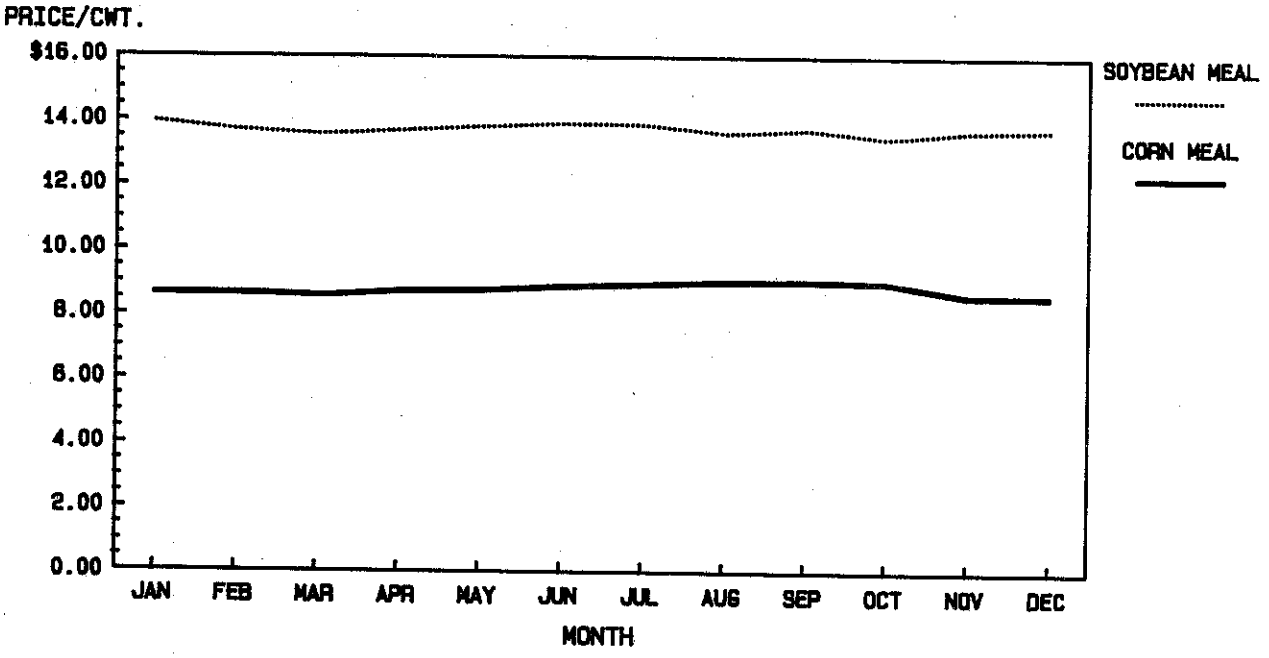


FIGURE A3.

MONTHLY HAY PRICES

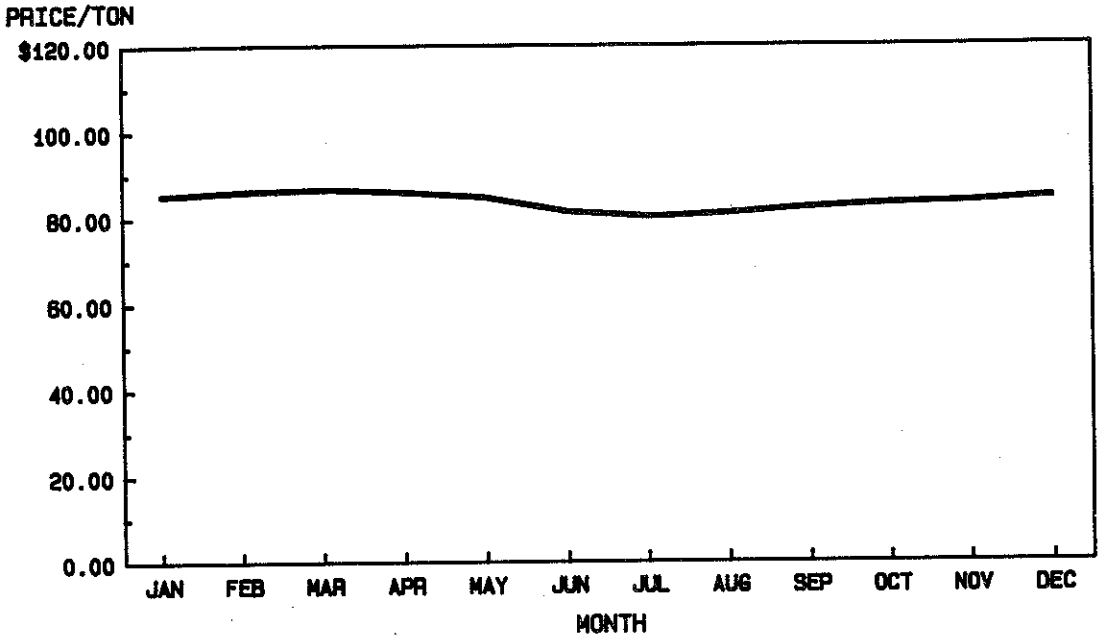


FIGURE A4.

MONTHLY CALF PRICES

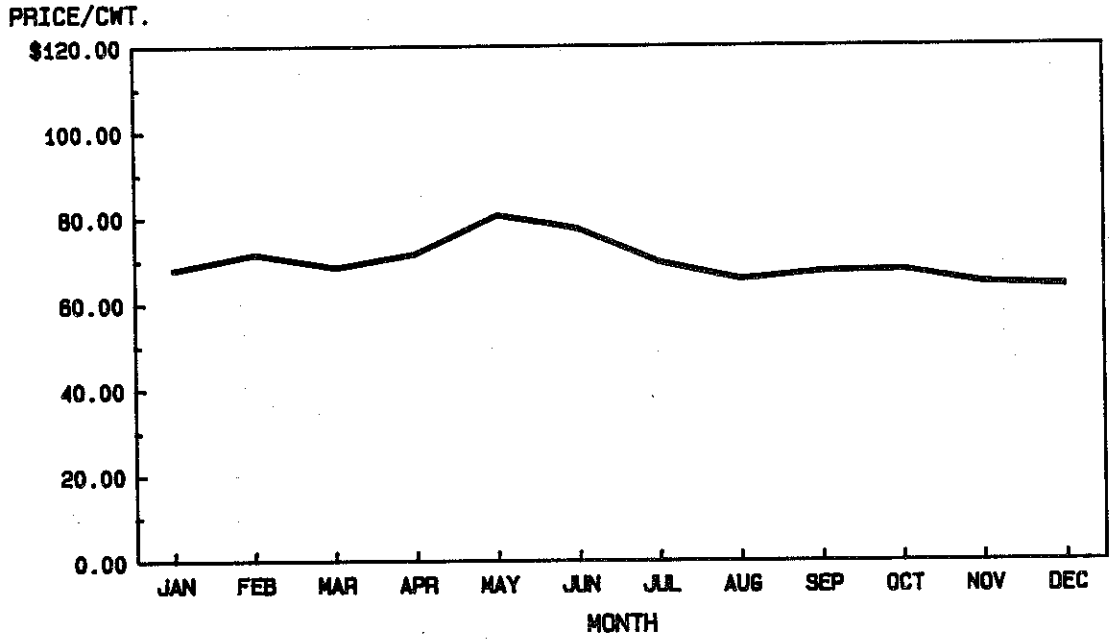


FIGURE A5. MONTHLY DAIRY REPLACEMENT PRICES

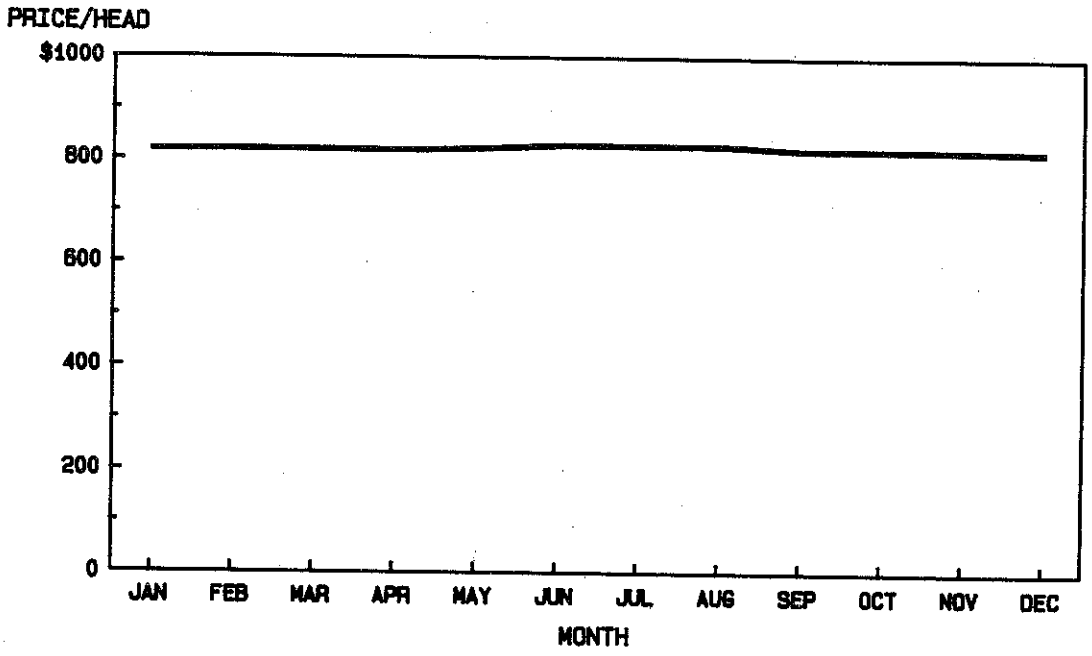


TABLE A1. 1984 FARM INCOME STATEMENT, BY SEASONAL GROUP

	Seasonal Group				
	Contra-seasonal	Even	Average	Seasonal	All farms
NUMBER OF FARMS	13	103	65	33	214
AVERAGE NUMBER OF COWS	79	100	77	73	88
	dollars per cow				
Income					
Milk Sales	2,083	2,119	2,132	2,018	2,097
Cattle Sales	147	161	163	141	158
Crop Sales	7	18	36	31	24
Other	78	48	50	38	49
CASH INCOME	2,315	2,347	2,381	2,227	2,328
Change in livestock inventory	81	29	13	2	24
Change in feed & crop inventory	61	20	33	0	23
Change in accounts receivable	-23	12	8	6	8
GROSS INCOME (a)	2,433	2,409	2,435	2,235	2,384
Expenses					
Labor	153	228	245	205	224
Land, Building, & Fence repair	19	19	20	18	19
Machinery & Equipment repair	95	99	97	70	94
Interest	213	212	257	201	222
Rent	38	52	55	44	51
Feed	585	573	486	570	547
Seeds & Plants	27	30	37	23	31
Fertilizer & Lime	129	105	99	91	102
Spray & Chemicals	29	24	26	20	24
Machine hire	7	12	16	4	12
Supplies	83	74	83	74	77
Breeding fees	29	24	31	27	26
Veterinary & Medicine	34	39	43	30	39
Fuel & Oil	80	83	77	69	79
Taxes	43	47	49	53	48
Insurance	38	40	40	33	39
Utilities-Farm Share	55	62	68	62	63
Milk Marketing & Hauling	201	183	177	187	182
Other	46	57	61	58	57
Cow Replacements	3	15	20	22	17
CASH OPERATING EXPENSES	1,907	1,977	1,987	1,861	1,952
Expansion Livestock	45	14	16	4	15
Building Depreciation	75	76	71	68	73
Machinery Depreciation	193	184	217	205	195
TOTAL EXPENSES	2,220	2,251	2,291	2,138	2,235
TOTAL EXPENSES B/F LABOR & INTEREST (b)	1,854	1,811	1,789	1,732	1,789
NET RETURNS B/F LABOR & INTEREST (a-b)	579	598	646	503	595

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