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AN EMPIRICAL ALLOCATION OF DAIRY FARM PARTNERSHIP INCOME TO CAPITAL, LABOR, AND MANAGEMENT

by

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Abstract

Farm record data are used to determine the allocation of dairy farm partnership income to operators' labor, management, and capital. Results indicate that at the margin labor and capital should be valued at their opportunity costs. In recent years, however, there has been insufficient income to reimburse at market values.

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Dividing partnership income between partners is simple when each partner provides equal amounts of capital, labor, and management to the partnership. However, equal input contribution is rare in farm partnerships, especially with parent-child partnerships. The parent generally provides more capital and sometimes less labor than the offspring. Management input is a difficult measure to quantify but is generally considered equally contributed. With unequal input contributions, arriving at an equitable or fair division of partnership income can be a complex decision. This article uses dairy farm partnership financial data in a linear regression model to determine if a systematic economic division of dairy partnership income can be made to the 3 unpaid factors of production--operators' labor, capital, and management.

The Practice of Allocating Partnership Income to Labor, Capital, and Management

Federal and state income tax laws allow a partnership to allocate its income to the partners based upon sound economic principles (Pinna, Vocke, and Wells). In practice, when unequal contributions are made, the common procedure is to impute a return to either labor or capital, subtract that payment from net farm income, and allocate the residual to the remaining factors of production (Thomas and Boehlje). For example, if partnership net income is $32,000 and the total value of labor provided by the partners is estimated to be $24,000, the residual of $8,000 is allocated to capital in proportion to the capital each partner provides. In contrast, the imputed value of capital estimated at some agreed rate of interest can first be subtracted, with the residual allocated to labor. A number of problems are inherent in these procedures, however.

First, the residual factor or input may receive a windfall gain or loss quite different from its economic contribution to partnership income. If this is a concern, and it might be if partners are providing unequal contribution of inputs, resulting in certain partners obtaining a windfall profit or loss, an adjustment is necessary to shift some of the windfall back to the imputed factor of production. Second, a decision has to be made on whether to recognize and reimburse management. Although a difficult input to quantify, management does affect the amount of net farm income. When imputing an opportunity cost to capital or labor it is possible to include some type of management return with these factors. More commonly, the factor of production that receives the residual net farm income also receives the gain or loss from management. Imputing a cost of capital, subtracting that cost from net farm income and allocating the residual to labor, means that labor receives the management income or loss. Capital receives the management income or loss if labor first receives the imputed return.

One remedy is to impute opportunity costs to both capital and labor and then allocate the remaining gain or loss equally among partners. This procedure assumes that management is provided equally by all partners and also is entitled to any windfall gain or loss. Another remedy is to impute an opportunity cost to both capital and labor, but then to sum these two costs and divide each of the two imputed costs by the sum. Then multiply each ratio, which by definition sum to one, by the partnership income to determine the allocation of partnership income to labor and capital. This procedure assumes that management is provided in proportion to the value contributions of both labor and capital. It also guarantees that any windfall gain or loss will be shared by labor and capital in proportion to their imputed values.

Allocating Income to Factors of Production

Income from a business can be allocated to the various factors of production such that

$$y = \Sigma p_i X_i \qquad (1)$$

where y is income, p_i is the price or reimbursement per unit of input factor i, and X_i is the amount of input factor used by the firm in the production process.

For a farm production function homogeneous of degree one, it can be shown by Euler's Theorem that if all inputs are paid a price equal to their value marginal product, then income will be completely exhausted. However, Equation (1) can be satisfied even if the farm production function is not homogeneous of degree one if the first-and second-order conditions for profit maximization are fulfilled, and the firm's profit is zero after all factors of production are reimbursed. A profit maximizing entrepreneur will guarantee fulfillment of the first- and second-order conditions. Free entry and exit from the industry will guarantee that excess profits will be zero because output price will be reduced and input prices will be bid up if excess profits exist (Henderson and Quandt).

Equation (1) can be used to determine the prices that unpaid factors of production could receive to exhaust net income. First, paid inputs will be used to the point where the value of their marginal products will be equal to their prices. Their total cost can be subtracted from income as expenses leaving net income and unpaid factors of production that have not yet been reimbursed. In a farm partnership these unpaid factors of production will be the operators' labor, management, and equity in the farm business. Labor, management, and equity can receive their share of net farm income based on the identity: Net Farm Income = Quantity of Operators' Labor x Salary + Quantity of Operators' Equity x Return Rate + Management Return.

Empirical Analysis

The partnerships from New York Dairy Farm Business Summary Records from 1980, 1981, and 1982 are used as the data in this analysis (Smith). Net farm partnership income for each of those 3 years was linearly regressed on dollars of equity, months of operators' labor, and various proxies for management. Net farm income is defined as labor, management, and ownership income with appreciation removed (Smith). Capital appreciation was also linearly regressed on the same independent variables for each of the 3 years. Appreciation was estimated by the summary participants. The regression analyses were completed to determine how net income and appreciation might be allocated to the unpaid factors of production--capital, labor, and management.

The first model (Table 1) regressed net farm income on equity, operators' labor, and an intercept term. The results for 1980 indicate that if equity is paid 12.8% and operators' labor is paid $774 a month, then on average a partnership would have paid out $22,961 more than it earned as net income in 1980. Of course, some farms would have an even larger deficit while others would have a smaller deficit, possibly even a surplus. The results for 1981 were similar with a slighter lower equity coefficient and higher labor coefficient. Except for a similar return to equity, the results for 1982 were very much different. The average return to operator's labor was a negative $1,133 per month, and a positive intercept of $15,935 existed.

The intercept term was used to account for any constant level of management on the farms. Management undoubtedly varies by farm but since it is difficult to measure it was initially decided to use an intercept term to estimate a standard measure of management. Management return in a given year can be positive or negative although in the long-run it should be positive. The large negative

Table 1. Allocation of Return to Labor, Management, and Ownership Income Using Linear Regression; New York Dairy Farm Partnerships

Variable	Model and Year					
	1			2		
	1980	1981	1982	1980	1981	1982
Intercept	-$22,961 (-2.41)*	-$22,471 (-1.59)	$15,935 (1.18)	-$52,378 (-2.94)*	-$57,666 (-2.51)*	-$48,705 (-1.94)
Equity in dollars	.128 (13.22)*	.107 (8.76)*	.121 (11.50)*	.122 (12.44)*	.099 (7.65)*	.11* (10.76)*
Operators' labor in months	$774 (2.01)*	$798 (1.50)	-$1,133 (-2.10)*	$831 (2.18)*	$780 (1.48)	-$1,136 (-2.18)*
Average milk production per cow in pounds				$2.08 (1.95)*	$2.67 (1.93)*	$4.57 (3.01)*
R^2	.64	.42	.52	.65	.44	.56
F	99.28*	38.96*	66.18*	69.09*	27.87*	50.10*
Number of Observations	115	112	123	115	112	123

Student t values are in parenthesis, $H_o: \beta_1 = 0$

*Statistically different from zero at the .95% confidence level.

intercepts for 1980 and 1981 were not expected. And, the 1980 intercept is statistically different than zero. These negative values may imply that one or more paid factors of production are being used beyond the level where the values of their marginal products are equal to their prices. Prices are variable in agriculture and it is not always possible to optimally adjust resource usage in a given year. Searching for these misallocations is beyond the scope of this paper[1].

[1]One possible cause of the negative intercept is that tax depreciation is used as the price of depreciable property since tax depreciation is subtracted as an expense to arrive at net farm income. Tax depreciation, because of accelerated provisions in the tax code, may be larger than economic depreciation.

The coefficient of determination of the models (R^2) ranged from .42 to .64, which indicates that 36 to 58 percent of the net income variability is still left unexplained. This remaining variability may be the result of different levels of management from farm to farm, errors in measurement such as operator labor, as well as stochastic elements such as weather. It is also possible that management is correlated with equity or operators' labor thus biasing their coefficients. In order to test these hypotheses a measure of management was added to the regression model. The most common measure of management performance in dairy operations is milk production per cow. Adding average milk production per cow leads to the results displayed as model 2 in Table 1. Although statistically significant, milk yield only explains an additional 1 to 4 percent of income. The equity coefficient is reduced for each of the 3 years while the change in the labor coefficient is not consistent over the 3 years. This implies that equity is positively correlated with this measure of management, while labor quantity is not correlated with management, although labor quality, which was not measured, could be. A high level of management will increase net income and thus lead to an increase in equity. The same quantity of operators' labor might be used regardless of the level of management.

The two regression models were also run using all 600 farms in the 1980 summary. This included sole proprietors and corporations, and allowed a greater range in the equity and labor variables. The results were similar to the results obtained from only using the partnerships.

These results indicate that operators' labor in 1980 and 1981 should have received approximately $800 a month, and equity should have received a 12 percent return at the margin. It is interesting that the 1980 farm business summary participants paid an average of $835 a month for hired labor, and farmers in the

First Farm Credit District paid an average of 11.97% to production credit associations during 1980. These values are not statistically different from the coefficients derived in the models (using the standard errors derived from the models for testing). Thus it would appear that the farmers on average are using their own labor and capital in the amounts approximating profit maximizing conditions.[2]

The results for 1982 indicate that partnership income decreases with additional operator labor input. This result may be the result of a deficiency in the data. Of the 123 partnership observations for 1982, only 47 had months of operator labor different from 24 months. In fact, using all 571 business summary farms produced a return to operator's labor of $428 a month. This is much higher than -$1,133, but still lower than the $800 estimated for all farms for 1980.

Asset appreciation was not included as income since appreciation can be viewed as the present value of future income to be generated by the business. That future income can be allocated to capital and labor when it is earned. However, it may be a good idea to allocate asset appreciation among the partners in case it becomes necessary to dissolve the partnership. There is also popular interest in being able to allocate annual appreciation to current capital, labor and management. To explore the feasibility of this allocation, appreciation was linearly regressed on equity, operators' labor, and an intercept term. Appreciation includes livestock, machinery and real estate appreciation (Smith). The results are presented as model 1 in Table 2.

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2 The borrowing interest rate should include an inflation component. Return on farm equity may be from annual income and appreciation. If the appreciation rate is similar to the inflation rate, it would be expected that the current income return rate on equity should be lower than the borrowing rate, ignoring risk differences.

Table 2. Allocation of Farm Asset Appreciation Using Linear Regression; New York Dairy Farm Partnerships

Variable	Model and Year					
	1			2		
	1980	1981	1982	1980	1981	1982
Intercept	$10,097 (.99)	$8,452 (.78)	-$3,340 (-.47)	-$3,621 (-.19)	8,451 (.47)	-$14,016 (-1.03)
Equity in dollars	.055 (5.39)*	.046 (4.89)*	.031 (5.66)*	.053 (4.95)*	.046 (4.57)*	.030 (5.25)*
Operators' labor in months	-$1 (0.0)	-$597 (-1.45)	-$64 (-.23)	$25 (.06)	-$597 (-1.44)	-$64 (-.23)
Average milk production per cow in pounds				.97 (.84)	7.30 (0.0)	.75 (.92)
R^2	.21	.20	.21	.22	.20	.22
F	15.05*	13.38*	16.24*	10.24*	8.84*	11.09*
Number of Observations	115	112	123	115	112	123

Student t values are in parenthesis, $H_o: \beta_i = 0$

*Statistically different from zero at the .95% confidence level.

In 1980, equity accrued appreciation at the rate of 5.5 percent. That decreased to 4.6 percent in 1981 and 3.1 percent in 1982. Essentially no appreciation was allocated to operators' labor in any year. As well as not being statistically different from zero, the estimated labor coefficient is also not numerically different from zero in 2 of the 3 years. This is not surprising since human capital appreciation is not included in the farm balance sheet. The intercept value is also not significantly different from zero but is positive in

2 of the 3 years. A positive intercept value would imply that part of the appreciation could be allocated to management. This allocation would be valid because appreciation accrues from assets, but it requires management to decide the equity/asset ratio and the type of assets that should be held. It would not be illogical to assign part of appreciation ownership to the management input as well as to capital.

Adding average milk production per cow as a variable leads to the results displayed as model 2 in Table 2. The estimated coefficient for milk production is not statistically different from zero. Thus, although some appreciation may be assignable to management, milk production per cow would not serve as a reliable measure of the results of management input.

Conclusion

Except for the year 1982 the results indicate that labor and capital in a farm partnership should be valued at their market opportunity costs. The problem, however, is that in recent years there has been insufficient dairy farm partnership income to reimburse at market values.

Thus, it is suggested that partnership income be prorated to labor and capital according to their market opportunity costs. This guarantees that any management gain or loss be shared by labor and capital in proportion to their imputed values.

There is no compelling reason to allocate annual appreciation to anything other than equity and possibly management, although the quantity (or quality) of management is difficult to ascertain.

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