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Department of Applied Economics and Management
Cornell University, Ithaca, New York 14853-7801 USA

U.S. Dairy Farm Cost Efficiency

Loren W. Tauer and Ashok K. Mishra

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Ashok K. Mishra*

Abstract

A stochastic cost efficiency equation was estimated for the U.S. dairy industry using national data from the production year 2000. The cost of producing a unit of milk was estimated into separate frontier and efficiency components, with both components estimated as a function of causation variables. Variables that might influence the cost of production and cost efficiency of an individual dairy farm were entered as impacting the frontier component as well as the efficiency component of the stochastic curve since *a prio*r both components could be impacted. The factor that has the greatest impact on the cost curve frontier is the number of hours a day the milking facility is used. Using the milking facility more hours per day decreased frontier costs. However, inefficiency increased with increased hours of milking facility use, such that there was no net reduction in costs. Thus farmers can decrease costs with increased utilization of the milking facility, but only if they are efficient in this strategy. Age increased cost of production since older farmers were less efficient. Parlors used for milking as compared to stanchion milking did not decrease frontier costs, but did decrease costs because of increased efficiency, as did the use of a feed nutritionist. Use of rotational grazing decreased frontier costs but also increased fixed cost inefficiency, with a net reduction in cost of production per cwt. of milk sold.

Introduction

The number of small dairy farms in the U.S. decreased significantly during the last decade, with farms having fewer than 100 cows decreasing from 159,866 operations in 1991 to 84,410 operations in 2000 (Blayney). Recent cost studies of dairy production have found lower unit costs associated with larger production units, explaining why

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smaller farms may have exited the dairy industry (Bailey et al.). However, Tauer and Mishra found that the efficient small U.S. dairy farm produced milk at a cost only slighter higher than the efficient large farm, but that the typical inefficient small dairy farm had much higher total cost than the efficient, or even the inefficient large dairy farm. The implication is that inefficient small dairy farms will continue to exit in a competitive milk market, but the efficient small dairy farm will not.

Tauer and Mishra also decomposed total cost into variable and fixed cost components and found that frontier variable cost was statistically flat and efficiency did not vary across farm size. That was not the case for the fixed cost component where the frontier cost decreased with farm size and larger farms on average were more cost efficient. Although it is a generally well accepted economic principle that fixed cost decreases with size due to cost economies, there is little research evidence to explain why fixed cost efficiency should change with farm size (Stefanou and Madden). Alvarez and Arias did find in Spanish dairy farms that observed diseconomies of size might be offset by sufficient increases in managerial ability, where managerial ability is measured by technical efficiency.

The purpose of this paper is to explore determinants of inefficiency to determine what managerial changes small as well as large dairy farms can make to become more cost efficient. This information would be invaluable in devising education or policy programs to ensure the U.S. dairy farm remains competitive in the world market. Causation is determined by estimating a stochastic unit cost curve where both the frontier and efficiency components of that cost curve are functions of causation variables. Both a stochastic total cost curve and stochastic fixed cost curve will be separately estimated.

Method

Although Tauer and Mishra found cost inefficiency by farm size in fixed cost, we first elect to decompose the total unit cost curve into frontier and efficiency components since there may be determinants not associated with fixed cost which may impact the frontier cost and cost efficiency. Most producers would like to minimize total per unit cost in a competitive market regardless of whether those costs are variable or fixed. Separately, the fixed cost of production only is estimated, decomposed into frontier and efficiency components to determine factors impacting fixed cost of milk production.

An average or unit total or fixed cost curve for a farm is estimated as a function of a covariate set X_i , an error term v_i, and an efficiency term u,

$$c_i = f(\mathbf{X}_i,\boldsymbol{\beta}) + v_i + u(\mathbf{Z}_i,\boldsymbol{\delta}), \quad u(\mathbf{Z}_i,\boldsymbol{\delta})\geq 0, \qquad (1)$$

where c_i is the cost of production per hundredweight of milk on farm i, $\mathbf{X}_i$ are the covariates which impact costs, and the v_i error term is independent of $\mathbf{X}_i$, $\mathbf{Z}_i$ and u. The efficiency term, u, is specified as a function of a set of covariates $\mathbf{Z}_i$, which may overlap with the covariate set $\mathbf{X}_i$. The $\boldsymbol{\beta}$ vector is the coefficients for the frontier cost curve, while the $\boldsymbol{\delta}$ vector is the coefficients for the efficiency cost curve.

The error term, v, is modeled as a normal distribution, iid $N(0,\sigma^2)$, while the efficiency term, u, is modeled as a truncated positive half-normal distribution specified as $N^+ (g(\mathbf{Z}_i), \sigma^2)$. This allows the error term for an individual farm observation to be either negative or positive, but the efficiency term u, which will be equal to or greater than zero, will shift with covariates $\mathbf{Z}_i$. An alternative specification for the efficiency term is $N^+ (0, h(\mathbf{Z}_i)^2)$, where the variance of the truncated half-normal changes with the covariates. Also, both mean and variance of the truncated half-normal can shift with covariates. We elect to shift the mean only, since shifting the variance as well as the frontier cost with the same covariates did not provide estimated results due to non-convergence. Even then, since $g(\mathbf{Z}_i)$ is the mean of the underlying distribution before truncation, both the mean and variance of the efficiency u are functions of $g(\mathbf{Z}_i)$ and σ^2. Estimation is by maximum likelihood simultaneously estimating the f and g functions with the specified error and efficiency structures. Since a stratified random sample was used in data collection, a weighted maximum likelihood model was employed with the weights applied to the likelihood function value of each data observation.

The procedure used is typically referred to as a stochastic cost function. Aigner, Lovell, and Schmidt; Battese and Corra; and Meeusen and van den Broeck introduced stochastic frontier production functions. They decomposed the typical error term of a regression model into an efficiency component plus a measurement error, and used maximum likelihood estimation to estimate simultaneously the parameters of the production function as well as efficiency and measurement error. The approach is now routinely used to estimate not only production but also profit and cost functions. More recently, beginning with Kumbhakar, Ghosh, and McGuckin; and Battese and Coelli, the efficiency component has also been simultaneously estimated as a function of causation factors. A recent discussion and assessment of the technique is Wang and Schmidt.

Since variables in set **X** and set **Z** may overlap, a change in those variables will impact cost in two ways. One impact will be a shift in the frontier curve; the other impact will be a change in efficiency. The impact from the frontier cost curve is simply the first derivative of the frontier cost curve with respect to the variable x_k as:

$$\partial f(\mathbf{X}_i,\boldsymbol{\beta})/\partial x_k \qquad (2)$$

where the marginal impact is the same for each firm with identical covariate values.

The impact of a variable k on efficiency will be firm specific, however. Wang showed how the marginal effect on firm efficiency is calculated when either or both the mean and variance of the truncated normal are functions of the covariates. We estimated only the mean as a function of the covariates. Specifying g as a linear function, g=$\mathbf{Z}*\boldsymbol{\delta}$ such that $\mu_i = \mathbf{Z_i}*\boldsymbol{\delta}$, and defining $\Lambda= \mu_i/\sigma_i$, and $\lambda= \varphi(\Lambda)/\Phi(\Lambda)$ where φ is the normal probability function and Φ is the normal cumulative function allows computing the expected marginal efficiency impact of a variable x_k on farm i as:

$$\partial E(u_i)/\partial x_k= \delta_k*(1-\Lambda*\lambda-\lambda^2) \quad (3)$$

where the term $(1-\Lambda*\lambda-\lambda^2)$ will vary by farm, but δ_k will be constant across farms.

The frontier and efficiency components of equation (1) were estimated jointly using Maximum Likelihood Estimation. The data had been collected using a stratified random sample with an enhanced sample of larger farms since few large farms would have been surveyed with a random sample. Since a stratified random sample was used, a weighted maximum likelihood model was employed with the weights applied outside the likelihood value of each observation.

Data

Data are from the Dairy Production Practices and Costs and Returns Report (Agricultural Resource Management Survey Phase II, commonly referred to as ARMS). These data were collected by a survey jointly administered by the National Agricultural Statistics Service and Economic Research Service of the USDA for dairy production during the calendar year 2000. The survey collects data to measure the financial condition and operating characteristics of farm businesses, the cost of producing agricultural commodities, and information on technology use and management practices. Unfortunately, prices of inputs were not collected and thus it was not possible to estimate a standard cost function where cost is a function of input prices. Rather, cost per hundredweight of milk produced will be estimated as a function of farm characteristics and practices, which we will refer to as a cost equation.

The target population for the survey was farms milking 10 or more cows in the 22 major dairy states. The sample is a multi-frame, probability-based survey in which farms were randomly selected from groups of dairy farms stratified by farm characteristics such as farm size, with greater coverage in the primary dairy production states. The survey design allows each sampled farm to represent a number of farms that are similar, the number of which being the survey expansion factor. The expansion factor, in turn, is defined as the inverse of the probability of the surveyed farm being selected. On-farm enumerators collected the data using a 36-page survey instrument.

Dairy costs and returns for each farm have been calculated by the USDA and are used to compute the cost of production per hundredweight of milk sold (Short). The costs include all costs, including family labor and capital costs. To calculate the total cost of producing milk per hundredweight of milk, sales of livestock and other non-milk income were subtracted from total farm costs, which were then divided by the hundredweight of milk sold. This approach presumes that the primary operation on these farms is milk production and the cost of producing other income is equal to that income. The fixed cost of milk production was extracted from total cost. Fixed costs include family labor and capital costs. The dependent variables were then the total unit cost of producing milk and the fixed unit cost of producing milk where units are the hundredweight f milk sold from each farm. Milk is priced and sold in the U.S. by hundredweight. These cost values were not transformed in logarithmic values.

Total costs per hundredweight of milk ranged from 2 negative values to 17 observations with costs over $100 per hundredweight of milk. Scrutiny of these farms revealed a variety of possible reasons for these extreme cost values. Some had large cattle sales, probably reflecting a profitable cattle-breeding program. Others had extremely low production levels. Since many other reasons may also have been responsible for extreme values, it was decided to use only farms with total cost greater than $4.00 and less than $35.00 per hundredweight of milk sold. Other farms were deleted because of missing age and experience data. This resulted in 749 observations. New weights were computed for the maximum likelihood estimation and estimated average efficiencies.

Variables that might influence the cost of production and cost efficiency of an individual dairy farm are uncommon in farm data sets, but a number of these were collected in the survey instrument. These are reported and defined in Table 1. Each variable was entered as impacting the frontier component as well as the efficiency component of the stochastic curve since *a prio*r both components could be impacted. An example is the years of formal education of the farmer. Greater formal education may allow farmers to select the lowest cost technology to define the frontier cost function, and that education may also allow that farmer to be efficient in the use of that leading edge technology. The continuous variables COWS, AGE, and INTENSE were entered in natural logarithmic form to produce a non-linear response to these variables. The only other continuous variable EXPERIENCE was not converted to a logarithmic value since it is highly correlated with the AGE variable. All remaining variables have (0,1) values. Since the included explanatory variables are not exhaustive, farm size as determined by the number of cows was included in the regressions to pick up residual frontier and efficiency costs correlated with farm size, serving as a proxy for these latent variables.

Results

Table 2 lists the estimated total unit cost stochastic cost curve and the estimated fixed unit cost stochastic cost curve, both decomposed into frontier and efficiency components. The estimated frontier total unit cost curve has an intercept of 22.90 and a coefficient of 1.23 on log(cows), although the coefficient on log(cows) is only statistically significant at probability=0.07. This implies that the frontier total unit cost increases slightly with size of the farm. This contrasts to the results of Tauer and Mishra who found no relationship between frontier total unit cost and size, when farm size was the sole explanatory variable. However, Hock, Dawson and others have found diseconomies of size in dairy farming, so when causation factors are added, many of which are associated with farm size, the residual frontier efficiency apparently displays diseconomies of size.

The estimated frontier fixed unit cost curve in contrast has a coefficient on log(cows) which is statistically insignificant, supporting constant returns to size in frontier fixed costs, whereas Tauer and Mishra found economies of size in frontier fixed unit costs, but again they did not include additional variables. The remaining variables in the fixed unit cost model must explain the variation of frontier unit cost across farms because farm size explains no remaining frontier cost. The implication is that the estimated fixed unit cost model has found those factors normally associated with farm size which changes frontier fixed unit cost.

Total Cost Estimate

The total unit cost frontier displays diseconomies of size. Going from the sample average of 125 cows to 225 cows, for instance, would increase the frontier unit cost curve by $0.85 per cwt. However, these larger farms are more cost efficient, leading to a net unit cost reduction as discussed later. Utilizing the milking system more intensively each day lowers the frontier total unit cost. The average hours milking systems are used each day on these farms is 5.5. If those systems were used up to 10.5 hours per day then the frontier total unit cost will fall by $2.55. As will be discussed later, however, inefficiency increases with greater intensity of use, offsetting much if not all of the frontier total unit cost saving depending upon usage increase, since the relationships are non-linear.

Grazing, which is more common on small dairy farms, decreases the total frontier unit cost by $2.43. The only other variable that is statistical significance is the age of the operator, which would decrease the frontier total unit cost curve by $0.69. Older farmers often have access to the newest technology so it would be expected that frontier unit costs might be lower for older farmers, although as discussed later, those older farmers are also less efficient.

Variables statistically significant in the efficiency component of the estimated total unit cost equation were the number of cows, age of the operator, use of a parlor for milking, use of a feed nutritionist, and intensity of using the milking system. Larger farms are more efficient and older operators are less efficient. The use of a parlor for milking increases efficiency, but using the milking system more intensively decreases efficiency. The use of a feed nutritionist increases efficiency, but what specific services these feed nutritionists provide to these farm was not questioned in the survey form, and may have ranged immensely in level of service. This variable may be a proxy for use of production advice in all facets of the business.

The impact statistically significant variables have on efficiency cost measured in hundred weight of milk is farm specific as given by equation (3). However, average impacts of these factors can be averaged over all farms using the stratified sample weights. The average weighted value of the term $(1\text{-}\Lambda^*\lambda\text{-}\lambda^2)$ was 0.66, so each estimated coefficient δ_k in the efficiency coefficients section of Table 2 was multiplied by 0.66 to arrive at per unit costs of efficiency for each variable. Table 3 shows these impacts along with the impacts from the corresponding frontier component if those corresponding variables were statistically significant.

Non-logged variables have a constant impact on both frontier and efficiency costs. Thus the use of a parlor does not decrease the frontier total unit cost (statistically) but would increase efficiency by $2.11 per cwt. of milk produced. Likewise, the use of a feed nutritionist does not decrease the frontier total unit cost but would increase efficiency by $2.62 per cwt. of milk. In contrast, grazing reduces frontier total unit cost by $ 2.43 per cwt., but increases inefficiency unit cost by $1.87, leading to a net unit cost decrease if $0.56. Impacts of the remaining logged variables depend upon beginning and ending values of these variables. Increasing cows from the sample weighted average of 125 to 225 would have a net impact of -$3.03 on combined total unit cost, consisting of an increase of $0.85 in frontier unit cost, but decease of $3.88 in inefficiency unit cost. Thus larger farms on average have lower net unit costs. A farmer who is 48 years old (sample average) compared to a farmer who is 58 years old would be more inefficient by $1.20.

Increasing use of the milking system from the sample average of 5.5 hours per day to 10.5 hours would increase combined total unit cost by $1.51. The frontier total unit cost would decrease by a significant $2.55, but inefficiency unit cost increases by $4.06. Thus increased utilization of the milking facilities would decrease frontier total unit cost as expected, but efficiency falls. Optimal use would be where the marginal increase in efficiency unit cost is equal to the marginal decrease in frontier unit costs, but since the marginal increase in efficiency unit cost is $6.28 per hour of use, and the marginal decrease in frontier unit cost is lower at $3.94 per hour of use, it is clear that optimal use from these estimates is a reduction in use.

A number of variables did not impact the frontier total unit cost or unit cost efficiency. Most significantly, the use of a computer in the milking system or the feeding system did not appear to have an impact. However, only 7 percent or about 53 of the survey farms used a computerized milking system and only 9 percent used a computerized feeding system. Over half, or 59 percent of the farms forage tested, but that did not have an estimated impact on either the frontier total unit cost or unit cost efficiency. Finally, neither the number of years of formal education nor whether the farm is multi-managed had an impact on the frontier total unit cost or total unit cost efficiency.

Fixed Cost Estimate

The fixed unit cost estimates of the frontier and efficiency components are similar to the total unit cost estimates of those components with a few differences. Strongly statistical significant variables from the total unit cost estimates carry over to the fixed unit cost estimates with similar coefficient estimates. Thus, for example, intensity of using the milking system reduces frontier unit costs but increases inefficiency in both the total and fixed unit cost estimates.

One difference is that now the existence of a multi-owned farm shifts the frontier unit cost up by $1.02. That may seem contrary to the concept of substitution of labor for capital since more operators would seem to allow a possible reduction in capital and thus fixed unit cost, but many of the multi-owned farms are large, with significant hired labor and the substitution is capital for all labor. Age now has a statistically significant impact on cost. A farmer 58 years old would have a lower frontier unit cost of $0.37 compared to a 48 year old farmer. Again intensity of using the milking system reduces frontier fixed unit cost by $1.25 as compared to a reduction of $2.55 in total frontier unit cost. Milking more intensely not only spreads out capital cost, but also appears to save other costs. Rotational grazing reduces the frontier fixed unit cost by $2.27, as compared to a reduction in total frontier unit cost of $2.43. Thus grazing appears to mostly economize on fixed costs, which is understandable since machinery costs can be reduced.

The average weighted value of the term $(1-\Lambda^*\lambda-\lambda^2)$ was 0.58 for fixed unit cost, so each estimated coefficient δ_k in the efficiency coefficient section of Table 2 was multiplied by 0.58 to arrive at per unit costs of efficiency for each variable reported in Table 3. Results for fixed unit cost efficiency are similar to total unit cost efficiency with some differences. Combined unit costs still decrease with farm size, with fixed unit costs falling $2.98, whereas total unit costs fell $3.03. The use of a milking parlor decreased net fixed unit cost by $1.51 whereas net total unit cost had decreased by $2.11. Major differences were that multiple owner businesses and education impacted net fixed unit costs, while those variables did not impact total unit costs.

Although multi-owned farms increased frontier fixed unit cost, those types of farms also reduced inefficiency, for a net impact on combined fixed unit cost of -$0.55. It appears that two or more heads for decision making is better than one, since unit cost efficiency is improved. Education, surprising, decreases fixed unit cost efficiency. Those with more than a high school education were more unit cost inefficient by $0.95 per hundredweight in their use of fixed costs. This inefficiency did not carry over to total cost efficiency.

Grazing did decrease frontier fixed unit cost but increased fixed unit cost inefficiency, whereas grazing had decreased frontier total unit cost but did not impact frontier unit cost efficiency. The net impact is for a reduction in net fixed unit cost of only $0.79 where total unit costs were reduced by $0.56 with grazing.

Conclusions

A stochastic cost efficiency equation was estimated for the U.S. dairy industry where both the unit cost frontier and unit cost efficiency is a function of causation variables. USDA data from the production year 2000 were used. Both a total unit cost and fixed unit cost of producing a unit of milk were estimated into separate frontier and efficiency components. As would be expected, most variables which influence the fixed unit cost frontier or fixed unit cost efficiency were also determinates of the total unit cost frontier or total unit cost efficiency. The most significant factors which decrease production costs, other than farm size, are use of a feed nutritionist and then use of a parlor for milking.

The factor that has the greatest impact on the total unit cost frontier is the number of hours a day the milking facility is used. Using the milking facilities more hours per day decreased frontier unit costs. However, inefficiency increased with increased hours of use such that there was no net reduction in unit costs. Thus farmers can decrease costs with increased utilization of the milking facilities, but only if they are efficient in this strategy. Age increased unit cost of production since older farmers were less efficient. Parlors did not decrease frontier unit costs, but did decrease unit costs because of increased efficiency, as did the use of a feed nutritionist. Use of rotational grazing decreased frontier unit costs but also increased fixed unit cost inefficiency, with a net reduction in cost of production per cwt. of milk sold.

Table 1. Variables Used to Estimate Frontier and Efficiency Unit Costs, U.S. Dairy Farms, Year 2000.

Variable Name	Definition	Weighted Average Value
COWS	Average number of milking cows during the year	125
FARMORGD	Type of ownership 1=partnership, family corporation, non-family corporation, other 0=individual	0.22
OP_AGE	Age of first or principal operator	48
PARLORD	Use of parlor to milk cows 1=parlor 0=no parlor (stanchion milking)	0.39
EDUC	Years of formal education 1=Beyond high School 0=High school or less	0.30
EXPER	Years making farm/ranch decision	24
COM_MILK	Computerized milking system 1=yes 0=no	0.07
COM_FEED	Computerized feeding system 1=yes 0=no	0.09
FEED_NUT	Use of a feed nutritionist 1=yes 0=no	0.72
FOR_TEST	Uses forage testing 1=yes 0=no	0.60
INTENSE	Hours per day milking system used	5.5
GRAZE	Use of rotational grazing 1=yes 0=no	0.22

Table 2. Estimated Frontier and Efficiency Unit Cost Components for U.S. Dairy Farms, Year 2000.

	Total	Unit Cost		Fixed	Unit Cost	
Variable Name	Estimate	Estimate / S. E.	Prob. (H_0:B_k=0)	Estimate	Estimate / S. E.	Prob. (H_0:B_k=0)
Frontier						
CONSTANT	22.90	2.74	0.01	13.90	4.14	0.00
Log(COWS)	1.23	1.82	0.07	-0.05	-0.19	0.85
FARMORGD	0.85	1.07	0.29	1.02	2.67	0.01
Log(AGE)	-3.62	-1.64	0.10	-1.95	-2.11	0.03
PARLORD	1.24	1.33	0.18	-0.06	-0.18	0.86
EDUC	-0.26	-0.38	0.71	-0.34	-1.13	0.26
EXPER	0.04	1.05	0.29	0.02	1.21	0.23
COM_MILK	-0.96	-0.68	0.50	0.78	1.27	0.20
COM_FEED	0.49	0.34	0.73	-0.46	-0.89	0.37
FEED_NUT	0.58	0.48	0.63	0.96	1.70	0.09
FOR_TEST	0.39	0.45	0.65	-0.09	-0.24	0.81
Log(INTENSE)	-3.94	-3.48	0.00	-1.94	-3.38	0.00
GRAZE	-2.43	-2.11	0.04	-2.27	-4.16	0.00
Efficiency						
CONSTANT	5.40	0.37	0.71	11.03	1.20	0.23
Log(COWS)	-8.48	-4.36	0.00	-7.42	-3.91	0.00
FARMORGD	-1.32	-0.94	0.35	-2.71	-2.41	0.02
Log(AGE)	9.63	2.21	0.03	10.24	3.12	0.00
PARLORD	-3.19	-1.90	0.06	-2.60	-2.42	0.02
EDUC	0.79	0.64	0.52	1.63	1.74	0.08
EXPER	0.05	0.73	0.46	0.03	0.59	0.55
COM_MILK	1.09	0.44	0.66	-0.99	-0.57	0.57
COM_FEED	0.72	0.28	0.78	1.55	0.99	0.32
FEED_NUT	-3.97	-2.68	0.01	-4.64	-3.24	0.00
FOR_TEST	0.64	0.49	0.63	1.04	1.31	0.19
Log(INTENSE)	9.52	3.82	0.00	6.76	3.46	0.00
GRAZE	2.84	1.67	0.09	2.56	2.48	0.01
$(1-\Lambda^*\lambda-\lambda^2)$	0.66	2.95	0.01	0.58	2.25	0.03
σ_v	1.83			0.71		
σ_u	6.60			5.45		
N	749			749		

Table 3: Impact of Statistically Significant Variables on Frontier Unit Cost and Efficiency Unit Cost, U.S. Dairy Farms, Year 2000.

Variable	Total Unit Cost Frontier	Eff.	Combined	Fixed Unit Cost Frontier	Eff.	Combined
CONSTANT	$22.90	$ 0.00	$22.90	$13.90	$ 0.00	$13.90
Log(COWS) 125 to 225 cows	$ 0.85	-$ 3.88	-$ 3.03	$0.00	-$ 2.98	-$ 2.98
FARMORGD	$ 0.00	$0.00	$ 0.00	$1.02	-$ 1.57	-$0.55
Log(AGE) 48 to 58 years	-$ 0.69	$ 1.20	$ 0.52	-$0.37	$ 1.12	$0.75
PARLORD	$ 0.00	-$ 2.11	-$ 2.11	$0.00	-$ 1.51	-$1.51
EDUC	$ 0.00	$0.00	$0.00	$0.00	$ 0.95	$0.95
FEED_NUT	$ 0.00	-$ 2.62	-$ 2.62	$0.96	-$ 2.69	-$1.73
Log(INTENSE) 5.5 to 10.5 hours	-$ 2.55	$ 4.06	$ 1.51	-$1.25	$ 2.54	$1.28
GRAZE	-$ 2.43	$ 1.87	-$ 0.56	-$2.27	$ 1.48	-$0.79

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