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Marketing cooperatives that operate on a pool basis allocate net returns on the basis of the "economic value" of the raw products each member has delivered. Economic values ideally reflect the raw products' expected contributions to pool net return. In a competitive market, raw product prices would reflect these expected returns quite well.

In the absence of such a competitive market, one must formulate expectations models of returns to each product, which requires identifying the separate returns. The purpose of this thesis is to describe and employ a method of distinguishing expected return to each raw product when raw products are commingled on the assembly line. The approach taken is to conduct a hedonic analysis of processed product net returns as a function of raw product ingredients.

Determining Member Contributions to Marketing Cooperative Returns When Raw Products are Commingled Before Sale

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDIX TABLES

DETERMINING MEMBER CONTRIBUTIONS TO MARKETING COOPERATIVE RETURNS WHEN RAW PRODUCTS ARE COMMINGLED BEFORE SALE

I INTRODUCTION

Vegetable marketing cooperatives frequently make payments to their members through pools. Several vegetable types often are represented in a single pool, in which case pool returns are divided among members in relation to the amount and type of vegetables delivered to the pool. An important issue in cooperatives is how to divide the pool return among members or vegetable types. One criterion which is in wide use and which seems fair to many is to allocate returns according to the expected return or profitability of the delivered raw products. In a competitive market, raw product market prices would reflect this expected profitability. Today, however, local markets for processing vegetables often do not exist. Thus, one has to look to the processed product market, which often is more competitive, to determine the profitability of inputs such as member-delivered raw vegetables. This clearly is feasible as long as each vegetable is handled and sold separately. But when vegetables are commingled on the assembly line and sold in blends, it is not a straightforward task. Return to each processed product must be divided among the vegetables in the blend. In the present thesis, this allocation will be accomplished using hedonic analysis, permitting us to identify the return to each vegetable as the expected contribution of that vegetable to the total return of the vegetable blend.

The following chapter includes a short literature review about hedonic analysis and a brief explanation of the use of economic values in a pooling-type cooperative. The third or conceptual chapter provides the general theory of hedonic functions and uses the theory to formulate testable hypotheses about net returns. Chapter four discusses model specification, including alternative functional forms and the method of calculating economic values from statistical results. It also describes variables and parameters employed in the final estimating equation and shows in more detail how economic values are calculated from the statistical results. Results are reported and discussed in chapter five and general conclusions are given in chapter six.

II REVIEW OF LITERATURE

Hedonic Functions

The hedonic technique is used to estimate the effect on price of changes in the characteristics or qualities of nonhomogeneous goods. This is accomplished by regressing prices of closely related products on the characteristics themselves. The price differentials caused by marginal changes in the characteristics are called the characteristics' implicit prices. Such hedonic price functions are of the general form;

$$p_i = p(x_{i1}, .., x_{in}) \quad (1)$$

where p_i is observed price and x_{ij} is the amount of characteristic j in good i.

Justifications for the existence of hedonic functions vary. Griliches (1971) points out that the existence of hedonic functions is based on empirical rather than theoretical questions. Further, there is no *a priori* reason for expecting price and quality to be related in any particular fixed fashion. Some of the early works, and especially those which estimate hedonic functions for the purpose of constructing quality-corrected price-indices, fall into this group (Waugh, 1928; Griliches; Adelman and Griliches, 1961).

Most of the recent research on hedonic functions refers to why and how prices should be treated as functions of the goods' characteristics. These theories can be divided into three groups. In the first group is the work of Houthakker (1952). He assumes the price of a commodity can be expressed as:

$$p_i = a_i + b_i v_i \tag{2}$$

where a_i and b_i are constants reflecting "quantity price" and "quality price", respectively, and v_i is the quality of good i, ($b_i > 0$ and $a_i + b_i v_i > 0$ for all v_i). Consumers maximize utility, which depends upon both the quantity q_i and quality of goods, subject to the income constraint I:

$$\Sigma\, q_i(a_i + b_i v_i) = I. \tag{3}$$

Houthakker looks at changes which occur to the consumer's utility as income and/or prices change. Finally, he suggests introducing more variables to specify a variety of commodities. But he limits his theory to situations where only one variety can be bought.

In group two, one can find the works of Gorman (1980), Lancaster (1966, 1971) and Ladd and Suvannunt (1976). The consumer's utility maximization problem is treated quite similarly in these works. First, utility U depends on the total amount x_j of each characteristic j, not directly on the quantity of goods consumed. Thus:

$$U = U(x_1,..,x_n) \tag{4}$$

where n is the number of characteristics. Maximization is performed subject to an income constraint I:

$$\Sigma_i p_i q_i = I \tag{5}$$

where p_i is the price paid for good i and q_i is the quantity bought of good i. The consumer can vary the quantities of goods bought but not the amount of each characteristic in each good. Total consumption of each characteristic can be expressed as a function of quantities of products consumed and of the amount of characteristic j in each good:

$$x_{0j} = f_j(q_1,..,q_m,x_{ij},..,x_{mj}). \tag{6}$$

Lancaster and Gorman specify an additive relationship between the total amount of characteristics and the amount of characteristics in each good:

$$x_{0j} = \Sigma_i x_{ij} q_i \tag{7}$$

so that $\partial x_{0j}/\partial q_i = x_{ij}$. Ladd and Suvannunt instead optimize (4) subject to (5) and (6) by forming a Lagrangian and solving for the first order conditions assuming the characteristics are measured on a continuous scale. The result is

$$p_i = \Sigma_j(\partial x_j/\partial q_i)[(\partial U/\partial x_j)/(\partial U/\partial I)] \tag{8}$$

where $\partial x_j/\partial q_i$ is the reciprocal of the marginal effect x_{ij} of the jth product characteristic on ith product volume. The bracketed term in (8) can be interpreted as the rate of substitution between characteristic j and income or expenditure. This is the marginal implicit price paid for the jth characteristic, and as long this is a constant, it can be denoted β_j. The relationship between product price and characteristics can thus be written:

$$p_i = \Sigma_j x_{ij} \beta_j \qquad (9)$$

In the case where the characteristics are discrete variables (e.g. Lancaster), this same relationship can be found by deriving the dual of the problem, as in Ladd and Suvannunt. Lancaster takes the approach of a cost minimizing problem, the dual of which also gives relationship (9) as shown by Lucas (1975).

One advantage of Ladd and Suvannunt's approach is that it allows for negative implicit prices, which are ruled out in the Lancasterian model. If the marginal utility of characteristics in a good are assumed constant, Ladd and Suvannunt suggest using a linear form of the hedonic function as in (9) above. If instead marginal utility of a characteristic is not believed to be constant, they suggest using a quadratic form. But the latter will not be consistent with their equation (8), which specifies product price as the sum of the products of characteristics marginal yields and their marginal implicit prices.

Muellbauer (1974) shows that a semilog form of the price-characteristic relationship is not possible in the household production framework, i.e in the Lancasterian approach. Lancaster, Gorman, and Ladd and Suvannunt see hedonic functions as a way of soliciting information about the demand for characteristics and they deliberately avoid considering the supply side of the problem.

The third theory direction is represented by Rosen (1974), whose work can be viewed as an extension of Houthakker's. Rosen limits his model to apply only when one unit of a brand, with given characteristics, can be purchased. His model assumes competitive equilibrium. Rosen claims that estimated hedonic functions typically identify neither demand nor supply; they are envelope functions of consumers' bid functions and producers' offer functions. Bid functions reveal consumers' preferences, being indifference curves showing price-characteristic combinations for which a consumer's utility is constant. Offer functions instead reveal the cost structure of individual firms, being indifference curves showing price-characteristic combinations for which a firm's profit is constant. Hedonic functions represent the price-characteristic combinations necessary in order for consumers and producers to agree on a particular product price.

There are two extreme situations in the Rosen framework. If all consumers have similar preferences, their bid functions are identical to each other. The hedonic function will then be estimated from the points where firms' offer functions are tangent to this unique bid function. Therefore, the hedonic function will be the same as the unique bid function and will identify the structure of the demand for characteristics. If, on the other hand, all firms have the same cost structure while consumers' preferences vary, the hedonic function will be estimated from points where consumers' various bid functions are tangent to the unique offer function. In this latter case, the hedonic function will be the offer function.

In most cases the situation is between these two extremes. The hedonic function, which is then a joint envelope function, will not identify consumers' preference structures or firms' cost structures. Rosen suggests, however, how to estimate bid and offer functions simultaneously after first obtaining the hedonic function. More recent studies, for example Epple (1987) who considers Rosen's approach, shows that only under special conditions is identification and estimation of these simultaneous models feasible. On the choice of functional form of the hedonic price function, Rosen comments that linearity is unlikely as long as there is increasing marginal cost of characteristics for sellers and as long as it is not possible to "untie packages" of characteristics. Thus, he suggests using the functional form which gives the best fit when estimating (1).

Economic Value

Most marketing cooperatives operate one or more pools. In each pool, payment to a particular raw product group is distributed from the pool's total net return. Payment G_jQ_j to the jth raw product is expressed as:

$$G_jQ_j = (P_jQ_j/\Sigma_j P_jQ_j)\ NR \qquad (10)$$

where Q_j is the quantity of raw product j, P_j is the "economic value" per unit of raw product j, and NR is net return in the pool. Each vegetable type delivered into a pool is assigned an economic value. Economic values, along with quantities Q_j, determine how total net return is distributed among raw products. It is only the relative size of the economic values, not the actual values assigned, which are important for the impact of economic values on payment to each raw product. Return per unit of raw product G_j is found by dividing both sides of (10) by quantity Q_j of the jth raw product:

$$G_j = (P_j/\Sigma_j P_jQ_j)\ NR. \qquad (11)$$

Cooperatives typically can, at least *ex post*, come up with good estimates for total net return and quantity of each raw product delivered to the pool. The problem is to derive good economic values P_j, that is, those which provide an efficient or equitable distribution of total net return. Cooperatives have various ways of assigning economic value weights P_j. They may use market prices, quality indices, or an equal weighting of raw products. All of these methods essentially are based on a forecasted return of the respective raw product (Buccola and Cornelius, 1989). One of the reasons for operating a pool is to reduce risk for the individual raw product producer; but in the long run, no raw product is meant to be subsidized by any other raw product in the pool (Buccola, Cornelius and Meyersick, 1989).

In order to eliminate such subsidies, it is often sufficient to base economic values on the expected return of the respective raw product:

$$P_j = E(R_j) \tag{12}$$

In an efficient market, prices for raw products are good forecasts of this expected return. Today, however, processing firms in many localities are becoming fewer, and often an efficient local market for vegetables does not exist (Buccola and Cornelius). Therefore, a proxy for expected return must be estimated in some other way. If raw products are processed and sold separately, returns to each raw product can easily be measured and, with suitable additional information, a forecast model for each raw product's net return can be developed. However, one of the reasons mentioned for operating a pool is that raw products frequently are commingled on the assembly line. When products are physically commingled, it is difficult to distinguish one raw product's sales revenue or processing cost from another. For these products, developing a patronage-weighted procedure along the lines of (10) requires a method for distinguishing one raw product's profitability contribution from another. In the remainder of this thesis, such a method --employing hedonic analysis-- is discussed.

III CONCEPTUAL FRAMEWORK

General Theory

The method essentially is to employ the hedonic technique to determine the relative values of raw products used in final products. Before this technique can be used, the following conditions must be satisfied: 1) the end products must be characterized as a group of nonhomogeneous goods, 2) the raw products must be viewed as characteristics of the end products, and 3) the amount of raw product (characteristic) in different end products must vary. In the present application, end products are various combinations of mixed vegetables. Return R_i from the ith end product is used as the dependent variable. A hedonic function relating end product return R_i of each unit of end product to the characteristics of the ith end product can be estimated as:

$$R_i = R(x_{i1},..,x_{in},k_{i1},...,k_{is}) \qquad i=1,2,..,m \qquad (13)$$

where x_{ij} (j=1,...,n) is the fraction of end product i consisting of vegetable j, and k_{it} (t=1,...s) is one of the other s characteristics which affect return to the ith product, such as size of container and container type.

Taking the first derivative of this equation with respect to fraction x_{ij} gives the marginal return to the jth raw vegetable, that is, the implicit value of a unit increase in fractional share of that vegetable. Multiplying both sides of (13) by Q_i, the quantity of end product i sold, gives the total net revenue from selling end product i:

$$R_iQ_i = R(x_{i1},..,x_{in},k_{i1},...,k_{is})Q_i. \tag{14}$$

Note that x_{ij} is specified as $x_{ij} = q_{ij}/Q_i$, where Q_i is total shipment or sale quantity of i and q_{ij} is the total amount of shipment i consisting of raw product j. If (13) is linearly homogeneous in the x_{ij}'s, then multiplying (13) by Q_i gives:

$$R_iQ_i = R(x_{i1},..,x_{in},k_{i1},...,k_{is})Q_i = R(x_{i1}Q_i,..,x_{in}Q_i,k_{i1},...,k_{is}).$$

Thus (14) can be expressed as:

$$R_iQ_i = R(q_{i1},..,q_{in},k_{i1},...,k_{is}). \tag{14'}$$

Hence the marginal implicit return R_{ij} to the jth raw product in end product i is

$$R_{ij} = \partial R_iQ_i/\partial q_{ij} = \partial R(q_{i1},..,q_{in},k_{i1},...,k_{is})/\partial q_{ij}. \tag{15}$$

If the cooperative is to completely distribute it's total profit $\Sigma_i R_iQ_i$ to member-producers, we require that the sum of the implicit returns to each unit of raw product equal total net return. Implicit return to all the jth raw product used in end product i is, from (15), $(\partial R_iQ_i/\partial q_{ij})q_{ij}$.

Hence the sum of this total over the n member-produced raw products should yield total return to the ith end product:

$$\Sigma_j(\partial R_iQ_i/\partial q_{ij})q_{ij} = R_iQ_i \tag{16}$$

Summing again over the m end products gives total pool return:

$$\Sigma_i\Sigma_j(\partial R_iQ_i/\partial q_{ij})q_{ij} = \Sigma_iR_iQ_i \tag{17}$$

where $\partial R_iQ_i/\partial q_{ij} = R_{ij}$ is the marginal implicit or prescribed economic value of the jth raw product in the ith end use.

It is interesting that dividing both sides of (16) by Q_i gives:

$$\Sigma_j(\partial R_iQ_i/\partial q_{ij})q_{ij}/Q_i = R_i$$

which says that unit return to the ith end product is the sum of the raw products' marginal contributions to the ith end product's net return weighted by these raw products' fractional shares in the ith end product. In Ladd and Suvannunt's terminology, our R_iQ_i is expenditure term E and our q_{ij}/Q_i is $x_{0j}/q_i = \partial x_{0j}/\partial q_i$. Substituting these expressions gives Ladd and Suvannunt's equation (8). This implies that analysis of pool net return calculations is formally equivalent to the analysis of consumer goods prices in terms of the goods' characteristics.[1]

Restriction (16) and (17) -- that pool returns be completely distributed to members -- will not hold unless (13) is linearly homogeneous in the x_{ij}'s (or equivalently (14') is linearly homogeneous in the q_{ij}'s). Linear homogeneity should not extend to the factors k_{it}, which represent nonmember-produced end product characteristics such as label and packaging type. Extending linear homogeneity to factors k_{it} would ensure, contrary to cooperative principles, that part of pool net return be paid to nonmember factors of production. Linear homogeneity in member-produced raw product contributions x_{ij} can be satisfied by using a linear or a Cobb Douglas specification in the x_{ij}'s.

Define the implicit return R_j to a unit of the jth raw product as:

$$R_j = \Sigma_i(\partial R_i Q_i/\partial q_{ij}) q_{ij}/q_j = \Sigma_i R_{ij}(q_{ij}/q_j) \tag{18}$$

where $q_j = \Sigma_i q_{ij}$ is the total amount of raw product j provided by members. Expression (18) says j's implicit

[1]Weil (1968) shows that in equilibrium, total costs of production always sum up to total revenues. He suggests using this restriction when costs are allocated among inputs. Following neoclassical theory of production, the optimal output level for a profit maximizing firm is when the marginal costs of employing an input equals the marginal revenues it contributes. Viewing characteristics as separate inputs, the same principle also holds for these. Thus this approach could be adopted to any profit maximizing firm with similar costs allocation problems as those we studied.

return per unit is the sum of its marginal net return contribution to each end product weighted by the proportion of j used in each end product. Multiplying (18) by q_j gives total implicit net return contribution of all the jth raw product provided:

$$R_j q_j = \Sigma_i R_{ij} q_{ij} \tag{19}$$

Summing (19) over all n raw products gives total raw product contribution to net return:

$$\Sigma_j R_j q_j = \Sigma_i \Sigma_j R_{ij} q_{ij} \tag{20}$$

Since, from (17), the right side of (20) equals $\Sigma_i R_i Q_i$, we have:

$$\Sigma_i R_i Q_i = \Sigma_j R_j q_j \tag{21}$$

The requirement of equation (17) is confirmed that total end product return equal the total implicit net return contribution of all raw products.

Expressing (17) in the form of (21) is useful because the concept of an end-product-weighted implicit return R_j permits us to apply principle (12) directly. In order to eliminate pool subsidies, that is, each unit of raw product should be given an economic value P_j equal to the expectation of its implicit return R_j. When products are commingled, the econometric task is first to estimate the hedonic function (13) or (14) using historical data.

Implicit returns R_j then are derived from (14) analytically.

However, to do this we need to suppose that there is some continuity in end product composition. If a separate end product were defined for every discrete combination of raw products, derivatives in (18) could not be computed because marginal changes ∂q_{ij} would not be possible. Assuming complete continuity among blended products permits us to drop the i subscript in (14'), giving regression surface:

$$RQ = R(q_1,\ldots,q_n,k_i,\ldots,k_s) \qquad (22)$$

The differential of (22) with respect to the jth raw good applies to a given level of non-raw-product factors. Thus, the jth product's implicit pool contribution R_j, as a mean across all non-raw-product characteristics k_t, is found by computing the expectation across such characteristics of the derivative of (22) with respect to q_{ij}:

$$R_j = E[\partial RQ/\partial q_j(k_1,\ldots k_s)] \qquad (23)$$

A forecast of this return, $E(R_j)$, can be derived by utilizing suitable forecasts of end product net return RQ.

Hypotheses

Vegetables Sold in Blended Versus Pure Form

The main objective in the following is to develop and test a new method of estimating implicit values of member-delivered vegetables in a cooperative where these inputs are commingled on the assembly line. Lately, vegetable mixes and blends have made up an increasing share of processed vegetables sold. Therefore it is of interest to investigate possible differences in returns to pure and blended products. Return in (22) is explained by two types of variables and thus also by two sets of coefficients. Each β_j coefficient gives the effect of a member-produced raw product j holding other variables constant. Each α_t coefficient, on the other hand, shows the effect of changing non-raw-product or nonmember-produced factor k_t holding all other variables constant. To see whether a member-produced vegetable will affect return differently if it is used in a pure rather than in a blended product, one can compare the β coefficients between the equation estimating returns to blended products with the one estimating returns to pure products:

H_0: β_j (pure) = β_j (blend), for each or all j.

A second potential source of difference between the returns from blended and pure products is a possible unequal effect of nonmember-produced characteristics in the two equations. This will be tested by comparing the estimated coefficients α_t in the blended product equation with those in the pure product equation:

H_0: α_t (pure) = α_t (blend), for each or all t.

It should be kept in mind that imputed value R_j of the jth raw product is conditional on k_t variable levels themselves as well as on the β_j, α_t parameters. Thus, it is not enough to show that the β_j and α_t coefficients are similar in the blended and pure product equations in order to conclude that the imputed value of a vegetable used in a pure product is the same as that in a blend. If the mean sizes of k_t variables differ between pure and blended products, imputed values R_j might differ even if the equations' β_j and α_t parameters are the same.

Choice of Return Estimate

Unfortunately, there is no "right" way to divide some non-raw-product costs among raw products. Unsegregable or fixed costs are somewhat subjectively allocated and the method of their division may influence vegetable profitability estimates. We therefore measure net return in two alternative ways. In return R2, administrative and finance costs and factory burden are not deducted from net returns. In return R1, these two types of costs are subjectively allocated and deducted from net return. R2 is always higher than R1. Failing to deduct administrative finance costs and factory burden from return essentially implies these costs are divided in proportion to return. It was indicated previously that the current fixed cost distribution across products depends on the products' expected returns. Comparing the coefficients from R1 and R2 equations allow us to check this conjecture.

Since explanatory variable specification is the same in each equation, at least some coefficients of the equations in which R2 is the dependent variable will differ from those in which R1 is the dependent variable. To compare such results, one must scale down R2 by the constant E(R1/R2)=a. Using dependent variable (R2)(a) instead of R2 will provide coefficients which are comparable to those estimated in the equation for R1. This will allow us to compare coefficients in order to determine whether the two alternative equations would generate different implicit values.

H_o: Estimates of implicit values derived when (R2)(a) is the dependent variable will provide the same relative implicit values as when R1 is the dependent variable.

This will be tested by determining whether β_j(R1) is within 1.96 σ_j-limits of βj[(R2)(a)] and whether α_t(R1) is within 1.96 σ_t-limits of α_t[(R2)(a)]. 1.96 is the T-value at five percent level when sample size is large, σ_j and σ_t are the standard errors of the estimated coefficients β_j(R1) and α_t(R1). The converse relationship also will be investigated, that is whether β_j[(R2)(a)] is within 1.96 σ_j-limits of β_j(R1) and whether α_t[(R2)(a)] is within 1.96 σ_t-limits of α_t(R1), where σ_j and σ_t are standard errors from equation [(R2)(a)].

Prescribed Versus Actual Economic Values

Estimating implicit values in the manner described above employs only one objective: Pay each raw product an amount proportional to what it has contributed in net revenue. It is of interest to compare the economic values the cooperative presently uses with those that will be estimated in the above manner. Other objectives, such as equalizing per-acre payments to each member or promoting a varied and complete end product line, might influence today's payment system. Possible reasons for differences in the economic values observed in practice and those prescribed could be divided into two groups: those which are unexpected and those which are expected given the cooperative's diverse objectives.

H_0: Allocation of the cooperative's income among raw products is the same using the prescribed approach as it is using the current approach.

This will not be tested statistically. However, return allocations using the prescribed approach will be compared with those the cooperative uses today.

IV MODEL SPECIFICATION

Choice of Model and Estimation

To estimate equation (13) or (14'), a functional form must be specified. The choice is between a linear form or a Cobb-Douglas form; these are the only linearly homogeneous relationships between returns and member-produced raw product quantities. Use of a linear form does not allow investigating changes in per-unit implicit values caused by proportionate changes in raw product combinations. But using a Cobb-Douglas form would restrict us to estimating (13) or (14') only for subsets of the cooperative's products. No end product contains every form of raw product, so some x_{ij} variables always will be zero. Cobb-Douglas forms can only be used after zero-level x_{ij} variables have been eliminated. The linear form, in contrast, allows estimation of implicit values combining all available information together. It provides statistical averages of implicit values over the whole sample, which reasonably may be used to determine payments to members.

Functional form may be linear only in member-produced raw products. In order to preserve linear homogeneity in the raw products, the total effect of other characteristics, K, must enter the equation multiplicatively. There are two major forms of K from which to choose. One is

$K = \alpha_1 k_1 + \alpha_2 k_2 + \ldots + \alpha_s k_s$, where k_t is a nonmember-produced raw product characteristic and α_t is a parameter. Using this expression implies no interaction between the k_t characteristics, although interaction between member-produced raw products x_j and the weighted sum K of the k_t's still would be permitted. On the other hand, a form such as $K = k_1^{\alpha_1} k_2^{\alpha_2} \ldots k_s^{\alpha_s}$ assumes interaction between all the k_t characteristics as well as between each k_t and each x_{ij}. The latter form of K is chosen in the present research. The model, then, can be expressed as:

$$R_i = k_{i1}^{\alpha_1} k_{i2}^{\alpha_2} \ldots k_{is}^{\alpha_s} (\Sigma_j \beta_j x_{ij}) \tag{24}$$

where x_{ij} is the fraction of j in a unit of output i and α_t (t=1,...,s) and β_j (j=1,...,n) are parameters.

Regression surface (24) represents the mean value of R encountered for different combinations of the k_{it}'s and x_{ij}'s. Dropping the i subscripts and multiplying (24) by end product quantity Q gives

$$RQ = k_1^{\alpha_1} k_2^{\alpha_2} \ldots k_s^{\alpha_s} (\Sigma_j \beta_j q_j). \tag{25}$$

Differentiating with respect to q_j gives the jth product's implicit or economic value:

$$R_j = \partial RQ/\partial q_j = k_1^{\alpha_1} k_2^{\alpha_2} \ldots k_s^{\alpha_s} \beta_j \tag{26}$$

for given combinations of non-raw-product characteristics $k_1, k_2, \ldots, k_s$. The condition that the sum of net return be completely allocated to members is satisfied because multiplying (26) by q_j and summing over j gives:

$$\Sigma_j R_j q_j = k_1^{\alpha_1} k_2^{\alpha_2} \ldots k_s^{\alpha_s} \; (\Sigma_j \beta_j q_j)$$

which equals (25).

It is clear from the above that economic values (26) can be derived by fitting either (24) or (25). Data supplied by a vegetable marketing coöperative, aggregates, in a given month, all end product sales with a given combination of raw products and other characteristics. Such aggregates represent varying quantities of output Q_i and fitting (24) would fail to reflect this. Each observation i instead should be weighted by the quantity Q_i associated with that observation. Otherwise, two observations i and i' with different sales volumes Q_i and Q_i' would have the same influence on the estimated regression surface. Multiplying (24) by Q_i, as in (25), before the function is estimated solves the weighting problem. In short, we estimate marginal contributions to total rather than to unit return, that is, equation (25).

Equation (25) is estimated using software package TSP4.1B[2], which employs the Gauss-Newton search algorithm. The Gauss-Newton algorithm is a least-squared-error

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[2] Documentation of TSP4.1B is found in TSP Reference Manual, Gauss Newton search algorithm is explained f.ex. in Judge et.al (1988).

procedure which finds coefficients giving the lowest sum of the squared error terms. Thus, if estimating (24) minimizes L where:

$$L = \Sigma_i e_i^2$$

then estimating (25) instead minimizes L':

$$L' = \Sigma_i (Q_i e_i)^2.$$

That is, (25) weights each observation in (24) by its volume importance Q_i.

Estimated Model and Prescribed Economic Values

Variables and Parameters

A number of the cooperative's raw products are processed and sold in pure as well as in blended form. For any pure product, $x_j=1$ since, apart from waste in processing, $q_j=Q_j$. Because the fraction x_j of raw product j in a blend is generally well below one, we do not assume continuity in raw products when comparing blends and pure products. Instead, we allow factors $(k_1,...,k_s)$ to affect blend returns differently from the way they affect pure products' returns.

Coefficients of the two independent functions (25) describing blends and pure products are here estimated simultaneously. This is done by introducing two dummy variables, D_p and D_b. D_p is zero when the ith product is a blended product and one if it is a pure product. D_p is zero for pure products and one for blended products. The estimated function is then

$$RQ = (K_b \Sigma_j \beta_{bj} q_j) D_b + (K_p \Sigma_j \beta_{pj} q_j) D_p \tag{27}$$

where b refers to blended product and p to pure product. K_b and K_p in (27) are the vectors of nonmember-produced characteristics described previously. β_{bj} and β_{pj} are parameters for blended and pure member-delivered raw products, respectively, allowing return to vary depending on the amount of raw product j used in the end product.

Raw products are divided into three groups: major, minor and purchased raw products. Major raw products are supplied to the cooperative mainly by members and together they make up a large part of the quantities of raw product handled by the cooperative. These products are

1. Green beans
2. Wax beans
3. Italian beans
4. Broccoli
5. Cauliflower
6. Zucchini
7. Yellow squash
8. Cut corn

9. Cob corn[3]

Minor raw products are both supplied by members and bought from other sources. In any event, they represent small volumes. They are here added together in one unweighted sum and included as a single x_j variable. In addition to the variables above, therefore we have the tenth variable:

10. Minor products

The minor products include carrots, peas, sugar-snap peas, peppers, and cooked squash. Finally, purchased raw products are obtained from nonmembers. Purchased raw products are not included among the x_j characteristics.

Five variables are included among nonmember-produced characteristics k_t. They are characteristics which are expected to affect a product's return. They include:

Purch: The fraction of output i consisting of vegetables from the purchased raw product group. This is the unweighted sum of the fractional shares occupied by: Garbanzo beans, mushrooms, onions, pearl onions, potatoes, and celery. For pure products, purch is always zero. Thus, purch is not an explanatory variable in the equation for pure products returns.

Size: Size of each container in ounces of capacity.

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[3]Corn cob is always a pure product, thus the equation estimating return to blended products does not contain x_9 (q_9) --cob corn-- as an explanatory variable.

Month: Indicated by successively numbering the month of sale from one to fourteen.

Label: Zero when the end product is sold under a private label, one if sold under a house label.

Pack: Zero when the end product is packed in a polyethylene bag, one if packed in a standard carton or microwavable carton.

Including the dummy variables in the form of the $k_t^{\alpha_t}$'s suggested in (24) would force expected return to be zero when one or more of the dummies are zero. To avoid this, each dummy may be included as an exponental term $e^{\alpha_t k_t}$, allowing k_t to be zero without forcing estimated return to be zero. In sum, K_{bi} and K_{pi} in equation (27) are defined as:

$$K_b = size^{\alpha_1} e^{\alpha_2 label} e^{\alpha_3 pack} month^{\alpha_4} e^{\alpha_5 purch}$$

and

$$K_p = size^{\alpha_1} e^{\alpha_2 label} e^{\alpha_3 pack} month^{\alpha_4}$$

Data Used

The data set includes approximately 600-700 observations per month for fourteen months, beginning in October 1987 and ending in November 1988. The sample used in estimating (27) had 8391 observations, of which 34% where observations of blended product sales and 66% where observations of pure product sales. Data were provided by one of Oregon's major marketing cooperatives for vegetables.

Calculating Prescribed Economic Values

Substituting K_b above into (27), we have, for blended products:

$$RQ_b = size^{\alpha_1} e^{\alpha_2 label} e^{\alpha_3 pack} month^{\alpha_4} e^{\alpha_5 purch} \Sigma_j \beta_{bj} q_j \quad (28)$$

The jth derivative of (28) is

$$R_{bj} = \partial RQ_b / \partial q_{bj} = size^{\alpha_1} e^{\alpha_2 label} e^{\alpha_5 pack} month^{\alpha_4} e^{\alpha_5 purch} \beta_b j \quad (29)$$

the implicit value, in a blend, of vegetable j for a given nonmember-produced factor k_t -- equivalent to (26). To remove the conditionality on the k_t variables, R_{bj} is computed as a mean across all nonmember-produced characteristics by calculating the expectation of (29) across such characteristics (as described in (23)):

$$E(R_{bj}) = E(size^{\alpha_1} e^{\alpha_2 label} e^{\alpha_3 pack} month^{\alpha_4} e^{\alpha_5 purch} \beta_j) \quad (30)$$

If the covariance between each pair of k_t variables were zero, (30) could be estimated as:

$$E(R_{bj}) = \beta_{bj} E(size^{\alpha_1}) E(e^{\alpha_2 label}) E(e^{\alpha_3 pack}) E(month^{\alpha_4}) E(e^{\alpha_5 purch})$$

Although the covariances in fact are small, (30) is calculated more exactly as:

$$E(R_{bj}) = \beta_j \Sigma_l (size^{\alpha_1} e^{\alpha_2 label} e^{\alpha_3 pack} month^{\alpha_4} e^{\alpha_5 purch} q_{lj}/q_b j) \quad (30')$$

where q_{bj} refers to total amount of j in blends and q_{lj} is quantity of j in output l.

Substituting K_p into (27), we have for pure products

$$RQ_p = size^{\alpha_1} e^{\alpha_2 label} e^{\alpha_3 pack} month^{\alpha_4} \Sigma_j \beta_{pj} q_j \quad (31)$$

where α_{pt} might differ from α_{bt} and β_{bj} might differ from β_{pj}. Differentiating (31) with respect to $q_{pj} = Q_{pj}$ gives marginal implicit return R_{pj} to the jth raw product in pure form at given levels of factor k_t:

$$R_{pj} = \partial RQ_p/\partial q_{pj} = size^{\alpha_1} e^{\alpha_2 label} e^{\alpha_3 pack} month^{\alpha_4} \beta_{pj} \quad (32)$$

Taking the expectation of (32) over all observations l, (where l refer to an observation with pure products), gives the jth product's mean implicit return contribution when sold in pure form:

$$E(R_{bj}) = \beta_{bj} E(size^{\alpha_1} e^{\alpha_2 label} e^{\alpha_3 pack} month^{\alpha_4}) \quad (33)$$

As in (30'), this may be estimated as:

$$E(R_{bj}) = \beta_j \Sigma_l (size^{\alpha_1} e^{\alpha_2 label} e^{\alpha_3 pack} month^{\alpha_4} e^{\alpha_5 purch} q_{lj}/q_{bj}) \quad (33')$$

R_{bj} and R_{pj} represent the implicit value of a unit of raw product contained in a final product. This is not identical to the implicit value of a raw product delivered by a member, because waste occurs in processing (q_{bj} is not equal to Q_{bj} and q_{pj} is not equal to Q_{pj}). This waste loss is accounted for by multiplying β_{bj} and β_{pj} with the fraction (w_j) of raw product j delivered by members which actually ends up in the final product. That is, $\beta'_{bj} = w_j\beta_{bj}$ and $\beta'_{pj} = w_j\beta_{bj}$. Substituting β'_{bj} for β_{bj} in (29') and β'_{pj} for β_{pj} in (33') will give R'_{bj} and R'_{bj} as the implicit value per unit raw product delivered by members.

Finally, the marginal contribution of the jth raw product to pool return is a weighted average of j's use in blends and pure products. This is found by applying (18) to (30') and (33'), recalling in the present case that i = b,p. The weighted average is j's marginal implicit contribution (30') to blend net return, weighted by the proportion q_{bj}/q_j of the jth product sold in blend form, plus j's marginal contribution (33) to pure product return, weighted by the proportion q_{pj}/q_j of the jth product sold in pure form:

$$R_j = R'_{bj}(q_{bj}/q_j) + R'_{pj}(q_{pj}/q_j) \qquad (34)$$

where $q_{bj}+q_{pj} = q_j$.

V RESULTS AND DISCUSSION

Hedonic Function Results

As discussed above, returns were defined in two alternative ways:

a) R1 = Price - Direct cost - Factory burden - Administrative overhead

b) R2 = Price - Direct cost

Equation (27) was estimated twice, first with R1 multiplied by Q_i (total shipment) as dependent variable, then with (R2)(a) multiplied by Q_i as the dependent variable[4] .

Table 1 shows the estimated coefficients and their standard errors when (R1)(Q_i) was the dependent variable. Holding all k_t (nonmember-produced) factors constant, the β_j coefficients show the implicit marginal contributions of raw products j to net return. Table 1 shows that a raw product's coefficient β_j, and coefficient α_t of a nonmember-produced characteristic, tends to differ between blend and pure form. The right-hand-side column of Table 1 indicates whether in each case the difference is significant, that is, whether the null hypothesis $\alpha_{bt}-\alpha_{pt} = 0$ and $\beta_{bj}-\beta_{pj} = 0$ can be rejected at the five and one percent confidence levels. Among nonmember-produced characteristics, only the effect of

[4]See page 20 for explanation of (a).

Table 1. Coefficients and Standard Errors Obtained With R1 as Dependent Variable

	Blend		Pure		
	Coef.	St.Error	Coef.	St.Error	Test*
Size	-0.0949	0.0152	-0.1488	0.0053	**
Label	0.1417	0.0152	0.1255	0.0059	
Pack	0.1154	0.0431	-0.0564	0.0162	**
Month	0.0345	0.0056	0.1452	0.0031	**
Purch	0.7074	0.2163	-	-	
Green Beans	0.2920	0.0282	0.2693	0.0058	
Wax Beans	0.4386	0.0824	0.4160	0.0406	
Italian Beans	0.2565	0.0447	0.3299	0.0116	
Broccoli	0.5507	0.0401	0.3244	0.0083	**
Cauliflower	0.4472	0.0631	0.3068	0.0132	*
Cut Corn	0.4141	0.0284	0.3710	0.0075	
Corn Cob	-	-	0.2358	0.0045	
Zucchini	0.6803	0.0565	0.2192	0.0093	**
Yellow Squash	0.3729	0.0715	0.2566	0.0159	
Minor Product	0.2977	0.0222	0.1398	0.0037	**

* T-test for the hypothesis that each pair of coefficients for blended and pure characteristics are equal.
Explanation:

a) ** The hypothesis is rejected on a 1 % level.
b) * The hypothesis is rejected on a 5 % level.

label type does not differ significantly at a 5 percent level between the pure and blended forms. Among raw products, coefficients of the minor products and of broccoli, cauliflower, and zucchini are significantly different at the 5 percent level between blended and pure products. The Wald test for the hypothesis that the coefficients of all characteristics are jointly the same between blended and pure products gives a computed Chi-Square of 1390.2. Thus, the hypothesis that blended and pure products give the same implicit values is rejected at the one percent confidence level.

Table 2 shows the estimated coefficients and their standard errors when (R2)(a) is used as the dependent variable[5]. Results are similar to those in Table 1 except that the differences between coefficients for the pure and blended forms seem to be somewhat greater than in the case of R1. Here, the hypothesis that a coefficient in the blended products equation is equal to that in the pure products equation cannot be rejected at the 5 percent level for wax beans, green beans, and label type.

The second hypothesis proposed in chapter three was to determine whether alternative methods of computing net returns would have any impact on estimated coefficients and thus on raw products' implicit values. Ninety five percent

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[5]Parameter a, which is the expectation of (R1/R2), was 0.739.

Table 2. Coefficients and Standard Errors Obtained With Adjusted R2 as Dependent Variable

	Blend		Pure		
	Coef.	St.Error	Coef.	St.Error	Test*
Size	-0.0823	0.0122	-0.1190	0.0040	**
Label	0.1214	0.0121	0.1055	0.0045	
Pack	0.0982	0.0345	-0.0362	0.0122	**
Month	0.0283	0.0045	0.1130	0.0023	**
Purch	0.8055	0.1709	-	-	
Green Beans	0.2733	0.0169	0.2694	0.0044	
Wax Beans	0.4676	0.0214	0.3739	0.0305	
Italian Beans	0.2621	0.0339	0.3320	0.0085	*
Broccoli	0.5280	0.0305	0.3119	0.0062	**
Cauliflower	0.4031	0.0473	0.3180	0.0100	*
Cut Corn	0.3898	0.0215	0.3425	0.0052	*
Corn Cob	-	-	0.2172	0.0031	
Zucchini	0.6408	0.0427	0.2304	0.0069	**
Yellow Squash	0.3951	0.0547	0.2617	0.0112	**
Minor Product	0.2872	0.0169	0.1596	0.0028	**

* T-test for the hypothesis that each pair of coefficients for blended and pure characteristics are equal.
Explanation:

a) * * The hypothesis is rejected on a 1 % level.
b) * The hypothesis is rejected on a 5 % level.

confidence intervals for each of the parameters in table 1 and table 2 were estimated. For blended products, all coefficients in each equation fell within the other's corresponding 95 percent confidence intervals. Thus, whether one uses R1 or R2 as the dependent variable for obtaining coefficients for blended products would seem to make little difference. At the five percent error level, we cannot reject the hypothesis that the two equations would give the same implicit values for vegetables used in blends.

For the pure products, on the other hand, results were mixed. Coefficients of size, label type, and month in the R1 equation all were outside the corresponding 95 percent confidence intervals in the R2 equation (and vice versa). This also was the situation for minor products, cut corn, and cob corn. In addition, the coefficient of broccoli in the R1 equation does not fall within the confidence interval of its adjusted coefficient in the R2 equation. Both pure cut corn and cob corn have significantly lower coefficients in the R1 equation than in the R2 equation. Thus, it would appear that using R2 as dependent variable would give a lower relative implicit value for corn than would the use of R1 as dependent variable. Since corn is one of the cooperative's major products, this difference might induce a substantial change in the share of total pool return paid to each raw product.

A third equation also was estimated using as dependent variable the gross price received for the end product, that is, with no processing costs deducted. These results are not of particular interest for the purpose of estimating implicit values since they would not necessarily reflect raw products' contributions to returns. As one would expect, relative economic values determined from these results differed substantially from the results obtained from the two returns equations discussed above.

Prescribed Economic Values

With the coefficients in (27) estimated, the implicit or economic values of each member-delivered raw product now can be calculated. The following tables and discussion are based on parameter estimates derived using returns R1 (table 1). Because of the conditionality of (29) and (32) on the k_t variables, we need to calculate such implicit values as expectations over the k_t. Table 3 shows expected values of nonmember-produced factors for blended and pure products, $E(K_{bj})$ and $E(K_{pj})$, respectively.[6] These expectations vary across vegetables because each vegetable is associated with a different mean combination of end products and a different

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[6]Dividing (30') and (33') with β_j we get $E(R_{bj})/\beta_j = E(K_{bj})$ and $E(R_{pj})/\beta_j = E(K_{pj})$, thus after these divisions the right hand sides of (30') and (33') show how the expectations of K_p and K_b are calculated.

Table 3. Expected Values of Nonmember-Produced Factors, Blended and Pure Products (Return R1)

Commodity	Blend $E(K_{bj})$	Pure $E(K_{pj})$
Green Beans	0.9034	0.7480
Wax Beans	0.9664	0.8048
Italian Beans	0.8791	0.7563
Broccoli	0.8752	0.8768
Cauliflower	0.8554	0.8762
Cut Corn	0.8771	0.7453
Corn Cob	-	0.6552
Zucchini	0.8810	0.6098
Yellow Squash	0.8728	0.6284
Minor Product	0.8751	1.4563

mean combination of nonmember-produced characteristics. For a given raw product j, $E(K_{bj}) \neq E(K_{pj})$, because of differing characteristic combinations and differences in parameter α_t across blends and pure products. Both the highest and lowest values of $E(K_j)$ are found among pure products.

Economic values, computed separately for each raw product in its blended and pure forms, are reported in table 4. Italian beans is the only raw product which has a higher implicit value in pure form than in blended form. However, this product is not one of the cooperative's major commodities. For the most part, raw products give a higher marginal return in blend than in pure form. A blended product can absorb more of a lower-grade vegetable before the loss in end product quality is apparent to most consumers. Thus, it is not likely that the difference in marginal value between blended and pure products is due to using a higher quality of raw products in blends. Indeed, we probably have underestimated the net profit advantage to members of selling raw products in blended form because the lower cost of producing lower quality vegetables has not been taken into account.

Table 5 shows economic values of each raw product considered as a mean between their blended and pure forms. This mean is estimated according to (35), weighting R_{bj} and R_{pj} by the proportions they represent of total output. Next to the prescribed or estimated economic values are those the

Table 4. Prescribed Economic Values, Blended and Pure Products (Return R1)

Commodity	Blend $/lb	Pure $/lb
Green Beans	0.2012	0.1536
Wax Beans	0.3158	0.2494
Italian Beans	0.1876	0.2076
Broccoli	0.4396	0.2594
Cauliflower	0.2337	0.1643
Cut Corn	0.2555	0.1943
Corn Cob[7]	-	0.2871
Zucchini	0.3758	0.0838
Yellow Squash	0.2164	0.1072
Minor Product	0.1907	0.1491

[7]Value per pound in cob corn form. Multiply with 2.667 to get value per pound in cut corn equivalent.

Table 5. Comparison of Prescribed Economic Values, Weighted Mean of Blended and Pure Products, and Actual 1988 Economic Values

Commodity	$/ton 1988 Actual	$/ton Prescribed[8]
Green Beans	178	330
Wax Beans	184	547
Italian Beans	250	400
Broccoli	350	740
Cauliflower	335	429
Corn	163	463
Zucchini	122	360
Yellow Squash	154	257
Minor Product	-	336

[8]Employing return R1.

cooperative used in 1988. Estimated implicit values are high compared to those the cooperative employed in 1988, which are based on rough estimates of processor's raw product market prices. But one should remember that the estimated values include all returns to the cooperative, including those which a noncooperative processor ordinarily would keep as net profit.

Table 6 compares relative economic values with those used by the cooperative in 1988. These values are normalized by expressing them relative to the implicit value for green beans. Table 6 suggests that wax beans, broccoli, corn, and zucchini were underpaid relative to green beans in 1988 while Italian beans, cauliflower, and yellow squash were overpaid relative to green beans. Values in table 5 now may be used in (10) and (11) to calculate each member's share of total pool returns. Implicit or prescribed economic values expressed as a percentage of some base value, as in table 6, could just as well have been used since only relative implicit values matter for this purpose.

Table 7 shows the share of total pool return that would have been paid to each type of raw product assuming the cooperative used (a) the economic values it did employ in 1988 and (b) economic values derived from the present research (table 5). Quantities Q_j delivered by members in 1988 were used for those calculations. Inspection of table 7 shows that using the prescribed or estimated economic

Table 6. Comparison of Prescribed and Actual 1988 Economic Values, Relative Basis

Commodity	1988 Actual	Prescribed[9]
Green Beans	1.00	1.00
Wax Beans	1.03	1.66
Italian Beans	1.40	1.21
Broccoli	1.97	2.24
Cauliflower	1.88	1.30
Corn	0.92	1.41
Zucchini	0.69	1.09
Yellow Squash	0.87	0.78

[9]Employing return R1.

Table 7. Comparison of Prescribed and Actual 1988 Pool Return Shares (Return R1)

Commodity	1988 Pool Return Share	Prescribed Pool Return Share
Green Beans	29.15	24.75
Wax Beans	0.98	1.33
Italian Beans	3.90	2.85
Broccoli	13.14	12.71
Cauliflower	13.31	7.80
Corn	34.85	45.28
Zucchini	2.90	3.92
Yellow Squash	1.77	1.35

values would give green beans a smaller share of return than it actually was paid in 1988. The return share going to broccoli also would decrease even though, relative to the other raw products, beans' prescribed economic value is larger than its economic value was in 1988. An increase in relative economic value does not necessarily translate into an increase in pool return share because the relative economic values of the other raw products and delivery quantities Q_j also must be taken into account.

Using the prescribed values would result in an increase in corn's return share to 45.28 percent compared to its 1988 share of only 34.85 percent. The share to zucchini and wax beans also would increase. The share of return going to cauliflower would decrease to 7.80 percent, about half of its 1988 level. In addition, return share would decrease for Italian beans and yellow squash.

Effects of Nonmember-Produced Characteristics

Table 1 shows that for both blended and pure products, selling a product under one of the house labels brought higher mean return, ceteris paribus, than did selling it under a private label. The effect of changing package type between carton and polyethylene bags, on the other hand, gave mixed results. With blended products, carton-packed products give a higher return than did identical products sold in poly bags. But among pure products, a carton-packed product brought a lower return than that in a poly bag. As a weighted average between blended and pure forms, carton packaging brings a slightly higher return than does poly bag packaging. All coefficients are significant at the 99 percent confidence level. But among both pure and blended products, package type has the lowest t-values (2.677 and 3.474 for blended and pure product, respectively), while label type, month, and size, all have clearly higher t-values.

Suppose the nonmember-produced characteristics that are not dummy variables are held at their sample means, namely:

	Blend	Pure
Size	41.6 oz	113.1 oz
Month	7.5	7.5
Purch	0.055	--

Altering the dummy variables for label and package type gives the change in raw products' marginal return contributions as label and package type vary. Table 8 shows some examples of the impact this would have on the estimated effects of nonmember-produced factors K_j and on the resulting implicit values of some selected raw products. The impact of changing dummy variables is greater among blended than among pure products. This is seen by comparing

Table 8. Change in Implicit Values as Label and Package Type Vary (Return R1)

Blended Raw Products

Label	Package	K_{bj}	$/lb Gr.Beans	$/lb Broccoli	$/lb Cut Corn
Private	Poly	0.78	0.174	0.392	0.226
Private	Carton	0.90	0.200	0.452	0.261
House	Poly	0.88	0.196	0.442	0.255
House	Carton	1.009	0.225	0.507	0.292

Pure Raw Products

Label	Package	K_{pj}	$/lb Gr.Beans	$/lb Broccoli	$/lb Cut Corn
Private	Poly	0.66	0.135	0.195	0.171
Private	Cartoon	0.63	0.129	0.186	0.164
House	Poly	0.75	0.154	0.222	0.195
House	Cartoon	0.71	0.146	0.210	0.184

the estimated nonmember factors K_b and K_p for different dummy variable combinations in table 8[10]. For both groups, blended and pure, a product with a combination of a private label and a polyethylene bag would give the lowest implicit raw product values. The highest values for a blended product are found for products sold under a house label and in a carton package. For pure products, the highest value is also obtained for a product sold under a house label but in a polyethylene bag. For blended green beans and cut corn, these variations would result in a variation in implicit value of between five and six cents per pound. For broccoli the implicit value variations would be at most 11.5 cents per pound, and possibly lower depending on the combination of package and label type. Among pure products, implicit values would vary about two cents per pound for green beans and cut corn and 2.7 cents for broccoli.

In addition to these effects, it is clear from table 1 that container size has a negative effect on an end product's profitability. As size increases, average return decreases with elasticity 0.09. That is, increasing container size by ten percent reduces net return by about one percent. The effect of month is positive, especially for pure products. This indicates that, on average, return

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[10]Purchased amount of vegetables which only affect $K_{bj,}$ has a positive effect on return, but we do not know wheter price of purchased raw products are accounted for or not, thus the true net effect is not known.

trended up more for pure products than for blended products during the 14-month sample period.

VI CONCLUSIONS

The results show that there generally are higher returns to raw products sold in blended form than in pure form. This was especially true for broccoli, cauliflower, and zucchini. The apparent implication is that the cooperative faces less competition for its products in the vegetable blend market than in the pure product market. However, one should keep in mind that only a 14-month time period was considered in the analysis.

The hypothesis that the subtraction of factory burden and administrative and finance costs from return does not affect relative economic values could not be rejected for blended products. For pure products, results were mixed. For example, among pure products, corn has a lower implicit price when such costs are subtracted than when they are not subtracted.

The cooperative's most important products are green beans and corn. Overall, our results show that corn has a higher implicit or economic value to the cooperative than has green beans. For example, when return R1 is employed, the ratio of bean to corn value is 1:1.4. Using return R2 instead decreases corn's relative value to 1.36, still a significant margin over beans. Assuming 1988 delivery quantities and using our prescribed implicit values instead of the cooperative's current ones would increase corn's return share and decrease the return to green beans. Among the other vegetables, our analysis suggests a relative increase in the share of return to zucchini and wax beans and a decrease in the share to Italian beans, cauliflower, and yellow squash.

Implicit values prescribed in this study can be used as forecasts of the raw products' profitability or for determining pool payments to raw products. These values should be recognized for what they are: returns to the respective raw products over a 14-month sample period. Atypical short-term conditions may influence such estimates. However, they serve as a good starting point for determining payments to raw products in the absence of competitive raw product markets.

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VIII APPENDIX

VIII APPENDIX

A. Results Based on Other Return Data

Tables A.1 though A.7 present the same type of information as tables 1 to 7, but based on a different data set. The new data set has 8191 observations because observations with cooked squash included in the minor products variable are deleted. The major differences between the two data sets are how returns are defined. In the previous data set, costs denoted as raw product costs are not deducted from the return estimate (for both R1 and R2). For a majority of the observations, however, this raw product category contains some non-raw-product costs. Specifically, many raw products are processed in two operations, first into bulk form and then into final form. For such products, the "raw product cost" category includes costs of processing raw product through to the bulk stage. This cost is approximately 50 percent of the "raw product cost" category.

In table A.1 through A.8, costs of initial processing (into bulk form) have been estimated as "raw product costs" less average accounting prices charged for each type of raw vegetables multiplied by quantity of the vegetable. Return is defined as:

a) R3 = Price - Direct cost - Factory burden -

Administrative overhead -

Estimated initial processing cost

b) R4 = Price - Direct cost -

Estimated initial processing cost.

Table A.1 shows coefficients and standard errors when R3 is used as return estimate. As earlier, a = E(R3/R4). Table A.2 shows the estimated coefficients employing [(R4)(a)] as estimated return. Tables A.3 through A.7 use coefficients obtained with R3 as an estimate of returns.

Table A.1. Coefficients and Standard Errors Obtained With R3 as Dependent Variable

	Blend		Pure		
	Coef.	St.Error	Coef.	St.Error	Test*
Size	-0.0920	0.0239	-0.2680	0.0079	**
Label	0.2464	0.0246	0.4462	0.0106	**
Pack	0.0634[11]	0.0698	0.1079	0.0241	
Month	0.0736	0.0087	0.3316	0.0064	**
Purch	0.8011	0.3636	-	-	
Minor Products	0.0758	0.0135	0.1111	0.0043	**
Green Beans	0.1943	0.0226	0.1002	0.0035	**
Wax Beans	0.0789	0.0536	0.1363	0.0247	
Broccoli	0.1439	0.0246	0.1497	0.0055	
Italian Beans	0.0038[11]	0.0310	0.1523	0.0079	**
Cauliflower	0.3968	0.0527	0.1488	0.0077	**
Cut Corn	0.2009	0.0206	0.1765	0.0055	
Zucchini	0.3461	0.0415	0.0991	0.0070	**
Yellow Squash	0.0921	0.0484	0.1460	0.0115	
Cob Corn	-	-	0.1039	0.0031	

* T-test for the hypothesis that each pair of coefficients for blended and pure characteristics are equal.
Explanation:

a) ** The hypothesis is rejected on a 1 % level.
b) * The hypothesis is rejected on a 5 % level.

[11]The coefficient is not significant on a 5 percent level.

Table A.2 Coefficients and Standard Errors Obtained With Adjusted R4 as Dependent Variable

	Blend		Pure		
	Coef.	St.Error	Coef.	St.Error	Test*
Size	-0.0713	0.0174	-0.1866	0.0054	**
Label	0.1807	0.0175	0.2872	0.0065	**
Pack	0.0482[12]	0.0500	0.1120	0.0164	
Month	0.0522	0.0063	0.2059	0.0036	**
Purch	0.9118	0.2516	-	-	
Minor Products	0.0881	0.0092	0.1185	0.0031	**
Green Beans	0.1552	0.0141	0.1135	0.0025	**
Wax Beans	0.1390	0.0359	0.1329	0.0181	
Italian Beans	0.0483	0.0200	0.1658	0.0055	**
Broccoli	0.1639	0.0166	0.1488	0.0038	
Cauliflower	0.2876	0.0318	0.1612	0.0056	**
Cut Corn	0.1752	0.0132	0.1650	0.0034	
Zucchini	0.2997	0.0266	0.1230	0.0047	**
Yellow Squash	0.1295	0.0322	0.1452	0.0071	
Cob Corn	-	-	0.0974	0.0019	

* T-test for the hypothesis that each pair of coefficients for blended and pure characteristics are equal.
Explanation:

a) * * The hypothesis is rejected on a 1 % level.
b) * The hypothesis is rejected on a 5 % level.

[12]The coefficient is not significant on a 5 percent level.

Table A.3. Expected Values of Nonmember-Produced Factors, Blended and Pure Products (Return R3)

Commodity	Blend $E(K_{bj})$	Pure $E(K_{pj})$
Green Beans	1.0476	0.8834
Wax Beans	1.1813	1.0010
Italian Beans	1.0330	0.8881
Broccoli	1.0060	1.0922
Cauliflower	0.9873	1.1761
Cut Corn	1.0086	0.8653
Corn Cob	-	0.6948
Zucchini	1.0348	0.6111
Yellow Squash	1.0312	0.7317
Minor Product	1.0145	1.0394

Table A.4. Prescribed Economic Values, Weighted Mean of Blended and Pure Products (Return R3)

Commodity	Blend $/lb	Pure $/lb
Green Beans	0.1552	0.0674
Wax Beans	0.0694	0.1015
Italian Beans	0.0033	0.1125
Broccoli	0.1320	0.1491
Cauliflower	0.2394	0.1069
Cut Corn	0.1317	0.0992
Corn Cob[13]	-	0.0578
Zucchini	0.2246	0.0380
Yellow Squash	0.0632	0.0710
Minor Product	0.0569	0.0854

[13] $/lb of corn in cob corn form. Multiply with 2.667 to get value per pound in cut corn equivalents.

Table A.5. Comparison of Actual 1988 and Prescribed Economic Values

Commodity	$/ton 1988 Actual	$/ton Prescribed[14]
Green Beans	178	177
Wax Beans	184	185
Italian Beans	250	140
Broccoli	350	277
Cauliflower	335	405
Corn	163	241
Zucchini	122	199
Yellow Squash	154	139
Minor Product	-	137

[14]Employing return R3.

Table A.6. Comparison of Actual 1988 and Prescribed Economic Values, Relative Basis

Commodity	1988 Actual	Prescribed[15]
Green Beans	1.00	1.00
Wax Beans	1.03	1.04
Italian Beans	1.40	0.79
Broccoli	1.97	1.56
Cauliflower	1.88	2.29
Corn	0.92	1.36
Zucchini	0.69	1.12
Yellow Squash	0.87	0.78

[15]Employing return R3.

Table A.7. Comparison of Actual 1988 and Prescribed Pool Return Share[16] (Return R3)

Commodity	1988 Pool Return Share	Prescribed Pool Return Share
Green Beans	29.15	24.89
Wax Beans	0.98	0.84
Italian Beans	3.90	1.87
Broccoli	13.14	8.92
Cauliflower	13.31	13.81
Corn	34.85	44.24
Zucchini	2.90	4.06
Yellow Squash	1.77	1.37

[16] Using quantity of member delivered vegetables from 1988.