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MARKETING MARGINS FOR MCINTOSH AND RED DELICIOUS APPLES IN CONNECTICUT

Jose Montero and Donald G. Stitts*

INTRODUCTION

Apple production in Connecticut averages 49.4 million pounds a year[1]. Most of these -- approximately 80 percent of the total production -- are sold for fresh use[2].

The purpose of this study is to estimate, using the existing price interrelations, wholesale and retail marketing margins for McIntosh and Red Delicious apples, in Connecticut. Knowledge of these margins, should assist apple growers in determining an optimum marketing strategy; by knowing how much he (the grower) pays for the use of the different distribution channels, and how these costs vary, the grower can estimate the profitability of using these channels.

PROBLEM

Apple growers have various alternatives for marketing fresh apples. (1) They may sell through their own roadside outlet, receiving a retail-level price. (2) They may sell directly to retail outlets, making store-door deliveries, receiving a wholesale price and providing packing and delivery services. (3) The grower may select to sell through a wholesale market place or outlet, receiving a first sale or farm-level price. Many growers use a combination of outlets to market their apples.

Decision making by the grower packer-seller is complicated by the numerous apple varieties, sizes and quantities; by the alternative types of packs (e.g., poly bags, trays and bulk); by the seasonality and temporal allocation of sales; and by the alternate geographic location of market places.

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[1] J. K. Ketcham, Fruit Report, United States Department of Agriculture, November 12, 1970.

[2] R. Goldman, Chief, Marketing Division -- Connecticut Department of Agriculture and Natural Resources, personal interview, November 1970.

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It can be expected, therefore, that at a point in time, apple prices will differ by stage of the marketing process; by quality, size and variety, and by region (location). Thus, even with a relatively competitive market structure, a constellation of apple prices will exist. Furthermore, market imperfections can lead to additional price differences. But, while accepting some imperfections, including imperfect knowledge, we expect the various prices to be interrelated.

Under conditions of monopolistic competition, a condition which would best describe apple retailing, the rational retailer may be viewed as maximizing profits by equating marginal revenue and marginal cost in a situation in which there is a nagatively inclined demand for each item he sells. It is often argued that retailers do not price in this fashion -- that, instead they apply the same percentage of markup to each item in the store or department[3]. There appears to be some truth in both propositions. Retailers commonly use an average percentage of markup as a starting point in establishing prices, but the variations in observed markups as between different items are so numerous as to indicate that demand conditions are considered in the price[4].

THEORETICAL DISCUSSION

Under conditions of monopolistic competition, the retailer would maximize profits by equating marginal revenue and marginal costs. Unfortunately, these data are not always readily available. Therefore, retailers may use some other system to price apples. This section will discuss the theoretical considerations behind three of these systems: (a) the same percentage markup to each item, (b) an average percentage markup to each item or (c) a constant markup to each item.

For purposes of this discussion, it is first assumed that retailers and wholesalers do consider both demand and cost and attempt to price for maximum profit. For the purpose of simplicity, it is further assumed that the demand curve is linear. Under these assumptions, we will proceed to analyze the relationship between retail prices and prices at other levels.

Retailer's demand for goods sold by the wholesaler is derived from the consumers' demand curve confronting the retailer. The nature of this relationship may be seen in Figure 1. The curve ANR is the net average revenue curve facing the retailer. It is the consumer demand curve minus any variable costs associated with the particular item other than the cost of goods. Few retailers have made distribution cost analyses to measure these variable costs, and over realistic volume ranges it is likely that total costs do not increase appreciably with an increase in sales of one item; so ANR might be taken simply as the consumer demand curve[5]. To this curve, draw the marginal revenue

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[3] In the case of apples, it is argued that wholesalers apply approximately, a 10 percent markup. J. Newmayer, Wholesaler Hartford Produce Market, personal interview, November 1970. Retailers, it is argued, apply a 36 to 38 percent markup (f.o.b., freight and markup included). G. Lewis, The Goodfruit Grower, Volume 22, Number 6, March 15, 1972, p. 6.

[4] F. Machlup, "Marginal Analysis and Empirical Research," American Economic Review, XXXVI (1964), 519-54; and "Rejoinder to an Anti-marginalist," American Economic Review, XXXVII (1947), 148-54.

[5] E. R. Hawkins, "Vertical Price Relationships," in Cox and Alderson (eds.) Theory in Marketing (Homewood, Ill.: Richard D. Irwin, 1950), Chapter 11. E. R. Hawkins, Johns Hopkins University.

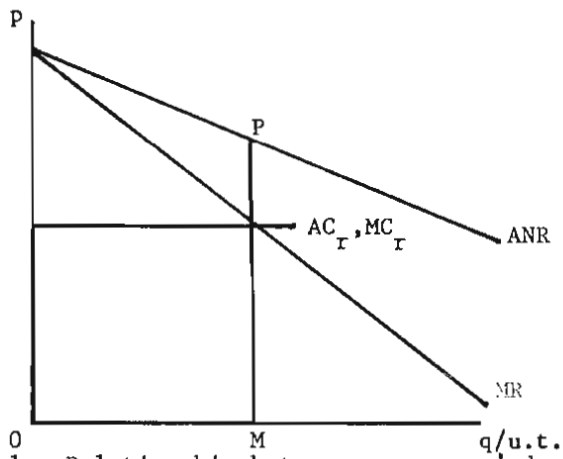

FIGURE 1. Relationship between consumers' demand curve and retailer's demand curve.

curve MR. The cost of goods to the retailer, AC_r, is identical with MC_r unless the retailer is in a monopsonistic position. Now, if the retailer equates MC_r, and MR, his demand prices must lie along MR, which is, therefore, the retailer's demand curve for the goods of the wholesaler.

The wholesaler's demand may be similarly derived from the retailer's demand, and the whole structure of prices would appear as in Figure 2, which shows the simple case in which all dealers at the same level have identical or isoelastic AR curves and buy and sell at the same price. In this chart, AR_r is the aggregate consumer demand curve; MR_r is the summation of retailers' marginal revenue curves, and is the aggregate retail demand curve; MR_w is the summation of wholesalers' marginal revenue curves and is the grower's average revenue curve; and MC_G is the summation of the growers' marginal cost curves and, assuming no external economies or diseconomies, is the grower's supply curve. The wholesalers' and the growers' average revenue curves are drawn discontinuous, to reflect the fact that retailers, as well as wholesalers, commonly use an average percentage of markup as a starting point in establishing prices. Grower's supply and demand determine the quantity sold, OM, and the farm price, MP[6].

When wholesalers are offered the goods at price MP, they equate this marginal cost to their own marginal revenue and will buy quantity OM, reselling it at a price MP', joining a marketing margin equal to PP'. Retailers make the same kind of calculation, and, buying quantity OM at a price MP', they will resell it at a price MP'', joining a marketing margin equal to P'P''.

[6] If growers were not purely competitive, they would determine output and price by equating their own marginal cost and marginal revenue.

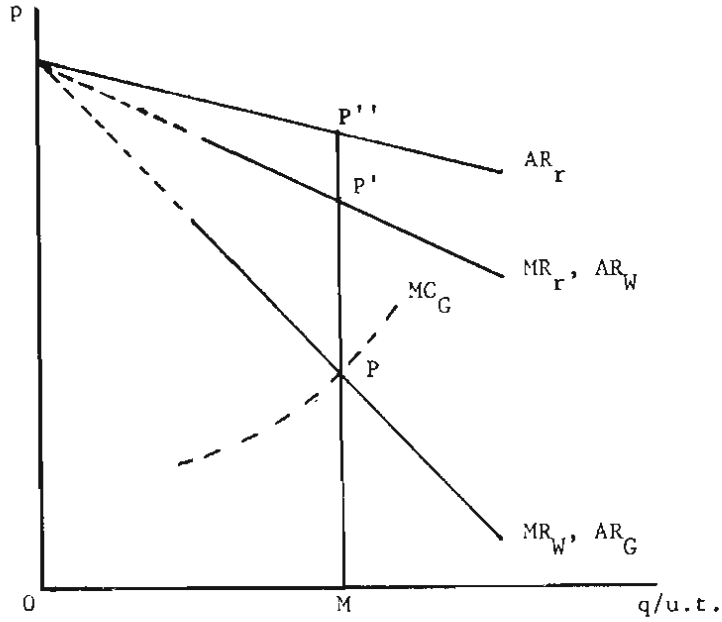

FIGURE 2. Profit maximizing markup and resulting price relationships.

If growers supply increases, prices at all levels decrease, but per unit marketing margins increase. If growers supply decreases, prices at all levels increase, but per unit marketing margins decrease.

Marginal analysis thus led us to the conclusion that both wholesale and retail marketing margins vary inversely with price and tend to disappear at a very high price.

Let us now assume that retailers and wholesalers use a fixed percentage markup pricing policy. Under this assumption, we will proceed to analyze the relationship between retail prices and prices at other levels.

As in the previous case, retailer's demand for goods sold by the wholesaler is derived from the consumer's demand curve confronting the retailers; and the wholesaler's demand for goods sold by the producer is derived from the retailer's demand curve confronting the wholesaler. The nature of these relationships and the whole structure of prices is shown in Figure 3. Again, it is assumed that all dealers at the same level have identical or isoelastic AR curves, and buy and sell at the same price. In this chart AR_r is the aggregate consumer demand curve; AR_W is the aggregate retail demand curve; AR_G is the aggregate wholesale demand curve; and MC_G is the summation of the growers marginal cost curves, which, assuming no external economies or diseconomies, is the growers' supply curve.

In this case, the aggregate retail demand curve is no longer marginal to the consumers' demand curve; and neither is the aggregate wholesale demand curve marginal to the retailers' demand curve. These curves represent whatever margin below the retail or wholesale price the retailer or the wholesaler desires. As in the previous

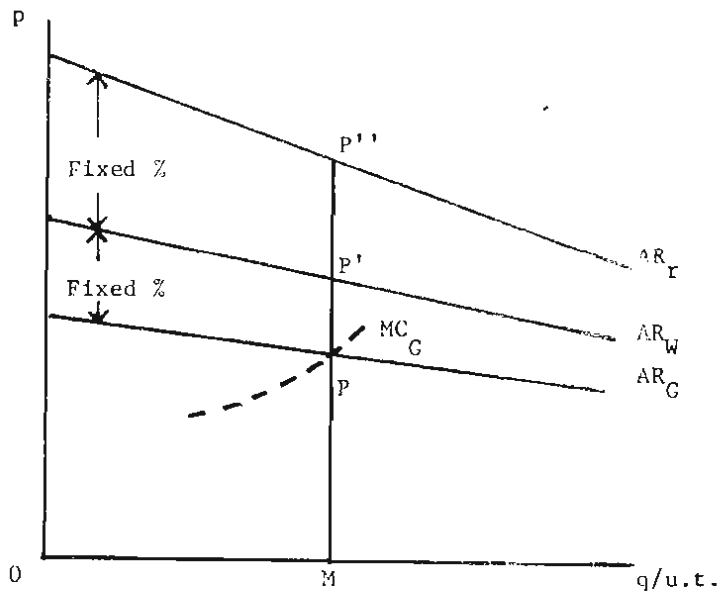

FIGURE 3. Fixed percentage markup and resulting price relationships.

case, at the farm level supply and demand determine quantity sold, OM, and farm price MP. When wholesalers are offered the goods at price MP, they add to it their percentage markup, PP', and sell them at markup MP'. Retailers make the same kind of calculation, buying quantity OM at a price MP', adding their percentage markup, P'P'', and reselling at a price MP''.

In this case, if grower's supply increases, prices at all levels decrease and so do per unit marketing margins. If grower's supply decreases, prices at all levels increase and so do per unit marketing margins.

Percentage markup analysis thus led us to the conclusion that marketing margins vary directly with prices, and tend to disappear at a very low price.

There is a third economic model which can help in understanding the behavior of marketing margins. This is the constant absolute margin model. The structure of prices under these conditions appears in Figure 4. Since the analysis is similar to that in the previous two cases, it will not be pursued any further; but it may be worthwhile to point out, that unlike the previous two cases, changes in supply do not affect per unit marketing margins; this implies that marketing margins do not vary with prices.

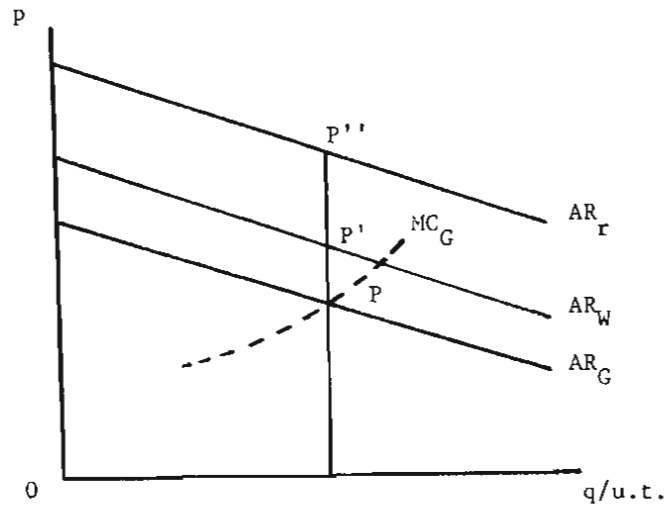

FIGURE 4. Constant absolute markup and resulting price relationships.

STATISTICAL MODELS

Economic theory suggests two approaches which could be used in estimating marketing margins.

One approach is to estimate retail-level and farm-level (derived) demand functions. The other approach is to describe what has been observed in different, but similar markets which report at different points in the marketing process. The model in outline form would be:

$P_r = f_1$ (Q; demand shifters:)

$P_j = f_2$ (Q; demand shifters; margin shifters)

The first equation is the demand function facing the retailer; and the second equation is the demand function facing the grower. Lack of sufficient price-quantity information on apples at the present does not permit this type of model[7].

The existing price interrelations were used to estimate the margins. This could be expressed in algebraic terms as follows:

$$M_T = P_R - P_j \quad (1)$$

$$M_W = P_W - P_j \quad (2)$$

$$M_R = M_T - M_W \quad (3)$$

[7] See Procedure in this paper.

where

M_T = total margin

M_R = retail margin

M_W = wholesale margin

P_R = retail price

P_j = farm price

P_W = wholesale price

Assuming a linear relationship between prices, we can express:

$$P_R = a_1 + b_1 P_j + e_1 \quad (4)$$

$$P_W = a_2 + b_2 P_j + e_2 \quad (5)$$

where

a = the basic wholesale apple price

b = amount the wholesale price varies with a unit change in volume

Substituting (4) and (5) in (1), (2) and (3)

$$M_T = a_1 + B_1 P_j + e_1 - P_j \quad (6)$$

$$= a_1 + (b_1 - 1) p_j + e_1$$

$$M_W = a_2 + b_2 P_j + e_2 - P_j \quad (7)$$

$$= a_2 + (b_2 - 1) P_j + e_2$$

$$M_R = a_1 + b_1 P_j - P_j + e - (a_2 + b_2 P_j - P_j + e) \quad (8)$$

$$= a_1 - a_2 + (b_1 - b_2) P_j + e_1 - e_2$$

The next step is now to study the results of the constant marketing margins, margins that vary direct with supply and margins that vary inversely with supply described in the appendix. Similar analysis should be applicable to the statistical wholesale and retail margin models (equations 7 and 8).

If all dealers use a profit maximizing markup, marketing margins would vary inversely with price; and tend to disappear at a high price in equation 6, this implies that B_1 should be less than one, and that A_1 should be positive. This has been explained in the Theoretical Discussion section.

If all dealers use a fixed percentage markup, marketing margins vary directly with prices and tend to disappear at a very low price; in equation 6, this implies that B_1 should be greater than one, and that A_1 should approach zero.

If all dealers use a constant absolute markup, marketing margins do not vary with prices; in equation 6, this implies that B_1 should equal one and that A_1 should be positive.

These relationships are illustrated in Figures 5, 6, and 7. The area between the 45° line and the price line represents the markup.

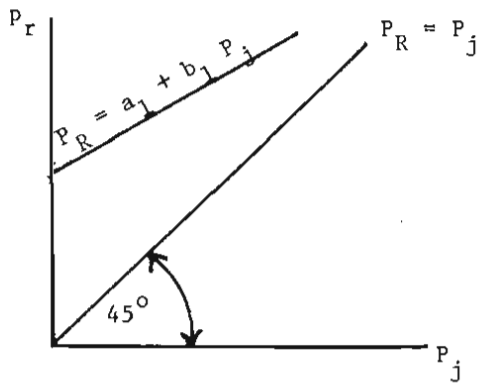

FIGURE 5. Profit maximizing markup.

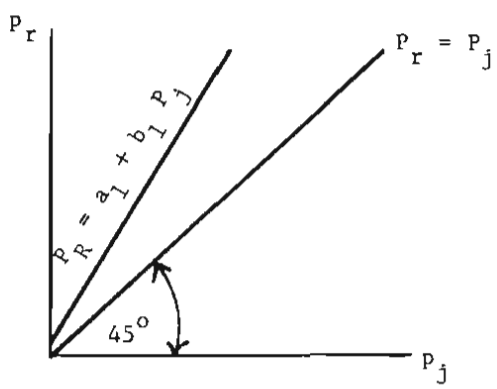

FIGURE 6. Fixed percentage markup.

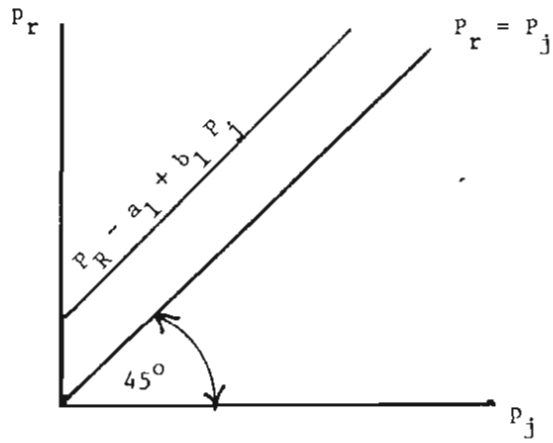

FIGURE 7. Constant absolute markup.

PROCEDURE

A descriptive approach was chosen because after a study of official sources to determine available information on apples, it became evident that, for the most part, the reported price data are not associated with the reported quantity data in any of the presently published series[8].

McIntosh and Red Delicious were the two apple varieties chosen for the study, because these two varieties account for more than 70 percent of Connecticut's total apple production[9].

The package chosen for the study was 12-3's, since it is one of the most commonly used types of packages today[10].

The statistical data consisted of a total of 238 observations, compiled from the Connecticut's Consumer Report, the Connecticut's Special Apple Market Report, and the New York Apple Report[11]. Although New York farm prices may be used to approximate Connecticut's, a problem of measurement of quality arose as New York reports prices for U.S. Fancy apples, and Connecticut reports prices for U.S. No. 1 or better. This problem was assumed away by using the lower limit of the range of prices reported for U.S. Fancy; and the upper limit of the range of prices reported for U.S. No. 1.

The least squares method was used to estimate the hypothesized retail and wholesale price functions.

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[8] D. G. Stitts, et.al., Information for Connecticut Apple Producers, Cooperative Extension Service, College of Agriculture and Natural Resources, The University of Connecticut, 1971.

[9] J. K. Ketcham, Apple Report, United States Department of Agriculture, January 27, 1972.

[10] Stitts, op.cit., p. 3.

[11] Since Connecticut does not publish f.o.b. farm and storage prices, Mr. Robert Goldman, Chief, Marketing Division, Connecticut Department of Agriculture and Natural Resources, suggested using New York prices.

RESULTS

The estimated retail and wholesale price functions for McIntosh and Red Delicious apples can be expressed as:

$$\overline{P}_{RM} = a_1 + b_1 P_{jm}$$

$$\overline{P}_{WM} = a_2 + b_2 P_{jm}$$

$$\overline{P}_{RD} = a_1 + b_1 P_{jd}$$

$$\overline{P}_{WD} = a_2 + b_2 P_{jd}$$

where

$\overline{P}_{RM}$ = estimated retail price of McIntosh

$\overline{P}_{WM}$ = estimated wholesale price of McIntosh

$\overline{P}_{RD}$ = estimated retail price of Red Delicious

$\overline{P}_{WD}$ = estimated wholesale price of Red Delicious

$\overline{P}_{jm}$ = farm price of McIntosh

$\overline{P}_{jd}$ = farm price of Red Delicious

Using the least squares technique to fit a curve on the date, the following estimated equations were obtained[12].

$$\overline{P}_{RM} = 4.380 + \underset{(8.767)}{1.160} P_{jm} \qquad : R^2 = .64$$

$$\overline{P}_{WM} = 2.097 + \underset{(8.397)}{0.793} P_{jm} \qquad : R^2 = .75$$

$$\overline{P}_{RD} = 5.757 + \underset{(5.620)}{1.068} P_{jd} \qquad : R^2 = .61$$

$$\overline{P}_{WD} = 2.059 + \underset{(3.922)}{0.820} P_{jm} \qquad : R^2 = .63$$

All the estimators of the B's proved significant at the 5% level, on a one-tail test; we can, therefore, conclude that the B's are greater than 0. Also all the regressions proved to be highly significant. These results are summarized in Table III in the Appendix.

The estimated price equations explained from 61 to 75 percent of the total variation. Unexplained variation could be the result of shifts in the demand curve, which in the model had been assumed constant or possibly the result of the measurement problem discussed before.

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[12] See Tables I and II in the Appendix for data and summary of results. Due to the recent changes; described in The Goodfruit Grower (footnote 3); which are taking place in the marketing of Washington Red Delicious apples, and which have rendered unstable prices, only the 69-70 crop year was used to estimate the Red Delicious equations.

Substituting the estimated equations on the marketing margins models (equations 6, 7, and 8), we obtained the following estimated margins:

McIntosh estimated total margin =

$$\bar{M}_{TM} = a_1 + (b_1 - 1) \; P_{jm}$$
$$= 4.380 + (1.16 - 1) \; P_{jm}$$
$$= 4.380 + 0.160 \; P_{jm}$$

McIntosh estimated wholesale margin =

$$\bar{M}_{WM} = a_2 + (b_2 - 1) \; P_{jm}$$
$$= 2.097 + (0.793-1) \; P_{jm}$$
$$= 2.097 - 0.207 \; P_{jm}$$

McIntosh estimated retail margin =

$$\bar{M}_{RM} = (a_1 - a_2) + (b_1 - b_2) \; P_{jm}$$
$$= 4.380 - 2.097 + (1.160 - .793) \; P_{jm}$$
$$= 2.283 + 0.367 \; P_{jm}$$

Red Delicious estimated total margin =

$$\bar{M}_{TD} = a_1 + (b_1 - 1) \; P_{jd}$$
$$= 5.757 + (1.068 - 1) \; P_{jd}$$
$$= 5.757 + 0.068 \; P_{jd}$$

Red Delicious estimated wholesale margin =

$$\bar{M}_{WD} = a_2 + (b_2 - 1) \; P_{jd}$$
$$= 2.059 + (0.820 - 1) \; P_{jd}$$
$$= 2.059 - 0.180 \; P_{jd}$$

Red Delicious estimated retail margin =

$$\bar{M}_{RD} = (a_1 - a_2) + (b_1 - b_2) \; P_{jd}$$
$$= (5.757 - 2.059) + (1.068 - 0.820) \; P_{jd}$$
$$= 3.698 + 0.248 \; P_{jd}$$

SUMMARY

The results of the estimated equations indicated that the marketing margins for U.S. No. 1 McIntosh and U.S. No. 1 Red Delicious apples in the state of Connecticut vary depending upon the apple variety and the stage of the marketing margin being observed.

Wholesalers of U.S. No. 1 McIntosh apples tend to use a profit maximization markup to determine their margins. During the study period, crop years 1969/71, they used a base price of $2.10 for 12-3's minus 21% of the farm price. Thus, during periods of heavy production margins per unit increased.

Retailers for the same variety and size tended to use a combination of the absolute amount and the fixed percentage markup to determine their markup. They added $2128 to the wholesalers base price, $2.10, plus 37% of the farm price. Thus, during periods of heavy production retail margins per unit decreased.

The wholesalers and retailers of No. 1. Red Delicious apples, during the same period used the same strategy as their respective counterparts did in marketing No. 1 McIntosh apples. Wholesalers used a base of $2106 less 18% of the farm price. Retailers added $3.70 to wholesalers base price $2.06 and then added 25% of the farm price.

DISCUSSION OF THE STUDY

In Connecticut wholesalers tend to use the profit maximizing markup, while retailers tend to use a combination of the constant absolute amount and the fixed percentage markups. The nature of these relationships is shown in Figure 8: where, if the quantity sold by the growers is OM, the farm price would be P, the wholesale price P', and the retail price P''; the wholesale per unit margin would be PP' or $2.10 minus 21: of the farm price, and the retail per unit would be margin P'P'' or $2.28 plus 37% of the farm price[13]. Given these types of markups, as supply increases, per unit wholesale markup increases, while per unit retail markup decreases. Therefore, in a period of over-production, growers may find it profitable to bypass the wholesaler, depending on how much it would cost him to do this. Using the estimated margin equations and his own estimate of increase in cost, the grower may determine the profitability of such action.

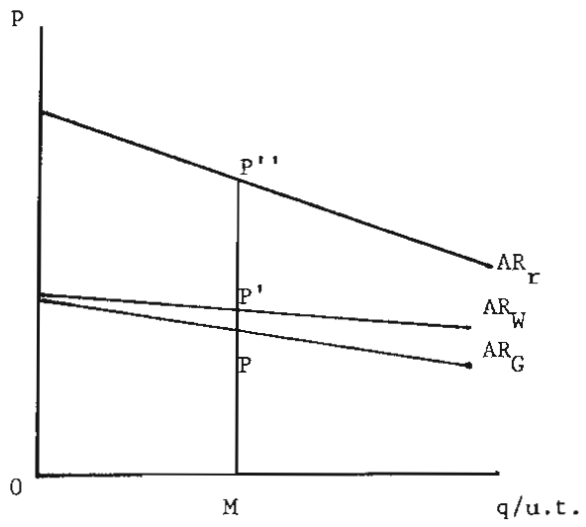

FIGURE 8. Existing price relationships in Connecticut for U.S. No. 1 McIntosh apples, sold in 12-3's.

For U.S. No. 1 Red Delicious apples, sold in 12-3's, Connecticut's wholesalers also tend to use the profit maximizing markup, and retailers tend to use a combination of the constant absolute amount and the fixed percentage markups. This also implies that as supply increases, per unit wholesale markup increases, while per unit retail markup decreases. The nature of these relationships would be similar to those shown in Figure 8; but in the case of Red Delicious, the wholesale per unit margin, P P' would represent $2.06 minus 18% of the farm price; and the retail per unit margin P' P'', would represent $3.70 plus 25% of the farm price. These relationships lead us again to the conclusion that, in a period of over-production, growers may find it profitable to eliminate the wholesaler. Thus, the grower, using the estimated margin equations and his own estimate of increase in costs, may determine the profitability of such action.

The total cost of getting a 12'3's container of U.S. No. 1 McIntosh apples to the consumer is $4.38 plus 16 percent of the farm price. For Red Delicious this cost is $5.76 plus 7% of the farm price. If the grower were to sell these apples directly to the consumer, his profits would increase by the above amounts minus selling costs; provided the consumer would buy as willingly from him as from the retailer.

In any decision the grower should also consider its long-run effects. It may be profitable to eliminate a channel this season, but, due to changes in supply, it may not be profitable next season. Also shifts in consumer demand may render a decision, which is profitable today, unprofitable tomorrow. One final consideration is that the bargaining power of the large retail chains, may be counteracted by the relatively large wholesalers; if the wholesalers were eliminated, growers may find themselves at the mercy of the decisions of the retailers; therefore, in any decision, the grower should also keep in mind, the power structure of the physical distribution system.

Appendix Table I: Data Used

Crop Year	Farm Price*		Retail Price**		Wholesale Price***		Crop Year	Farm Price*		Retail Price**		Wholesale Price***	
	MC's	R.D.	MC's	R.D.	MC's	R.D.		MC's	R.D.	MC's	R.D.	MC's	R.D.
1969-1970	1.75	2.65	7.08	8.28	3.50	4.50	1970-1971	1.85	2.50	5.88	7.08		
	1.85	2.75	5.88	9.00	3.75	4.25		1.85	2.50	5.88	8.28	3.75	4.50
	1.85	2.75	6.60	9.00				1.75	2.65	5.88	8.28	3.50	4.50
	1.85	2.75	6.60	9.00	3.75	4.50		1.85	2.75	7.08	7.08	3.50	4.50
	1.75	2.75	5.88	9.00	3.50	4.50		1.85	2.75	7.08	9.48		
	1.85	2.75	7.08	9.00	3.50	4.50		1.75	2.75	7.08	9.48	3.50	4.50
	2.00	3.00	5.88	8.28				1.75	2.75	7.08	9.48	3.50	4.50
	2.00	3.00	5.88	8.28	3.25	4.00		1.85	2.75	5.88	9.48	3.50	4.50
	2.50	3.25	7.08	9.48				1.85	2.50	6.60	9.48	3.50	4.50
	2.50	3.25	7.08	9.48	3.25	4.00		1.75	2.75	6.60	9.48	3.50	4.50
	2.60	4.00	7.80	9.48				2.00	3.50	6.60	9.48		
	2.75	4.25	7.80	9.48	4.25	5.75		2.25	3.25	7.08	8.28	3.50	4.50
	2.65	4.00	8.28	9.48				2.25	3.50	7.08	8.28	3.50	4.50
	2.75	4.00	8.28	9.48	4.25	5.50		2.25	3.25	7.08	8.28		
	2.85	4.25	8.28	9.48	4.00	5.00		2.25	3.25	7.08	8.28	3.50	4.50
	2.75	4.00	7.08	9.48	4.50	6.00		2.50	3.75	7.08	9.48	4.25	5.00
	2.85	4.00	7.80	10.68				2.50	3.85	8.28	9.48		
	2.90	4.25	7.80	10.68				2.50	3.75	7.08	8.28	4.25	4.50
	3.00	4.25	8.28	10.68				2.50	3.75	7.08	8.28	4.50	4.50
	3.15	4.00	8.28	10.68				3.00	3.90	7.08	8.28	4.25	4.75
	3.25	4.50	8.28	10.68				2.50	3.90	7.08	8.28		
	3.50	4.50	8.28	11.88				2.50	4.00	7.08	8.28	4.25	4.75
	3.50	4.75	8.28					2.50	4.00				
	3.75	5.00	8.28					3.00	4.00				

*Source: New York Department of Agriculture and Markets, Apple Report, Albany, November 1969-April 1972.

**Source: Connecticut Department of Agriculture and Natural Resources, Consumer Report, Hartford, November 1969-April 1972.

***Source: Connecticut Department of Agriculture and Natural Resources, Special Apple Market Report, Hartford, November 1969-April 1972.

Appendix Table II: Summary of Calculations

	$\overline{P}_{RM}$	$\overline{P}_{WM}$	$\overline{P}_{RD}$	$\overline{P}_{WD}$		$\overline{P}_{RM}$	$\overline{P}_{WM}$	$\overline{P}_{RD}$	$\overline{P}_{WD}$
N	46.00	26.00	22.00	11.00	S^2	0.24	0.04	0.35	0.19
ΣX	109.50	55.15	78.90	36.40	S	0.49	0.20	0.59	0.44
ΣY	329.56	98.25	210.96	52.50	F	76.85	70.51	31.58	15.38
ΣX^2	274.34	121.63	292.71	124.96	n_1	1.00	1.00	1.00	1.00
ΣXY	797.99	212.09	766.99	177.43	n_2	44.00	24.00	20.00	9.00
ΣY^2	2375.74	375.19	2041.08	255.38	B_1	1.160	0.793	1.068	0.820
$\overline{X}$	2.38	2.12	3.59	3.31	S_{B_1}	0.132	0.094	0.190	0.209
$\overline{Y}$	7.14	3.78	9.59	4.77	t	8.767	8.397	5.757	3.921
R	0.79	0.86	0.78	0.79	B_0	4.380	2.097	5.757	2.059
R^2	0.64	0.75	0.61	0.63					

Appendix Table III: Testing the Significance of Estimated Equations

Estimated equation	Estimated t	Tabular $t^{a/}$	Estimated F
$\overline{P}_{RM}$	8.767	1.684	76.85**
$\overline{P}_{WM}$	8.397	1.711	70.51**
$\overline{P}_{RD}$	5.620	1.725	31.58**
$\overline{P}_{WD}$	3.921	1.833	15.38**

a/ At 5% level of significance on one-tail test.
** significant at both the 5% and 1% level of significance.

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