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Practitioner's Abstract

Commingling cattle in the feedlot increases the odds of cattle getting sick. However, backgrounded cattle are less susceptible to diseases which allow the generalizing statements like "backgrounding is just like single source". Using data from over 15,000 cattle fed in 12 Iowa feedlots, we show that although backgrounded cattle do better than preconditioned cattle commingled in the feedlot, they have poorer carcass quality, health, and performance than single source cattle. Backgrounded cattle should be discounted $8.24/head relative to single source, and only received a small premium over multi-source preconditioned cattle though not significantly different.

Keywords: Cattle, Backgrounding, commingling, profitability, source

Introduction

The US cattle industry is made up of 770,000 farms with beef cows producing feeder cattle of which over 85% are fed in approximately 2200 feedlots. The pen size in many feedlots will hold 150-200 head of cattle, but nearly a third of the calves are born on farms with less than 50 cows. While there are some ranches that have a large enough herd to produce uniform pens of cattle for feeding, commingling of cattle into larger lots to fill trucks and feedlot pens is a business reality. How cattle are managed shortly before weaning until arrival at the feedlot can greatly impact the performance and profitability of the cattle in the feedlot as it impacts the health of the animal.

Busby, et al. found that the number of times that a feedlot steer or heifer was treated for illness was inversely related to feedlot performance, quality grade, and numeric yield grade. Ibarburu and Lawrence also found a negative impact on carcass quality grade associated with treatments and some feedlots are willing to pay more for feeder cattle that are double vaccinated at auction (Ibarburu, Doran, and Lawrence).

Yet there remains confusion about semantics and management practices and which have value and when. Preconditioning programs involve a series of management practices on the ranch to improve health and nutrition of calves (Avent, Ward, and Lalman). Typically, preconditioning involves vaccination for selected disease, particularly respiratory diseases, and weaning 30-45 days or more and a sound nutritional program. Lalman and Smith conclude, "Conservatively, preconditioning may capture $50 to $75 per head of additional value from weaning through the packing phase compared to a production system where weaning, vaccination, and other management practices associated with preconditioning occur after shipment from the ranch of origin."

Another commonly used feeder cattle management practice is backgrounding. McKinnon and Snodgrass refer to backgrounding as the time and functions between the cow/calf and finishing sectors. Feeder calves are under stress during this adjustment period of weaning, shipment, and diet change and are most susceptible to respiratory disease. Backgrounders also provide a repackaging service for the industry by putting together relatively small groups of calves, transition them through the weaning period, add weight to the calves, then package and market the feeder cattle in larger, more uniform lots. The resulting groups of feeder cattle are through a stressful time and therefore less likely to be sick in the feedlot.

The exact definitions and differences between preconditioning and backgrounding may differ, and there are similarities and important differences between them. For the purpose of this study preconditioning is defined as cattle that have been properly vaccinated, started on feed, and held on the farm of origin for at least 45 days before being commingled with other cattle at the feedlot. Backgrounding in this study is defined as cattle commingled at weaning with other cattle, vaccinated, and started on feed at least 45 days before going to the feedlot. The question is whether preconditioned cattle commingled at the feedlot are comparable to backgrounded cattle that were commingled prior to entering the feedlot?

This research evaluated 15,349 head of retained ownership cattle fed in 144 groups or pens that were either commingled and background prior to the feedlot or as preconditioned cattle that were commingled at the start of the feeding period in the feedlot. Furthermore, preconditioned cattle are evaluated using single, two or three, and four or more sources to determine if the number of source of preconditioned cattle commingled in a feedlot pen has a physical or economic impact. The cattle were compared on feedlot performance, carcass grade, and feedlot profitability to address the following objectives:

- Does the source or number of sources impact feedlot performance and carcass value?
- Are backgrounded cattle "*as good as*" single source cattle?
- How much adjustment can a feedlot afford to pay for cattle due to number of sources and pre-feedlot management?

Model Specification and Estimation

In order to estimate the feedlot and carcass performance of preconditioning and backgrounding, five different models were estimated. Discrete choice models for health performance (H), Quality grade (Q) and Yield grade (Y) and least squares estimation for estimating average daily gain (ADG) and profit equations. The general specification of the model estimated is of the form:

$$G = f(Z, \varphi, \ \varepsilon)$$

Where G in the case of the discrete choice models are discrete binary variables where for ADG and profit they are continuous variables. Z is the matrix of independent variables, φ is a vector of parameters (not limited to coefficients of independent variables), and ε is a vector of random disturbances. For the discrete choice models, it is assumed that:

$$\varepsilon | Z \ \sim \Lambda(0, \pi^2/3)$$

Therefore, the probability of an event occurring has a logistic distribution defined as:

$$\Pr(G = 1) = [1 + \exp(-Z\varphi)]^{-1},$$

For the least squares estimation, the statistical model fitted is:

$$G \sim N(Z\varphi, \sigma^2 I).$$

To avoid problem of endogeneity, a reduced form of the structural equations for each model was estimated. This is because, for example, what is not observed that affects the health of an animal will probably affect the carcass grading of the animal and hence it's profitability. The shortcoming of doing this is that the interactions between these different models especially for the profit equation are not captured. For the least squares regressions, the robust standard error was reported to correct for heteroscedasticity in the disturbance term.

Health: On the health of the cattle in the feedlot, a logistic model was used to estimate the odds of an animal to be healthy (not treated for illness) conditional on it having been preconditioned or backgrounded and other characteristics such as: age at delivery, weight at delivery, group health treatment, and dummy variables for season of delivery.

A priori, it is expected that the older the animal is at delivery, the lower its probability of getting sick, while animals that are heavier at delivery is also a sign of it been healthy. Also, season of delivery is a factor in cattle health with higher health risk for animals delivered in a particular season.

Average Daily Gain: A least square model was used to estimate the average daily gain in the feedlot. In addition to the source variables, age at delivery, sex, delivery weight, delivery condition score, disposition score, group health treatment, delivery season, and observed breed were also controlled for.

We expect that steers will gain more than heifers and wild animals will gain less than calm animals. Also, we expect that the heavier a cattle is at delivery, the less it will likely gain at the feedlot.

Quality Grade: A logistic model was used to estimate the probability of grading high quality vs. low quality. High quality grade cattle are characterized as grades of average Choice (Ch), upper Choice (Ch^+), and Prime. This probability was estimated conditional on commingling information, sex, days of age, on test weight, days on feed, disposition score, delivery season, and breed.

In line with previous studies, it is expected that British will have better quality than other breeds and that steers will have lower quality than heifers with cattle delivered in the fall/winter gaining the most (Busby et al and Ibarburu and Lawrence).

Yield Grade: Also, for Yield grade a logistic regression estimating the probability of an animal having a high numeric yield grade (USDA YG 3,4,5) vs. low numeric yield grade (USDA YG 1,2) was estimated. A YG 1 carcass is expected to have the highest percentage of boneless, closely trimmed retail cuts, or higher cutability, while a YG 5 carcass would have the lowest percentage of boneless, closely trimmed retail cuts, or the lowest cutability. The same variables as in the quality grade were controlled for.

Steers are expected to have lower yield grade than heifers with continental being the leanest of the breeds. Also, delivery season affects the risk of disease and the yield grade.

Profit: Lastly, a least squares model was used to explain the impact of source variables and other factors on profitability of the cattle controlling for sex, delivery age and weight, hot carcass weight, disposition score, group health treatment, delivery season, and breed.

Heifers are expected to be more profitable than steers in the feedlot (Ibarburu and Lawrence) and we expect that delivery age will positively affect profit though at a decreasing rate and delivery weight is also expected to negatively affect profit at the feedlot since most of the profit would have accrued to the producer. Also, since single source cattle are healthier and have a higher carcass quality than other commingled cattle, they should be more profitable.

An alternative to modeling health, quality grade and yield grade as binary choices is to have more than two alternatives/grades. That is modeling health as healthy, sick once, sick more than once; quality grade as Ch, Ch^+ and Prime as one group, Ch^- as the base group and Select and Standard as the last group; and yield grade in the order $\{(1,2),(3),(4,5)\}$. The conclusions were however similar when this approach was used in terms of the relationship between single source and backgrounded cattle.

To be able to make comparison between single source and commingled cattle, an odds ratio is computed. An odds ratio is defined as the ratio of the odds of an event occurring in one group to the odds of it occurring in another group, or to a data-based estimate of that ratio. In our case, these groups will be single source and commingled cattle. So if the probabilities of the event in each of the groups are p (singles source) and q (commingled in the feedlot or backgrounded), then the odds-ratio is:

$$\frac{p/(1-p)}{q/(1-q)}$$

An odds ratio of 1 indicates that the condition or event is equally likely in both groups. And an odds ratio less than 1 indicates that the condition or event is less likely in the first group. The odds ratio must be zero or greater than zero. As the odds of the first group approaches zero, the odds ratio approaches zero. As the odds of the second group approaches zero, the odds ratio approaches positive infinity. The logarithm of the odds-ratio is the difference of the logits of the probabilities.

Data Description

Individual performance and carcass data from 15,349 calves fed in 12 Iowa Feedlots in 2001-2005 under the Tri-County Steer Carcass Futurity Cooperative (TCSCF) program is used for this study. All of the cattle fed in the TCSCF program are retained ownership cattle from beef cow-calf herds across 10 states. Cattle are traceable to birth and all have breed information for sire and dam, and birth date information. To get the breed of a cattle, an individual was classified British if it is 75% and above British, likewise continental. Cattle classified as Some Indicus are those that are 25% Indicus or more. Data observed at delivery is recorded. TCSCF collects and provides information to beef producers on feedlot performance including ADG, health treatment, disposition score, estimated individual feed efficiency and carcass grading.

There are 9870 steers and 3963 heifers. Only 65 of the single source cattle are heifers with 905 steer; 900 steer and 287 heifer for 2&3 sources; 2987 heifer and 7034 steer cattle for 4 or more sources and 2048 steer and 1123 heifer cattle in the backgrounding category.

In each feedlot, there are multiple pens of cattle where commingling of cattle from different owners occurs. An animal was characterized as single source if only one owner owns all the cattle in the pen. Likewise, it is considered 2 or 3 sources if there are two or three owners in the pen, and 4 or more sources if there are four or more owners in a pen. Information on animals that were backgrounded was provided by the manager of TCSCF. There are 4 or more owners of cattle in all of the backgrounded pens, but these cattle were commingled at weaning into a common backgrounding lot and raised for 60 or more days before being shipped to TCSCF feedlots.

One of the requirements for participation in the program is that the cattle have to be preconditioned before coming to the feedlot. The minimum preconditioning process include that four weeks prior to delivery at the feedlot, cattle treated for internal and external parasites, horns removed, and the bulls must be castrated, and proper immunization must have been done to all cattle. Also, they must have been weaned and started on a light ration at least 28 days prior to delivery. The backgrounded cattle were weaned and commingled in the backgrounding feedlot more than 28 days before entering the feedlot. Put another way, the single, 2 or 3, and 4 or more source cattle were preconditioned on the farm of origin before being commingled at the feedlot. The backgrounded cattle were commingled then put through a preconditioning program before arriving at the feedlot.

Of the 15,349 calves in our dataset, 970 (6%), in nine pens were single source, 1187 (8%), in 12 pens were 2 or 3 sources, 10,021 (65%), in 89 pens were 4 or more sources and 3,171 (21%), in 34 pens were backgrounded (Table 1). Single source and backgrounded cattle had a higher percentage of healthy cattle (Table 1). The 2 or 3 source cattle had a higher percentage of cattle treated at least once. There was little difference in the percent of cattle that were sick enough to require two treatments.

As expected, backgrounded cattle were the oldest (300 days) at delivery because they were held in a backgrounding yard followed closely by 4 or more sources that were 298 days old on average (Table 5). Single source and 2 or 3 sources cattle were 298 days old on average. Quality grade appears to have differed by number of sources (Table 2). Somewhat surprisingly the 2-3 sources cattle had the highest percent Choice in spite of having higher percent treated. This is counter to earlier work (Busby et al and Ibarburu and Lawrence). The 4 or more cattle had the lowest percent Choice and as may be expected the percent of Yield Grade 1 and 2 were higher for 4 or more sources, the leaner cattle (Table 3).

In order to estimate how much adjustment a feedlot can afford to make for backgrounded cattle, profit value for each cattle in the feedlot was estimated using standardized prices. This is to remove market variations on the parameters estimated. The price per head at delivery was estimated using the average for each month of auction markets in three Midwest states (Missouri, Kansas, and Oklahoma) adjusting for weight using a $5/cwt price slide from the USDA price reported (USDA, Agriculture Marketing Service) by Livestock Marketing Information Center (LMIC) to approximate the price the feeder cattle would have been sold to the feedlot. These prices differ by sex and month with steers priced higher than heifers at delivery. The five year average of monthly average from the National Carcass Premiums and Discounts for Slaughter Steers and Heifers reported by USDA Agriculture marketing service was used to predict the Choice-Select spread of the cattle. The monthly average of 12 years (06/1992-06/2004) fed-cattle price was used as the base price to calculate the profit. The monthly trend in price variability was calculated from the same dataset. The grid was built with the actual premiums and discounts that each combination of quality and yield grade would have received if marketed in 2005 (Table 4).

The feed price was adjusted by a corn price monthly index which was based on average price received by Iowa Farmers. That is, the average feed price of the dataset was multiplied by the average corn price index for the period the cattle were in the feedlot. Other costs like group health treatments, insurance and data collection fee was deducted from the revenue prorated per cattle. We however did not adjust the price for fleshiness which may have been higher on the backgrounded cattle.

Results

Health: The Logit coefficients on health suggest that the older and heavier the animal is at delivery to the feedlot, the higher the probability of it being healthy (Table 6). Also, the higher the amount spent on average on the cattle in each pen in the form of preventive health treatment of the lot, the healthier it will be. In line with Busby et al (2004), cattle delivered in the fall/winter are more likely to be healthy followed by those delivered in the spring.

Table 7 shows the odds ratio. For the continuous variables, an odds ratio greater than 1 implies that the variable leads to an improvement in health. Thus, age at delivery, weight at delivery, group health treatment all positively contributes to the health of an animal. These results further buttresses those of Faber et al (1999) that younger calves had higher BRD morbidity than older calves though their explanation that it is because younger calves have not been weaned will not suffice in our case since all the cattle in our sample are preconditioned and vaccinated.

For the discrete variables, the odds ratio showed that calves delivered in the fall/winter are about 0.7 times healthier than those delivered in the summer while those delivered in the spring are also about 0.6 times healthier than those delivered in the summer. A joint test showed that cattle delivered in the fall/winter are not statistically different from those delivered in the spring in terms of health though different from those delivered in the summer. This is intuitive because cattle delivered in the summer would have been born during the winter (9 months earlier) with higher risk and exposure which might affect their health in comparison to those delivered in other periods. Depending on the average delivery age of the data set used in Busby et al, we can argue that the results are similar.

In comparison to single source cattle, backgrounded cattle are about three times worse in terms of health but performed better than cattle that were commingled in the feedlot (Tables 6 and 7). This gives a quantitative explanation to Falkner's statement that even though an animal has acquired immunity and has been "straightened out," the disease stability of the group can be broken by commingling. This explains why commingled animals will perform worse than those that were not commingled and also explains why backgrounded cattle will still get sick in the feedlot even though they have acquired immunity to the disease. Thus cattle commingled in the backgrounding yard are healthier in the feedlot than their preconditioned counterpart commingled in the feedlot but not healthier than single source. All coefficients were significant at 5% level.

Average Daily Gain (ADG): As stated earlier, a least square model was used. Our result shows that steers gain more on average than heifers, those delivered in the fall/winter and spring gain more on average than those delivered in the summer but fall/winter and spring are not significantly different. This result is consistent with Busby et al. Also, the older an animal at delivery, the more it gains on average in the feedlot; the more expenses on preventive health treatment at the lot, the more the daily gain on average; British breed gain more on average than Continental, but Continental gain more than 25% Indicus but less than other breeds (Table 6).

Caution should be applied in the interpretation of the coefficient on the source variables and backgrounded because on average, backgrounded cattle have lower days on feed and higher delivery weight and the one with the largest impact might be difficult to capture. With this in mind, on the source variables, cattle commingled in the backgrounding yard on average gain less daily that single source, and cattle commingled in the feedlot. The feedlot appears to be giving up some compensatory gain on backgrounded cattle, but for retained ownership cattle, the owner of the cattle may be indifferent as to where the gain occurs.

Quality grade: From the logistic regression, heifers have higher odds of having high quality grade than steers; age increases the probability of grading upper Choice; cattle with a higher disposition score (1 being tame and 6 being aggressive) have a lower probability of grading upper Choice and cattle that are 75% British have a higher probability of grading upper Choice that those that are 75% continental or 25% Indicus. Cattle delivered in the spring have a lower probability of grading Choice and above than those delivered in the summer and fall/winter while those delivered in the fall/winter grades the best. This is expected since our earlier result showed that they are healthier. This result is also consistent with Ibarburu and Lawrence. From the odds ratio, days of age does not contribute much to having a high quality grade and cattle with different breeds grade differently (Tables 8 and 9).

Single source cattle have a higher probability of grading upper Choice than cattle commingled in the backgrounding yard and those commingled in the feedlot (Table 8). Commingling increases the acquired immunity of cattle to diseases but as stated by Falkner, some might be carriers of the disease in which case when exposed to others might result to disease outbreak and some may suffer performance degradation due to exposure. Our result shows that commingling of cattle result in increased risk of sickness which affects carcass quality of the cattle. Therefore, backgrounded cattle though are stronger and less vulnerable to diseases, previous diseases in the backgrounding yard has a large influence on their carcass quality.

Yield Grade: The results showed that heifers have a higher probability of having higher yield grade than steers; age and on test weight increases the odds of a high yield grade carcass; high disposition score reduces the probability of having a high yield grade; and cattle that are 75% British have higher probability of having a high yield grade than 75% Continental and 25% Indicus. Therefore, steers have lower quality grade but leaner than heifers; wild animals grade poorly and are also leaner than calm animals; fall/winter cattle have high quality grade but also have a higher yield grade; and Continental have a lower quality grade and are leaner than the other breeds all consistent with Ibarburu and Lawrence.

Single source cattle have higher probability of having a higher yield grade than those commingled. An explanation for this might be because commingled cattle are more challenged than those that are not commingled. The higher the rate of commingling, the more likely the cattle will be lean – 4 & more cattle are the leanest followed by backgrounded, then 2 & 3 then single source.

How much adjustment can a feedlot afford to pay?

Using a least square regression, the profitability of preconditioned and backgrounded cattle in the feedlot conditioned on other cattle characteristics is estimated. Steers were about $46 less profitable in the feedlot than heifers. The magnitude of this coefficient is counter intuitive in comparison to earlier results by Ibarburu and Lawrence. The result is sensitive to the nature of our data where singles source cattle had very few heifers and because an actual market does not exist between the farmer and the feedlot in our sample (they are retained ownership cattle), we had to approximate the delivery price for each feeder cattle which priced steers more than heifers. When the source variables were not included, the coefficient on sex was consistent with earlier studies. An explanation for this disparity is that the effect of health and some other factors were excluded from the profit equation. Further work will attempt to solve all the five models taking into consideration possible interaction (Table 10).

At delivery, heavier cattle are less profitable and older cattle are more profitable up to a certain age where it starts to reduce profitability (holding other factors constant, profit reaches its peak at delivery age of 550 days after which profit declines); fall/winter cattle are more profitable which is expected since are healthier and have high quality grade. Also, the heavier the carcass weight the higher its profitability though also reaches a maximum at 1380lbs after which profit starts to decline; and pen preventive treatment increases profitability of the cattle. British cattle are more profitable than all the other breeds and 25% Indicus are the least profitable and consistent with earlier studies.

The choice of commingling or buying backgrounded cattle by a feedlot manager factors in the price of the feeder cattle and the facilities available to them. On how much adjustment a feedlot can afford to pay for cattle due to number of sources and pre-feedlot management, these results show that a discount of $8/head on backgrounded cattle relative to single source cattle. There was no statistical difference between how much discount they should pay between cattle commingled in the backgrounding yard and those commingled with more than four sources in the feedlot.

Therefore, the management practice of not commingling at the feedlot will gives about $8 premium per head. The decision to commingle therefore relies in comparing the cost of commingling to the benefit in terms of ability to make use of more space. The joint significance of the source variables indicate that commingling is an important factor in determining feedlot profitability and according to Falkner, the management of purchased cattle to minimize disease exposure can pay huge dividends in managing diseases and is a critical part of the strategy to contain disease outbreak with compromises as regards to commingling will result in disappointments with the best cattle.

Conclusion

Information on the management practice used prior to the feedlot is quite valuable at the feeder auction; however, of more importance is commingling practice in the feedlot too in determining how profitable cattle will be. The pen size in many feedlots will hold 150-200 head of cattle, but nearly a third of the calves are born on farms with less than fifty cows. The feedlot manager therefore has to decide not to commingle in the feedlot and gain higher profit but loose space by not filling the pens or to buy backgrounded cattle that do well even when commingled in the feedlot but less profitable than single source. If backgrounded cattle are however priced the same as single source cattle at the feeder auctions, then the feedlot manager will probably find it more profitable not to commingle in the feedlot. In the even that commingling is inevitable for the feedlot, proper vaccination and practice like not commingling until after the cattle are all free of disease will be helpful in reducing the risk of disease (the risk of disease outbreak is usually higher when commingling occurs immediately the cattle arrive at the feedlot with some still shedding a significant number of pathogens).

This study has shown that the number of sources impacts animal feedlot performance and carcass value and that backgrounded cattle are not as good as single source cattle. However, the choice of commingling at the feedlot depends on the opportunity cost involved. Single source cattle are more healthier, have higher quality grade, with more fat and more profitable in the feedlot while backgrounding cattle are less susceptible to diseases and with better quality grade than cattle that were commingled in the feedlot. Even after the disease has stabilized in a particular group, the carcass performance of the cattle would have been affected and the cattle can still be a carrier of the disease.

Further research will attempt to estimate all the models used to estimate health, carcass value, and profitability as a system to capture possible interaction between these models. This method will attempt to introduce a term into each of the models that will allow for correlation between the models. This is important because health is endogenous in determining the carcass quality of the cattle which also affects its profitability. This will also help to know how much impact health has on quality grade, yield grade and profitability of the cattle.

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Table1. Source and Health information summary from the data.

	Single source	2 or 3 sources	4 or more sources	Back grounded
Total cattle	970 {9}	1187 {12}	10,021 {89}	3,171 {34}
Healthy	845 (87)	922 (78)	8099 (81)	2694 (85)
Treated once	89 (9.2)	217 (18.3)	1047 (10.4)	181 (5.7)
Treated > 2	36 (3.7)	48 (4)	556 (5.5)	95 (3)

Note: Numbers in braces ({}) indicate number of pen; parentheses are percentages.

Table 2: Number and percent of cattle by quality grade for each source

	Single source	2 or 3 sources	4 or more sources	Back grounded
Prime	14 (1.5)	10 (0.9)	166 (1.7)	27 (0.9)
Choice	680 (71)	871 (78.1)	7204 (74.6)	1997 (67.1)
Select	236 (24.7)	224 (20.1)	2085 (21.6)	826 (27.7)
Standard	27 (2.8)	10 (0.9)	196 (2.0)	128 (4.3)

Note: Numbers in parentheses are percentages.

Table 3: Number and percent of cattle by yield grade for each source

	Single source	2 or 3 sources	4 or more sources	Back Grounded
1,2	573 (59.8)	494 (44.3)	5586 (57.9)	1798 (60.3)
3	370 (38.6)	580 (52)	3882 (40.2)	1125 (37.8)
4,5	15 (1.6)	41 (3.7)	185 (1.9)	56 (1.9)

Note: Numbers in parentheses are percentages.

Table 4. Premium and discount grid.

		Quality Grade				
		Prime	Upper 2/3 Choice	Lower 1/3 Choice	Select	Standard
Yield Grade	1	21.0	10.0	6.5	ChSel +6.5	ChSel +3.5
	2	17.0	6.0	2.5	ChSel +2.5	ChSel -0.5
	3	14.5	3.5	0.0	ChSel	ChSel -3.0
	4	-1.0	-12.0	-15.5	ChSel -15.5	ChSel -18.5
	5	-5.5	-16.5	-20.0	ChSel -20.0	ChSel -23.0

Where ChSel is the choice-select spread seasonally adjusted for the month the animals are slaughtered.

Table 5: Data Summary Statistics

Description	Mean	Std. Dev.	Min	Max
Delivery Age for single source	288	44	204	397
Delivery Age for 2 or 3 sources	288	51	175	492
Delivery Age for >4 sources	298	84	127	713
Delivery Age for backgrounded	299	57	174	635
Dvry weight for single source	661	95	380	974
Dvry weight for 2 or 3 sources	638	98	340	1016
Dvry weight for > 4 sources	632	105	316	1204
Dvry weight for backgrounded	679	116	366	1260
Adj. final wt for single source	1214	101	820	1535
Adj. final wt for 2 or 3 sources	1169	111	558	1482
Adj. final wt for > 4 sources	1175	120	535	1625
Adj. final wt for backgrounded	1168	119	640	1649
ADG for single source	3.27	0.52	1.15	4.80
ADG for 2 or 3 sources	3.25	0.51	1.31	5.29
ADG for > 4 sources	3.26	0.56	-0.01	5.99
ADG for backgrounded	3.14	0.58	0.30	5.50
Days on feed for single source	169	22	18	223
Days on feed for 2 or 3 sources	162	31	7	234
Days on feed for > 4 sources	167	29	1	243
Days on feed for backgrounded	158	33	5	236
Stdized profit for single source/hd	39.83	65.58	-205.24	269.24
Stdized profit for 2 or 3 sources/hd	27.84	66.92	-317.68	251.53
Stdized profit for > 4 sources/hd	33.84	69.22	-376.82	312.56
Stdized profit for backgrounded/hd	9.59	60.47	-264.93	194.80

Table 6: Results for Logit regression for health and OLS regression for ADG.

Variable (Coefficient)	Health (Logit)	Average Daily Gain (OLS)
Constant	-1.40	2.35
Steers	-	.217
Dvry age	.006	0.001
Dvry WT	.002	-0.0007
Dvry Cond Score	-	-0.05
Disp. Score	-	-0.08
Grp HlthTrt	.102	.01
Dvrd fall/winter	.532	.145
Dvrd Spring	.452	.132
British	-	0.06
Continental	-	-0.03
Some Indicus	-	-0.12
2&3 sources	-1.94	-0.15
> 4 Sources	-1.46	-0.06
Backgrounded	-1.03	-0.19
	-4491.9 (LLIK)	0.15 (R square)

Note: Logit coefficients refer to the odds of being healthy. All coefficients are significant at 5% level.

Table 7: Odds ratio of having healthy cattle given the variable in question

Variable	Health
Dvry age	1.006
Dvry WT	1.002
Grp Hlth Trt	1.107
Dvrd fall/winter	1.703
Dvrd Spring	1.571
2&3 sources	0.143 (7x worse)
4&more Sources	0.233 (4.3x worse)
Backgrounded	0.358 (2.8x worse)

Note: An odds ratio of 1 says the event is equally likely in both groups. Less than one implies the event is more likely in the base group.

Table 8: Logit regression results, impact of selected variable on Quality and Yield grade

Variable	Q-Grade	Y-Grade
Constant	-1.41	-2.35
Steers	-0.67	-0.77
Days of age	.002	.0007
On test WT	.0004*	.002
Days on feed	0.004	.005
Disp. Score	-0.23	-0.14
Dvrd Fall/Winter	0.17	-0.18
Dvrd spring	-0.69	-0.44
British	0.45	1.39
Continental	-1.01	-1.07
SomeIndicus	-1.18	0.38
2&3 sources	-0.87	-0.20*
4&more Sources	-0.58	-0.84
Backgrounded	-0.48	-0.74
LLik	-3590.78	-4131.16

All coefficient are significant at 5 percent except those with a *. Logit coefficients refer to the odds of grading choice and better and high yield grade (4, 5).

Table 9: Odds Ratio for Quality grade and yield grade (Base is single source for source variables).

Variable	Q-Grade	Y-Grade
Steers	0.51	0.46
Days of age	1.002	1.0006
On test WT	1.00	1.002
Days on feed	1.00	1.005
Disp. Score	0.79	0.87
Dvrd Fall/Winter	1.19	1.19
Dvrd spring	0.50	0.64
British	1.57	4.03
Continental	0.37	0.34
Some Indicus	0.31	1.47
2&3 sources	0.42 (2.4x worse)	0.82 (1.2x worse)
4&more Sources	0.56 (1.8x worse)	0.43 (2.3x worse)
Backgrounded	0.62 (1.6x worse)	0.47 (2.1x worse)

Note: An odds ratio of 1 says the event is equally likely in both groups. Less than one implies the event is more likely in the base group.

Table 10: Profit regression with source variables (OLS)

Variable (Coefficient)	Profit
Constant	-973.14
Steers	-46.07
Age at delivery	0.22
Age sq	-0.0002
IA Del Wt	-0.46
Carcass Wt	2.76
Carcass Wtsq	-0.001
Disp. Score	-4.64
Grp Hlth Trt	0.88
Dvrd Fall/Winter	14.2
Grp Hlth Trt	0.88
British	5.58
Continental	-8.98
Some Indicus	-20.43
2&3 sources	-2.45*
4&more Sources	-8.31
Backgded	-8.24

R-square is 0.45

Note: All coefficient are significant at 5 percent level except those with a *****.