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The Effect of Human Resource Management Practices on Farm Profitability: An Initial Assessment

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Abstract

Sound human resource management practices such as performance bonuses, performance reviews and feedback, and standard operating procedures allow farm managers to improve the human capital, and profitability, on the farm. To date, no research of the impact of HRM practices on farm profitability has been published. This article provides a theoretical justification for analyzing the impacts of HRM practices on firm profitability. This model assumes that HRM practices are labor-augmenting technologies, causing existing labor to be more efficient in production. Empirical results provide little support for a positive relationship between HRM practices and farm profitability, although additional research is suggested.

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1. Introduction

Human resource management (HRM) is a vital component of managers' responsibilities. In addition to legal or regulatory issues related to hiring and firing employees, HRM incorporates practices such as recruiting, training, managing work processes, motivating, leading, evaluating employees, and communication. Generally, HRM can be thought of as the set of practices that are intended to lead to improvements in the quality of a firm's labor force. In dairy farm business operations, the focus of this research, the use of HRM practices such as training in milking, feeding, and calf care; developing and applying standard operating procedures (SOPs); and clearly defining roles and responsibilities through job descriptions are important ways of ensuring that employees are capable of performing at a high level.

As borne out in the review of literature below, HRM practices have scarcely been analyzed as factors that may impact farm profitability. However, there are compelling theoretical arguments in favor of incorporating HRM measures into models explaining farm profitability. One could argue that the appropriate measure of effective HRM would reflect the ability of employees to perform the tasks included in their job descriptions. Practically, however, this type of measure is difficult to create and to apply universally.

For example, recent research shows that job descriptions on dairy farms vary considerably across farms even though position titles (e.g., milking manager, crop manager, etc.) are similar or identical (Holden, et al., 2004). Thus, an appropriate measure would necessarily be one by which an employee's competencies are assessed relative to his or her individual responsibilities. Because nearly every position is unique in some way, this is prohibitive.

That well-defined HRM practices are used on a given farm indicates that management is implementing tools to improve the quality of the labor input. Thus, this serves as a measure of HRM effort, rather than a measure of actual improvement in labor quality. In the absence of such an objective quality measure, however, the next best measure is one in which effort is assessed.

The primary objectives of this research are to provide a theoretical and empirical analysis of the impact of HRM on farm profitability. We argue that the incorporation of data on the implementation of HRM practices may well lead to an improved understanding of the factors that affect farm profitability. Specifically, this and proposed future work will lead to a more complete understanding of the empirical impact of HRM practices on farm profitability. This information would be useful to researchers, extension educators, farm business consultants, and policy makers who establish research funding priorities.

2. Literature Review

Many studies have analyzed the relationships between farm profitability and a number of factors that may impact it. We provide a brief overview below, assessing the non-HRM and HRM-related variables typically included in such studies. A more thorough review focusing on dairy farm profitability was recently provided by Gloy, Hyde, and LaDue (2002). Interested readers are encouraged to refer to that for details beyond the scope of the current objectives. For information on a broader set of farm types, readers are directed to Fox, Bergen, and Dixon (1993) or Rougoor, et al (1998).

Additionally, there has been some non-farm analyses of the type performed here. However, these tend to be performed on publicly-traded companies about which a great deal of data are available and the researchers' measure of profitability is typically the firm's market capitalization. While a thorough review of that literature is not provided here, interested readers are directed to Huselid, Jackson, and Schuler (1997) and Huselid (1995) for two representative examples of those studies. Note that HRM programs are positively related to profitability in those studies.

2.1 Choice of Profitability Measure

Researchers have differed in their selection of an appropriate measure of profitability to use as the dependent variable. Some have used cash measures of income, either net income or returns to labor and management (e.g., Haden and Johnson, 1989; Kauffman and Tauer, 1986; Mishra and Morehart, 2001; Melichar, 1979; and Ford and Shonkwiler, 1994). Others have used ratios of income to some measure of assets. Purdy, Langemeier, and Featherstone (1997) as well as Kauffman and Tauer (1986) use the farm's return on equity assets (ROE). Plumley and Hornbaker (1991) divide income measures by the amount of tillable acres and farm equity to calculate their measures.

Gloy, Hyde, and LaDue (2002) use the farm's rate of return on farm assets (ROA). They argue that this is the most appropriate because it accounts for the use of debt financing and farm size. Therefore, it accurately measures the returns as a percentage of all assets, both debt and equity, invested in the farm business. The use of relative measures, such as ROA and ROE, leads to a more straightforward interpretation of differences in farm performance regardless of farm size. For research like that described here, this is a compelling feature because farms in our data set differ greatly in size.

2.2 Non-Human Resource Management Factors

Explanatory variables in these types of studies can be categorized into four groups. The first, farm and operator demographics, includes variables such as farm size (acreage and/or head of livestock), age of the operator, and education level of the operator. Often, farm size is found to be statistically significant in explaining farm profitability (Purdy, Langemeier, and Featherstone, 1997; Ford and Shonkwiler, 1994; Kauffman and Tauer, 1986; and Gloy, Hyde, and LaDue, 2002), even when relative measures of profitability are used.

However, operator age and educational attainment are not as robust in explaining farm profitability. Haden and Johnson (1989), for example, find that operator age is statistically significant in explaining two of their three measures of profitability. In these cases, its coefficient is negative. Purdy, Langemeier, and Featherstone's (1997) results are consistent with these findings. Kauffman and Tauer (1986) do not find a significant relationship in their study, however. Mishra and Morehart (2001) find that attainment of a college education is significant in explaining returns to operator's labor and management. Finally, Gloy, Hyde, and LaDue (2002) find no significant relationships between profitability and their measures of age or education.

The second group of variables, input use and production efficiency, provides measures of expenses on inputs such as feed, vet and medicine, and labor. Kauffman and Tauer (1986) find that hired labor per cow is a negative factor affecting farm profitability and that use of fertilizers has no impact. Haden and Johnson (1989) find that profitability is negatively impacted by forage production costs per cow and building and equipment values per cow. Wage rates are also shown to be negatively related to profitability by Gloy, Hyde, and LaDue (2002). Finally, Ford and Shonkwiler (1994) showed that expenses on veterinary services and medicine are positively related to farm profitability.

Financial management measures account for the third group of variables. Most frequently, these are comprised of financial ratios to provide a view of the farm's solvency, liquidity, and capital use. By far, the most commonly used ratio is debt-to-assets (DA) (Haden and Johnson, 1989; Mishra and Morehart, 2001; Gloy, Hyde, and LaDue, 2002; Plumley and Hornbaker, 1991; Purdy, Langemeier, and Featherstone, 1997; and Kauffman and Tauer, 1986). Ford and Shonkwiler (1994) use a ratio of equity assets to total assets, which represents 1 - DA. Other measures used include operating margin, debt per cow, current ratio, asset turnover ratio, ratios of individual to total expenses, operating expense ratio, and proportion of long-term assets. Most studies, however, use only one or two financial measures to explain farm profitability.

Finally, some research has incorporated variables to represent the use of specific production technologies or management practices. Researchers hypothesize that practices such as the use of advanced marketing tools and using production technologies such as milking parlors (relative to tie-stall or other operations), for example, are positively related to farm profitability. Mishra and Morehart (2001) show that the use of production and marketing contracts as well as forward contracting for inputs are both positively related to farm profitability. Gloy, Hyde, and LaDue's (2002) results indicate that profitability is positively impacted by use of milking parlor technology and the use of a farm accounting service.

2.3 Human Resource Management Factors

Several of the studies reviewed here attempt to capture the quality of human capital invested in the business by the farm operator. Human capital is obtained through formal learning and informal experience. Therefore, researchers use variables such as operator's age and education levels to proxy this. These results were discussed above. Some results also show that those farms that use cooperative extension services are more profitable than those who do not (Mishra and Morehart, 2001). However, HRM practices, those that relate to all employees, including the farm operator, have not yet been incorporated directly into studies of farm profitability.

3. Theoretical Justification

Consider a profit-maximizing firm with production function Y = Y(K, L) where Y is the firm's production from a given combination of capital (K) and labor (L). The implementation of an effective HRM program can be thought of as the adoption of labor-augmenting technology. Thus, the firm's production function can be modified; $Y_t = Y(K, A(t)L)$. A(t) is a function representing the factors that cause $\partial Y / \partial L$ to change over time. If A(t) represents the stock of human capital at time t, then $A(t) \geq A(t-1)$, assuming no depreciation of human capital. Levels of A(t) in excess of A(t-1) indicate that labor has been augmented and is more productive than it was previously.

Differentiating Y with respect to t yields

$$\partial Y/\partial t = \left(\partial Y/\partial K \cdot \partial K/\partial t\right) + \left(\partial Y/\partial A \cdot \partial A/\partial t \cdot L\right) + \left(A \cdot \partial Y/\partial L \cdot \partial L/\partial t\right), \tag{1}$$

or

$$\partial Y/\partial t = \partial Y/\partial A \cdot \partial A/\partial t \cdot L \tag{2}$$

assuming that the levels of capital and labor do not change over time[1]. This is a simplifying assumption. By normalizing the level of labor to unity, dividing both sides by Y, and multiplying the right hand side by A/A, equation 2 can be represented as

$$\frac{\partial Y/\partial t}{Y} = \partial Y/\partial A \cdot A/Y \cdot \frac{\partial A/\partial t}{A}. \tag{3}$$

Note that the left hand side is the growth rate of Y over time (G_Y) and the final argument is the growth rate in A over time (G_A). The remaining arguments represent the elasticity of output with respect to changes in A, denoted here as e_A. The resulting expression,

$$G_Y = e_A \cdot G_A \tag{4}$$

indicates that the growth rate of output is equal to the growth rate of technological progress (through effective HRM practices) times the elasticity of output with respect to technological progress. Thus, holding all else equal and assuming that e_A is positive, production will increase over time as employees improve their skills. The rate of growth depends upon the rate of change of skills and the parameters of the production function, which are incorporated into e_A.

Given that A(t)L, which we now define as Λ, is a measure of labor effectiveness, it follows that Λ increases as A(t) increases for a given level of L. Thus, any output level, say Y^*, can be produced with fewer units of L as A(t) increases. Alternatively, higher levels of Λ lead to higher levels of $Y > Y^*$. Now turn to the firm's profit function:

$$\pi = p \cdot Y(K,\Lambda) - vK - w\Lambda, \tag{5}$$

where π is profit, p is output price, and v and w are prices for capital and effective labor units. The firm's profit is increasing in Λ assuming that $p \cdot Y(K,\Lambda) > w\Lambda$ over a particular range of Λ. Whether or not profit is increasing in Λ, is an empirical concern.

4. Empirical Applications and Data

Regression analysis was used to assess the relationship between HRM and dairy farm profitability. To assess the robustness of the results, three alternative relative measures of profitability were used. These include the farm rate of return on assets (ROA), its rate of return on equity (ROE), and net farm income per cow (INCPCOW). Details of each of these models are presented with their discussions below.

The data do not allow us to calculate ROA and ROE according to Farm Financial Standards Taskforce (FFST) recommendations. Specifically, we do not have data on the operator's value of unpaid labor and management. We proxy this with the level of financial draws for family living. The calculations are consistent with FFST recommendations with that exception.

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[1] This theoretical model ignores issues related to economies of scale and economies of scope. Because we are only concerned with the impacts of HRM, the model we develop here focuses only on the impacts of A on farm profits. Analysis of economies of scale and scope is possible by relaxing the simplifying assumptions that the stock of capital and labor does not change over time. The derivation is similar to that developed here.

The data (Table 1) are from a 2001 survey of dairy farmers in Pennsylvania. These were collected as part of a study seeking to characterize well-managed dairy farms. Surveyors collected information on management and production practices as well as financial and production success. Because the scope of the project was broad, only 80 farms were originally included in the sample. Over the period of data collection, which was conducted via phone interview and three on-farm visits, about half of the farms chose not to complete the entire instrument. Thus, the analyses included in this paper reflect a small sample (31 farms in the ROA and INCPCOW analyses and 29 in the ROE analysis).

Table 1. Summary Statistics of Sample Data

Variable	Description	Mean	St. Dev.
ROA	Return on farm assets	6.03	13.00
ROE	Return on farm equity	10.43	26.05
INCPCOW	Net farm income per cow	556.13	801.62
EMPTOT	Number of employees (full time, part time, and seasonal)	10.23	8.70
DARATIO	Debt-to-asset ratio	51.75	26.78
HERDSIZE	Number of milking cows	280.33	263.44
ADVTEAM	Dummy = 1 if farmer has an advisory team	0.29	0.46
BUSPLAN	Dummy = 1 if farmer has a current written business plan	0.29	0.46
MARKET	Dummy = 1 if farmer uses advanced marketing tools	0.35	0.49
PARLOR	Dummy = 1 if farmer uses a milking parlor	0.87	0.34
SUCCESS	Dummy =1 if farmer considers finances the most important measure of success	0.77	0.43
AGE	Dummy = 1 if farmer is older than 40	0.71	0.46
EDUC	Dummy = 1 if farmer has any education beyond high school	0.65	0.49
DESCFULL	Dummy =1 if farm has job descriptions for full time workers	0.58	0.50
ANYSOP	Dummy = 1 if farm has at least one written standard operating procedure	0.55	0.51
QUALPERK	Dummy = 1 if respondent offers an incentive for milk quality	0.13	0.34
REVWFULL	Dummy = 1 if respondent has annual review of full time workers	0.32	0.48
HRTRAIN	Dummy = 1 if respondent has received HRM training	0.61	0.50

Note: n = 31 in ROA and INCPCOW analyses. n=29 in ROE analysis.

It is important to note that the data were collected from a small group of larger dairy farms. This will impact the conclusions that may be drawn from this analysis. Conclusions may be applicable only to larger dairy farms. However, it is also important to note that these farms are more likely than the average dairy farm to hire outside labor.

Note that each of our variables reflects only the current situation on the dairy farms. This may be important for some variables because of the timing of implementation of practices such as a business plan or an advisory team, for example. These variables equal one if they are currently in effect on the farm. If, for example, a farmer used an advisory team for some time and was able to increase profitability by doing so, yet has since disbanded the team, then that may impact our results. We do not know if this is the case, yet it is important to note this caveat.

5. Results and Discussion

This section provides a discussion of each model individually. It concludes with a review of all results, highlighting commonalities across models. Diagnostic tests on the regression errors were performed on all estimated equations. In all cases, ordinary least squares provided an appropriate model.

5.1 ROA Model

Overall, this model has good explanatory power, with an R^2 of 0.67. The results show several relationships that meet *a priori* expectations (Table 2). Advisory teams (ADVTEAM) are used on some farms to provide the owner with a broader perspective of the farm's operation. Individuals such as business consultants, accountants, nutritionists, and lenders may be part of an advisory team. Results indicate that the use of an advisory team has a strong positive influence on ROA.

Table 2. Estimated Regression Coefficients

Variable	ROA[a]	ROE	INCPCOW[a]
Constant	6.72	41.38	1944.7*
EMPTOT	-1.40	-4.60*	-81.74*
DARATIO	-0.19	-0.04	-14.67*
HERDSIZE	0.02	0.13*	1.38
ADVTEAM	24.17*	32.73*	1110.2*
BUSPLAN	-10.52*	-23.22*	-842.99*
MARKET	18.76*	32.09*	1060.8*
PARLOR	-6.46	-27.85	-448.79
SUCCESS	17.33*	13.79	681.78*
AGE	-0.64	-25.68*	-538.23
EDUC	7.14	4.97	74.00
DESCFULL	-6.22	-0.18	-144.03
ANYSOP	9.26	20.27	355.61
QUALPERK	14.37*	17.31	810.22*
REVWFULL	-1.06	-23.13*	-304.13
HRTRAIN	-14.67*	-15.19	-881.58*
R^2	0.67	0.72	0.59

* Indicates significance at a 10% or lower level.

MARKET, which indicates the use of advanced marketing practices such as options, futures, or hedging, is positively related to ROA. This is an indication that farmers who are able to assess market conditions and make appropriate risk-management decisions are more profitable than those who are not. This supports Mishra and Morehart's (2001) findings. Additionally, SUCCESS, which indicates that the farmer focuses on financial measures as key indicators of farm success, is also positively related to ROA. This provides evidence that farm managers focused on financial success as a key objective, rather than simply as a necessary condition to maintain production, are able to generate funds to meet current costs and to provide a pool for expanding the farm operation.

The only HRM practice that is significant and meets expectations is QUALPERK, a dummy indicating that the farm pays a bonus to workers based on the quality of milk produced. Results indicate that implementation of a quality bonus increases ROA by over 14 percent. This provides some evidence that incentives may lead to desired behaviors on dairy farms.

Two variables in this model have statistically significant coefficients yet their signs are not as was expected. BUSPLAN, indicating that the farm has a current written business plan, is negatively related to ROA. HRTRAIN, indicating that the farm owner has received formal training in HRM, is also negatively related. These relationships might match expectations if data were available to analyze the longer-term impacts of these two variables. Written plans are often required for farms requesting a loan, particularly for those farms that are not evidently profitable. Thus, it may be that the incidence of a written business plan is a corrective measure and that longer-term analysis might provide a better view of the true dynamic relationship. To the extent that HRTRAIN is also a corrective step to address profitability issues, then the same argument holds for that relationship.

5.2 ROE Model

This model provided the best fit of the three, with an R^2 value of 0.72 (Table 2). Although fewer variables are statistically significant in the ROE model, those that are significant are of the same sign as the ROA model. This indicates that the results are robust across these measures of farm profitability. The coefficients do tend to be larger in absolute value, however. This indicates a greater impact on ROE than on ROA. This makes sense given the profile of these farms, which have an average DARATIO of almost 52 percent.

AGE, which indicates that the farmer is older than forty, is negatively related to ROE. This is a surprising result given that age is as a proxy for managerial ability, or human capital. This result suggests that younger farmers are more profitable, perhaps due to increased focus on educational attainment beyond high school. Indeed, further analysis shows that only fifty percent of farmers over forty years old attained formal education beyond high school. Conversely, 100 percent of farmers who were forty or younger attained education beyond high school.

With respect to ROE, only REVWFULL is statistically significant. It has a large and negative coefficient, indicating that those farms with formalized review and feedback programs for full-time employees tend to be less profitable than those which do not have such a program.

5.3 INCPCOW Model

The data fit the model well, with an R^2 of 0.59, but not as well as the earlier models (Table 2). With the exception of EDUC, the same variables are statistically significant and of the same sign as the ROA model. This model yields little additional insight into the factors affecting farm profitability, including the HRM variables.

5.4 Summary of Results

In general, the models fit the data well and provide some insights into the impacts of HRM practices on dairy farms. Because the models yield very similar results, we conclude that the results are fairly robust across alternative measures of dairy farm profitability. In general, profitability is positively impacted by the presence of an advisory team, the use of advanced milk marketing practices, and the farmer's definition of success (i.e., whether or not success is measured by some financial statistic). In the ROA and INCPCOW models, profitability is positively affected by the use of milk quality premiums paid to employees. This is the only HRM variable shown to positively affect any of the profitability measures.

Profitability is negatively related to the number of employees, the debt-to-asset ratio, the existence of written business plans, and whether or not that farmer has been trained in HRM. In one model (ROE), age is shown to be negatively related to profitability. Many of these negative relationships are surprising. It is reasonable to expect, for example, that the number of employees might positively impact profitability. We conclude that either employees are overpaid on dairy farms or that there are too many people employed. Results for BUSPLAN, AGE, and HRTRAIN are also surprising.

The scale of the coefficients indicates large differences in profitability that could be achieved given changes in management practices. For example, the existence of an advisory team (ADVTEAM = 1) increase ROA by 24 percent, ROE by 33 percent, and INCPCOW by over $1,100 in the model. These are very large coefficients given that the mean values are about six percent, ten percent, and $550, respectively for ROA, ROE, and INCPCOW. Other variables such as BUSPLAN, MARKET, SUCCESS, QUALPERK, and HRTRAIN also have large coefficients.

6. Conclusion

This study expands the literature on factors affecting farm profitability by introducing specific HRM practices as explanatory variables. Our objective was to determine whether any of several HRM practices affected dairy farm profitability. The practices selected were job descriptions (DESCFULL), standard operating procedures (ANYSOP), premiums for milk quality (QUALPERK), and formal employee reviews (REVWFULL). These represent components of a well-designed, holistic HRM program. As noted above, milk quality premiums were positively related to profitability. This is the only variable that was positive and statistically significant. Its coefficients are relatively large, indicating an important impact on profits.

With that as our only positive statistically significant finding, our ability to strongly promote HRM programs is weak. However, profitability may not be the driving force for improving the quality of the labor input. The farmer may want to improve production efficiency such that fewer employees can be hired. Hiring fewer but better employees may not, in net, affect the wage bill. It will, however, lower the burden on the manager to oversee employees. Of course, these hypotheses cannot be tested here given available data.

Future research is warranted to better understand the link between HRM and farm profitability. Many university and government entities have programs to collect farm-level data, of the type needed to perform this analysis, on a regular basis. The marginal cost of collecting HRM-related data may be low for these well-established programs. However, the marginal benefit could be high if the data provide a better understanding of factors affecting profitability across farm types and geography. This work provides some insights on the types of data that may be collected. Some thought regarding specific practices versus general categories or practices (e.g., ANYSOP versus an SOP for milking, for feeding, etc.) would help to clarify the data needs.

Another potentially useful extension would be to use technology adoption models to assess the investment in labor-augmenting technology (HRM practices). This analysis analyzes only the net benefits of the decision. However, a disaggregated analysis of the costs and benefits of technology adoption might provide a greater understanding of the conditions under which the farmer should invest in HRM as a production technology.

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