Factors Affecting the Price of Hay at a Pennsylvania Auction

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The effect that selected characteristics of a Pennsylvania hay auction has on winning bids of loads of hay are presented in this paper. Survey data from 107 buyers over the period September 1982 to April 1983 were used. Hay type, perceived quality, and the intended use of the hay were found to be significant factors in explaining prices paid per ton. Sellers could increase their revenues by producing alfalfa hay, alfalfa and legume-grass hay of higher quality, and attending marketing days with a larger number of horse feed buyers.

The auction market has long been used as a transfer mechanism in allocating and procuring agricultural commodities. The most popular commodities exchanged at auction markets in the United States include livestock, tobacco, flowers, fruits and vegetables, hay, and fish. A common characteristic of commodities sold on auction markets is that qualitative differences exist among lots or objects sold. Commodities of homogenous quality are rarely exchanged on auction markets. The widespread popularity of the auction market is due to its resemblance of a purely competitive market. The most common type of auction used for agricultural commodities is the English or progressive market where a single object is offered by calling prices in an ascending order. In the absence of buyer collusion, the object is sold to the bidder with the highest reservation value at a price just above the second highest bidder's reservation value.

The purpose of this paper is to investigate the effect of selected factors on the winning bids of hay sold at a Pennsylvania auction market. The factors examined are the characteristics of the hay, winning bidders, and market at the date of sale. In the first section, conceptual issues and previous empirical studies of auction markets are examined. The area of study and data description are presented in section two and the methodology is outlined in section three. The results and their implications on prices paid are presented in the final section.

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Concepts of Auctions and Previous Studies

Literature on the theory of auction or bidding markets has proceeded at a rapid pace since Vickery's seminal paper. This literature has primarily focused on the independent private values market where a single indivisible object is sold. In its simplest form three assumptions are commonly made; 1) each buyer's utility function is linear in income, implying risk neutrality, 2) there are n potential buyers with the ith buyer holding a reservation value v_t, i = 1, . . . , n, and 3) the reservation values of all buyers are independent and identically distributed, drawn from a common distribution whose values range between zero and one. Given these assumptions, bidding under the English auction continues to a level approximately equal to the second highest bid. The optimal strategy of each bidder is to submit his reservation value (Riley and Samuelson). If all bidders follow this strategy the price paid for the object is the market clearing price and is Pareto optimal (Milgram and Weber). Under the assumption of risk aversion with bidders sharing a common utility function, uniformly higher bids are made for increases in risk aversion (Riley and Samuelson, and Milgram and Weber). Sequences of auctions with more than one player are much more difficult to

analyze and there are essentially no qualitative results in this area (Engelbrecht-Wiggans).

Empirical studies of auction markets selling agricultural commodities have centered on two principal issues. The first has focused on price trends at livestock auctions that sell a number of lots in sequential order (Traylor, Sosnick (1965), Kuehn, and Buccola). Given that buyers with the highest reservation value may place higher bids during the early part of the auction and then withdraw, prices are expected to decline throughout. However, Sosnick (1963) suggested that other factors such as qualitative differences in lots offered, entry and exit of buyers, and differences in bidding strategy could nullify a downward price trend. Many studies have found support for this hypothesis. In a related study, Schotter found the order in which race horses were auctioned played a strong role in the outcome. Selling more valuable horses in the early part of the auction resulted in more horses being sold, but with a smaller total profit to sellers than would occur otherwise.

The second issue has focused on the effect of selected characteristics of the livestock and auction market on prices paid. Investigating Virginia feeder calf sales, Williamson, Carter, and Gaines found size of sale lot, breed, average weight of sale lot, and grade to have a significant impact on prices paid. Our investigation of the hay auction market takes this approach. In addition, characteristics of the buyers and a set of dummy variables on the use, type, and quality of the hay sold are included. An effect not investigated is the position in which the load of hay was sold.

Area of Study and Description of Data

Pennsylvania is a large hay producing state, ranking 13th in production and 5th in value in 1982 (Agricultural Statistics, 1983). During 1982, 4,840,000 tons of hay were produced with a value of $423,500,000. It is the single most important crop in the state, accounting for 40 percent of the total value of all crops produced (Pennsylvania Crop Reporting Service). The percentage of hay produced that was sold off farm is not known, but the average over the period 1977-80 was 18 percent. Pennsylvania is also an importer and exporter of hay, with imports coming from New York, the New England states, and Eastern Canada and exports going to New Jersey, Delaware, and Maryland. The extent to which the state is a net importer or exporter is not known.

Hay marketed is sold either directly off the farm, at one of the eleven established auction markets, or at one of the many informal auction markets. The emergence of the hay auction markets evolved out of the need for dairy farmers to supplement their production and market surpluses. More recently, race and pleasure horse establishments have been large buyers of hay.

Over the period September 1982 to April 1983 the New Holland, Pennsylvania hay auction market, located in Lancaster county, was visited once per month. Each of the winning bidders was asked to take along and fill out a questionnaire. A total of 107 usable questionnaires were returned, representing approximately ten percent of the total loads sold during this period. Hay is auctioned every Monday throughout the year. The months of September to April were selected for investigation since this period comprises the storage season. The market was not expected to be influenced by new production coming on stream. This is also the period of heaviest marketing on the established auction markets. During the summer production months more transactions tend to occur at the field or farm level.

The New Holland market has been in operation for over twenty years. Within a thirty mile radius there are two other markets that auction hay on other days of the week. The settled range of prices of the various types of hay at auction markets in the state are reported weekly by the local news media, allowing both hay producers and sellers to be familiar with prevailing prices. Prices at the New Holland market tend to be in line with those at other markets as indicated by prices reported in the news media.

Hay sellers pay an initial fee of $2.50 per load offered and an additional three percent of the total value of the sale at the termination of the auction. Sellers can withdraw their hay if the settled price is less than their reservation price. Over the sample period, 3 percent of the loads offered were withdrawn. The loads are lined up in the order in which they arrive. The market is well attended with twenty-five to fifty people observing the calling for each load, of which less than ten are typically active bidders. Buyers rarely purchase more than a single load, suggesting that the turnover of active participants is high.

The means and standard deviation of the variables used are reported in Table 1. Three sets of variables were used; 1) characteristics of the market, 2) characteristics of the winning bidders, and 3) characteristics of the hay. Characteristics of the market were the number of loads sold on each auction day and the month in which the auction occurred. Characteristics of the winning bidders were the distance traveled to the market, total tons of hay purchased during the year, percent of purchased hay received at an auction, and the intended use of the hay. The latter characteristic was divided into two categories; hay fed to race and pleasure horses and hay fed to cattle. In the latter category, 74 percent of the loads purchased were used in dairy production, 13 percent for beef cattle, and the remainder for small livestock.

Characteristics of the hay were type and buyers' perception of the hay quality. Hay type was classified as alfalfa, legume-grass, and straw. Buyers were asked to evaluate the quality of the load they purchased. These evaluations were grouped into two categories, above average and average quality. Thirty-seven percent of the hay was perceived to be of above average quality. A below average category was not used as only two loads were perceived to be of this quality.

Methodology

A linear multiple regression model was used to estimate the impact that characteristics of the market, buyers, and hay had on prices paid per ton. The hay use, type, and quality characteristics were included as dummy variables individually and combined into two and three way sets to determine their interaction effects. After making the appropriate dummy variable deletions, the estimated equation is:

$$P - A> + \&Xi + ,g_2x_2 + /3_3X_3 + 0_4X_4 + /3_5X_5 + /3_6X_6 + /3_7X_7 + p_8X_s + pgXg + /3i_oXio + £llXu + /3i2Xi2 + pisXjs + ^4X14 + pigXis + pigXie + ArX_{17} + U$$

where:

P = Price paid per ton
X_1 = Month of sale
X_2 = Number loads sold
X_3 = Distance to market in miles
X_4 = Total annual purchase in tons
X_5 = Percent purchased at auction
X_6 = Load weight in tons
X_7 = Use dummy (cattle = 1, horses — 0)
X_8 = Alfalfa dummy (alfalfa = 1, zero otherwise)
X_9 = Straw dummy (straw — 1, zero otherwise)
X_{10} = Quality dummy (above average — 1, average = 0)
X_{11} = Alfalfa-Use dummy (alfalfa for cattle = 1, zero otherwise)
X_{12} = Straw-Use dummy (straw for cattle = 1, zero otherwise)
X_{13} = Quality-Use dummy (above average quality for cattle = 1, zero otherwise)
X_{14} = Alfalfa-quality dummy (alfalfa of above average quality — 1, zero otherwise)
X_{15} = Straw-quality dummy (straw of above average quality = 1, zero otherwise)
X_{16} = Use-alfalfa-quality dummy (alfalfa of above-average quality for cattle = 1, zero otherwise)
X_{17} = Use-straw-quality dummy (straw of above-average quality for cattle = 1, zero otherwise)
u = Normally distributed error vector with mean 0 and variance cr^2.

The three one-way interaction variables are hay use (X_7), type (Xg and X_9) and quality (X_{10}). There are three sets of two-way interaction variables; type and use (Xu and Xi2)> quality and use (X_{13}), and type and quality (Xi4 and Xi_5). The three-way interaction variables of use, type and quality are X_{16} and X_{17}.

Table 1. Description of Selected Characteristics of the Hay Auction Market

Variable	Mean	Standard Deviation
Average load size (tons)	5.13	4.12
Loads sold per auction	135	60
Miles to market	19	18
Tons purchased annually	115	301
Percent purchased at auction	83	25
Percent used for cattle feeding	66	47
Alfalfa		
Percent of total hay	27	
Price per ton ($)	113	29
Legume Grass		
Percent of total hay	46	
Price per ton ($)	96	19
Straw		
Percent of total hay	27	
Price per ton ($)	79	14
Percent above-average quality	37	

The estimates of parameters β_7 through β_{17} are used to test a wide range of hypotheses involving the qualitative explanatory variables.

Results

The estimated results of the regression equation are reported in Table 2. All of the non-dummy variables individually were not significantly different from zero. The variables month of sale and number of loads sold are characteristics of the market. The result for the former variable implies sellers could not expect to receive a positive return from storing and selling later in the marketing season. While seasonal variation in hay prices is not known, it is expected to increase over the storage season in most years. Thus, the above result should be used with caution since it applies only to a single storage period. The results for the number of loads sold per auction implies buyers (sellers) could not expect to pay (receive) different prices on low and high volume days. This result was unexpected since discussions with a number of market participants revealed a general impression that prices on higher volume days tend to be lower.

The distance traveled to the market, the total annual tons of hay purchased, and the percent of total purchases transacted at auctions are characteristics of the bidders. Traveling longer distances to the market was expected to reduce bidders' valuation because of the backhaul costs. Buyers that purchase larger volumes of hay and make more of these purchases at auctions would be expected to be more prudent in bidding and pay lower prices in general. The parameter estimate for load size, a characteristic of the hay, was not significant. Smaller loads were not bringing higher prices per ton than larger loads. This is in contrast to the conventional wisdom of most buyers and sellers that smaller loads bring higher prices per ton. Sellers could not expect to profit by offering more smaller loads rather than fewer larger loads.

An interpretation of the individual coefficients of the eleven dummy variables is not obvious because of the interaction effects. Consequently, discussion of the t-tests for these coefficients is inappropriate. The proposed relationships between dependent and independent variables allowing for the interaction effects are identified in Table 3. These relationships are used to develop a variety of hypotheses that attempt to explain the differences in prices paid. For example, consider the hypothesis test for differences in prices

Table 2. Regression Estimates of Hay Prices Per Ton on Market, Buyer, and Hay Characteristics

Independent Variables	Parameter
Intercept	101.88 (11.20)[h]
X_1 = Month of sale	1.65 (1-02)
X_2 = No. loads sold	-0.07 (0.05)
X_3 = Distance to market (miles)	—0.15 (0.14)
X_4 = Total annual purchase (tons)	0.0001 (0.007)
X_5 = Purchase at auctions (%)	—1.32 (7.78)
X_6 = Load weight (tons)	0.09 (0.50)
X_7 = Hay Use[a]	-11.99 (7.90)
X_8 = Alfalfa[b]	31.37 (12.68)
X_9 = Straw"	-9.40 (8.98)
X_{10} = Above average quality^	14.58 (10.41)
X_{11} = Cattle and alfalfa[d]	-28.03 (14.59)
X_{12} = Cattle and straw[d]	-3.96 (11.20)
X_{13} = Cattle and above average[e]	7.26 (12.44)
X_{14} = Alfalfa and above average[f]	0.71 (16.74)
X_{15} = Straw and above average'	—18.37 (16.35)
X_{16} = Cattle, alfalfa, and above average"	—4.07 (20.05)
X_{17} = Cattle, straw, and above average"	8.15 (21.17)
R-square	0.54
F-statistic	5.84[1]

[a] Dummy variable; cattle = 1, horses = 0.
[b] Type dummy variable; the specified type equals one, zero otherwise.
[c] Quality dummy variable; above average = I, average = 0.
[d] Use-type dummy variable; the specified use-type equals one, zero otherwise.
[e] Use-quality dummy variable; the specified use-quality equals one, zero otherwise.
[f] Type-quality dummy variable; the specified type-quality equals one, zero otherwise.
[g] Use-type-quality dummy variable; the specified use-type quality equals one, zero otherwise.
[h] Standard errors in parentheses.
[I] Significant at the 0.0001 level.

Table 3. Expected Hay Prices Given Various Combinations of Hay Type, Quality, and Use[a]

Hay Use and Quality	Hay Type		
	Alfalfa	Legume-Grass	Straw
Cattle Above Average	/3$_7$ + *fa* + *fa* + *fa* + *fa* + *fa* + *fa* + *fa* + *fa*	*fa* + *fa* + *fa*	*fa* + *fa* + *fa* + *fa* + *fa* + fr$_s$ + &$_7$ *fa*
fa Average		*fa*	+ *fa* + *fa*
Horses Above Average	/3$_8$ + fto + *fa* Average	*fa* 0	*fa* + *fa* + *fa fa*
A,			

[3] The addition of ft, + S^ftX] is required to obtain the expected value, where X is the mean of variable Xj.
i–i

paid by hay use given above average quality in Table 4. This test involves an evaluation of the hypothesis over the three hay types; i.e., simultaneously testing by use given above average quantity alfalfa (0_7 + 0ii + 0is + 0ie — 0)» by use given above average quality legume-grass (07 + 0i3 = 0), and by use given above average quality straw (0_7 + $0i_2$ + As + AT = 0). The hypothesis test for differences in prices paid by hay use given alfalfa involves an evaluation over the two quality categories; i.e., simultaneously testing by use given above average quality alfalfa (0_7 + 0n + 0ia + 0ie = 0) and by use given average quality alfalfa (0_7 + 0_n - 0).

The results of various hypothesis tests concerning the differences in hay prices paid by its intended use are reported in Table 4. For hypothesis testing purposes, the critical F and t values associated with .05 probability level of significance are used in this study. A significant difference was found when testing for differences in prices paid for hay by its intended use over all types of hay and quality categories. While a significant difference in prices paid by use was found for above average hay quality over all types of hay, use does not significantly influence the difference in hay prices for average quality hay regardless of type. Buyers purchasing hay for horses or for cattle feeding paid significantly different prices only for alfalfa.

The results of one-tailed hypothesis tests, which consider the differences in prices paid by use given the hay type and quality, are reported in Table 5. The alternative hypothesis, given hay type and quality, is that buyers purchasing hay for horses pay more than those purchasing hay for cattle. Cattle feed buyers paid an estimated $28.69 and $40.02 per ton

Table 4. Hypothesis Tests for Differences in Prices Paid Per Ton by Hay Use

Test Description	Null Hypothesis	F-Statistic	Probability Level of
	fa = *fa* = *fa* = *fa* = *fa* = AT = 0	3.34	
By use given quality	*fa* + /3$_U$ + *fa* + *fa* = 0 j8$_7$ + 0$_{13}$ = 0	6.47	
Above average	*fa* + *fa* + *fa* + *fa* = 0 A = 0 *fa* +	1.13	.341
Average	*fa* = 0		
By use given type		8.34 1.20	.0005 .306
Alfalfa	*fa* + *fa* = 0		
	fa + *fa* + *fa* + *fa* = 0	1.60	.208
Legume-grass Straw	*fa*+ *fa* = 0 *fa* + As = 0		
	/3$_7$ = 0		
	fa + *fa* + *fa* + 0,7 = 0		
	fa + *fa* = 0		

[a] Use is hay purchased for horse and cattle feeding.

Table5. One-tail Tests for Differences in Prices Paid Per Ton By Hay Use

Test use given[a]	Null Hypothesis	Estimated Difference	Standard Error
By use given[a]			
Above average quality and alfalfa	$\beta_7 + \beta_{11} + \beta_{13} + \beta_{16} = 0$	**- 28.69**	**10.04**
Average quality and alfalfa		**- 40.02**	**12.95**
Above average quality and legume-grass		**- 4.73**	**10.38**
Average quality and legume-grass		**- 11.99**	**7.90**
Above average quality and straw		**- 0.54**	**14.42**
Average quality and straw		**- 15.94**	**8.91**

[a] Use is hay purchased for horse and cattle feeding.

less for alfalfa hay of above average and average quality, respectively, than horse feed buyers. Prices paid for legume-grass and straw were not significantly different for varying combinations of type and quality.

The general results of the various hypotheses tests by hay use suggest the market for alfalfa by horse feed buyers may be distinct from the market for the other types of hay in general and from all hay purchased for feeding cattle. Horse feed buyers satisfy their alfalfa hay requirements by bidding up prices. Hay sellers who attend markets on those days with a larger number of horse feed buyers could significantly increase their revenues.

The hypothesis tests by hay quality are reported in Tables 6 and 7. A significant difference in prices paid per ton was found for hay by quality regardless of the intended use and type. When tested by quality given use, significant differences in prices were paid for hay when used in cattle feeding, but not horse feeding. Given the individual hay types, significant differences in prices paid due to quality were found for alfalfa and legume-grass, but not straw.

One-tail t-tests were calculated for hay quality given the various combinations of hay use and type (Table 7). The alternative hypothesis in these tests was given the intended use and hay type, purchasers of hay for horses pay more than purchasers of hay for cattle. Alfalfa and legume-grass hay of above average quality used for cattle feeding sold at significantly higher prices than the same types of hay of average quality. The price differential per ton due to qualitative differences was $26.62 for alfalfa and $21.84 for legume-grass purchased by cattle feeders. Quality was not a significant factor influencing prices of hay purchased by

Table 6. Hypothesis Tests for Differences in Prices Paid Per Ton by Hay Quality

Test Description	Null Hypothesis	F-Statistic	Probability Level of Significance
By quality[8]	Ao = As = A* = As = As = AT = 0		.002
By quality given use	Ao + A4 = 0 Ao = 0 Ao + As = 0	3.77	.341
Horses	Ao + &3 + #4 + Ae - 0 Ao + As = 0		.0006
Cattle	Ao + As + As + A7-0	1.13	.001
By quality given type	Ao + As + A* + As * 0 Ao + A_4 = 0	6.47	
Alfalfa	Ao + As = 0		.003
	Ao= 0	7.21	
Legume-Grass Straw	Ao + As + As + A? = 0 Ao + As = 0		.573
		6.10	
		0.56	

[8] Quality is above average and average.

Table 7. One-tail Tests for Differences in Prices Paid Per Ton By Hay Quality

Test Description	Null Hypothesis	Estimated Difference	Standard Error
By quality given[a]			
Horses and alfalfa		15.30	13.15
Horses and legume-grass		14.58 -	10.41
Horses and straw	Ao + #4 = 0 fto = 0	3.79	15.13
Cattle and Alfalfa	fto + ft. = O	26.62	9.48
Cattle and legume-grass	&o + As = 0 &o + 0,3 +	21.84	6.83
Cattle and Straw	$\beta_{10} + \beta_{13} + \beta_{15} + \beta_{17} = 0$	11.61	11.39

[a] Quality is above average and average.

horse feeders. Similarly, quality did not influence the price of straw purchased by cattle feeders.

The general results of the hypothesis tests by hay quality show perceived quality to be an important economic variable in the market for alfalfa and legume-grass for cattle feeders. Sellers could significantly increase their revenues by producing hay of higher quality. The higher estimated prices paid for alfalfa and legume-grass" of above average quality by cattle feeders suggest that cattle hay buyers either place greater emphasis on quality or have different criteria for judging quality than horse feed buyers.

The final set of hypothesis tests was on hay type. Because three types of hay were included in the estimated equation, multiple restrictions on parameters were required in the hypothesis tests, precluding the use of a one-tail t-test to determine the magnitude and sign of the estimated price difference. Significant differences in prices paid were found for each individual hay type (Table 8). When testing by type given use, a significant difference in prices paid were found for all three hay types in both use categories. Each hay type was compared on an individual basis to the other two types combined as a group. The F-tests by type given quality differences were similar to those found above conditioned on use. In the first three tests, one hay type was compared to the other two as a group over all uses and quality. A significant difference in prices paid was found for each hay type (Table 8).

The F-tests by type given use, by type given quality, and by type given use and quality compares one hay type to the other two as a group, given the use and quality categories. The results for alfalfa are reported in Table 8. The results of tests for legume-grass and straw, respectively, are identical to those of alfalfa and are not reported. The F statistics are identical since the null hypotheses are equivalent for similar tests across the three hay types. As a demonstration compare the restrictions for alfalfa given its intended use by horses reported in Table 8 to the unreported restrictions for legume-grass given its intended use by horses. The restrictions for the latter test are:

(i)
$$\begin{aligned} \beta_8 + \beta_{14} &= 0 \\ \beta_9 + \beta_{15} &= 0 \\ \beta_8 &= 0 \\ \beta_9 &= 0 \end{aligned}$$

Since the restrictions in (1) must hold simultaneously, it is clear that they are equivalent to corresponding restrictions in Table 8 for alfalfa. The restrictions for all tests involving legume-grass and straw can be derived from the combination of restrictions using the relationships reported in Table 4.

A significant difference in price paid was found for the two tests by type given the intended use and the two tests by type given the hay quality. The final set of tests involve evaluation of the difference in prices paid by type given the intended use and hay quality. The test by type given use and above average hay quality indicates a significant difference in prices paid. The results for hay of average quality were mixed, significant for horses but not significant for cattle. The general results of the hypothesis tests by hay type suggest that type is important in determining prices paid, particularly for above average hay quality. However, the estimated price difference due to type given a specific use and quality combination cannot be determined due to the multiple restrictions.

Implications and Conclusions

This study analyzes the relationships of selected characteristics of the market, bidders,

Table 8. Hypothesis Tests for Differences in Prices Paid Per Ton by Hay Type and Alfalfa Given Use and Quality

Test Description	Null Hypothesis	F- Statistic	Probability Level of Significance
By type	08 = 011 = 014 = O_{16} = 0	3.81	.007
Alfalfa	A = 09 = ft, = 0!$_2$ = 0i$_3$ = 0,4 = 0i6 = 0i7 = 0	5.64	.0001
Legume-grass	09 = 012 = 015 = 017 = 0	3.15	.018
Straw	08 + 014 = 0 O_8 + 0H - 09 - 015 = 0 08 = 0 08 ~ 09 = 0 08 + 0.1 + 014 + 016 = 0 08 + 011 + 014 + 016 ~ 09 ~ 012 - 015 - 017 = 0 08 + 011 = 0 08 + 0.1 - 09 - 012 = 0		
By alfalfa given use			
Horses	08 + 01, + 014 + 016 = 0 08 + 011 + 014 + 018 - 09 - 012 - 015 - 017 = 0 08 + 014 = 0 08 + 014 - 09 - 015 = 0 08 + 011 = 0	8.08	.0001
Cattle			
By alfalfa given quality Above average			
Average	08 + 011 - 09 - 012 = 0 08 = 0 08 - 09 = 0	2.95	.0001
By alfalfa given Horses and above average quality	08 + 0,4 = 0 08 + 014 - 09 ~ As = 0		
	07 ~ 08 = 0 08 - 09 = 0 08 + 011 + 014 + 016 = 0		
	08 + O_{ll} + 014 + 016 - 09 - 012 ~ 015 ~ 017 = 0 08 + 011 = 0 08 + 011 - 07 - 09 - 012 = 0		
Horses and average quality Cattle and		7.25	.00001
above average quality Cattle and		3.90	.006
average quality		11.15	.0001
		5.14	.008
		3.39	.038
		2.55	.084

and hay on the prices paid at a Pennsylvania hay auction market. Organized hay auctions are important transaction points for buyers and sellers, and prices revealed at these markets serve as guidelines in hay marketing transactions at the farm level.

The variables hay use, perceived quality, and type were found to be important in determining the hay prices paid. Alfalfa hay intended for horse feeding brought higher prices than alfalfa intended for cattle feeding, suggesting that bidding by horse feed buyers applies upward pressure on these prices. Alfalfa producers can benefit by attending markets on days when a large number of horse feed buyers are in attendance and cattle feed buyers can benefit when fewer horse feed buyers are present. By following this strategy alfalfa producers can increase their revenue and the cattle feeders can decrease their hay expenses. Hay perceived to be of above average quality by winning bidders sold at higher prices than hay of average quality. The differences in the prices paid per ton due to the perceived quality differences of alfalfa and legume-grass purchased by cattle feeders was large enough to warrant special consideration in production and harvesting plans. Alfalfa hay brought higher prices than legume-grass and straw, suggesting that an operator can realize higher revenues by producing alfalfa. The benefits an individual operator may realize by following any of the strategies mentioned above must be balanced against the cost of implementation. That is, information regarding horse feed buyers' attendance is not costless, producing higher quality hay requires a cost increasing alteration in the production plan, and production costs of alfalfa are higher than the production costs of legume-grass and

straw. Furthermore, if a large number of operators altered their production plans in accordance with the above recommendations, advantages gained by an individual operator could dissipate.

High quality alfalfa and protein concentrates are substitutes in dairy feeding. A decrease in the price of protein concentrates could result in a decrease in the quantity demanded of high quality hay. However, dairy feeding requires a certain quantity of fiber and producers will continue to purchase hay. Horse feed buyers are likely to continue purchasing high quality alfalfa hay due to the lack of acceptable feeding substitutes and because high feed costs can be easily passed on to stable renters.

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