EXPLAINING DIFFERENECES IN PRICES RECEIVED BY FARMERS: TESTING THEORY BASED ON ACTUAL FARMER TRANSACTIONS

By

LEWIS THEOPHILUS CUNNINGHAM III

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Thesis Approved:

Dr. B. Wade Brorsen

Thesis Advisor

Dr. Kim B. Anderson

Dr. F. Bailey Norwood

Dr. Al Carlozzi

Dean of Graduate College

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Essay I

Cash Marketing Styles and Performance Persistence of Wheat Producers

Introduction

Past research has sought to help farmers with marketing commodities. This research includes optimal hedging strategies (Harwood et al.; McNew and Musser; Musser, Patrick, and Eckman; Simmons; and Zuniga, Coble, and Heifner), tests of market efficiency (Brorsen 2000; Kastens and Schroeder; McKenzie and Holt; Shiller; Simmons; Zulauf and Irwin), and price forecasting (Just and Rausser; Norwood and Schroeder; O'Brien, Hayenga, and Babcock; Robledo, Zapata, and McCracken; Tomek), yet there is little research studying actual farmer marketing. Past research has shown that few farmers are following hedging strategies; and if they do, they are not using "optimal" hedging strategies (Anderson and Mapp; Katchova and Miranda; McNew and Musser; Selley and Wilson; Simmons).

Most tests of efficiency found markets to be at least close to efficient, which suggests there may be little chance of increasing profit with a marketing strategy. Similarly, the price forecasting literature has rarely found one method to be significantly better than another. Yet, farmers still demand considerable market information from both private market advisory services and extension economists (Ortmann et al.). This dichotomy between research results and farmer actions suggests a need for further research.

Coble and Barnett call for further investigation of producer decision-making. It is apparent that there is a lack of real-world knowledge of what farmers are doing. Brorsen and Irwin argue there needs to be a move to the use of actual data and the study of what farmers are doing; because if producers are not using the research, then what good is it? There have been a few limited studies of individual farmer marketing decisions (McNew and Musser; and Slusher), but only Slusher used actual farmer transactions. McNew and Musser used data from a hedging game to evaluate producer marketing decisions; while Slusher collected four years of actual marketing data from 129 farmers to evaluate farmers.

There have been numerous surveys to find what marketing information farmers are using (Ford and Babb; Gloy, Akridge, and Whipker; Ortmann et al; Patrick and Ullerich). However, the surveys vary regarding which information sources were the most important to farmers. Mostly, the farms used information from paid sources and on-the-farm data. Paid sources that farmers use include computerized information, magazines, and consultants. Farmers highly value consultants, or market advisory services (Bertoli et al.). Bertoli et al. found that market advisory programs make mostly cash marketing recommendations rather than suggesting futures and options market strategies, which is confirmation that research on optimal hedging strategies and futures market efficiency has not been of much direct benefit to farmers. If farmers are using cash marketing strategies, then research should focus on cash marketing strategies.

Farmers have two basic choices in marketing styles. One is to follow an active marketing strategy where they acquire information and make decisions based on price expectations. The second is a purely mechanical strategy that is the same every year regardless of market information. An active style can be based on fundamental and/or technical analysis. Such information is likely filtered before being provided to farmers by extension economists or market advisory services. An active style is not necessarily inconsistent with efficient markets as Zulauf and Irwin argue that the basis exceeding storage costs can be a signal for producer to store even in an efficient market.

In contrast to an active marketing style is a mechanical style of doing the same thing every year. One of the simplest mechanical styles is always selling at harvest. Anderson advocates a mechanical style of selling equal portions of 1/3 in June, 1/3 in September, and 1/3 in November (Anderson and Brorsen). The benchmark used by Irwin, Martines-Filho, and Good is a mechanical style of selling the same amount every day. The argument for using a mechanical strategy is that since markets are efficient, there is no gain in trying to "fight the market." Mechanical styles are also supported by behavioral finance because people may make psychological mistakes and end up losing when they speculate on price movements (Brorsen). Therefore, through doing the same thing every year, producers can eliminate these psychological mistakes.

The paper first measures the extent to which the styles used by producers are either active or mechanical. The data allow measuring for each producer, the annual average week sold, number of weekly transactions, and total bushels sold. The activeness of the marketing style is measured by whether the producer follows the same strategy each year. Then price received is regressed against activeness to determine if producers using an active style receive a higher price than those using a mechanical style.

An alternative approach to determine if there is any possible advantage or disadvantage in trying to fight the market is to test for the existence of performance persistence among Oklahoma wheat producers. The null hypothesis tested is that the past ranking of a farmer's price received does not help predict the farmer's future ranking. If there are farmers that have consistent performance, then these farmers' actions can be used to identify styles with superior performance. Performance persistence has been measured in past literature, but primarily in finance markets (Agarwal and Naik; Blake and Timmermann; Brorsen and Townsend; Harri and Brorsen; Kazemi, Schneeweis, and Pancholi; Tonks). Research with mutual funds and commodity trading advisors has found small amounts of performance persistence, but these differences are likely because of differences in cost. Performance persistence may also exist for farmers for costs and production, but the focus here is on marketing performance persistence.

Data

Data are from three grain elevators located in the north, south, and center of western Oklahoma. The data are from the harvest of 1992 through the spring of 2001 (nine crop years). The data contain all individual transactions of wheat sales at each elevator. Each transaction has the seller, number of bushels, price per bushel, and date. However, each seller's name was not always spelled correctly and some sellers operated under a variety of names. To remedy this problem, elevator managers were asked to identify the primary marketing decision maker for each sale. This was done by giving the elevator managers a spreadsheet containing the seller names, and then they identified the primary decision maker for each seller.

Table I-1 contains the descriptive statistics for each elevator. Average price is the actual average price that producers received over 9 years of data. The average net price is the adjusted average price that producers received over the 9 years of data. The price is adjusted for carrying costs, which includes interest and storage costs. Harvest price is the average price that producers received at harvest, which is a four-week period defined differently for each elevator. Beginning harvest dates for the southern, central, and northern elevators are May 25, June 1, and June 12 respectively. Percent of harvest sales is the percent of sales that occurred during the four-week harvest, compared to the whole year. Average week is the average week that producers chose to market their wheat for all years.

Table I-1. Descriptive Statistics for Each Elevator

Descriptive Statistics	South	Central	North
Average price ($/bu.)	3.41	3.32	3.39
Average net price ($/bu.)	3.35	3.12	3.17
Harvest price ($/bu.)	3.47	3.20	3.39
Number of observations	14434	7089	6389
Percent harvest sales	58%	19%	14%
Average week[a]	5	16	18

[a] Harvest is 4 weeks long and considered to be week 1.

A number of other data errors were also corrected, and some transactions were deleted from the data set. First, the northern elevator is missing transactions from 5/1/98 to 6/1/99. Second, if the price per bushel was less than $1.50, it was deleted. The reason for deletion was that the transaction was probably for wheat cleanings or a data entry error. If the price per bushel was greater than $10.05, it was deleted. The reason for deletion was that the transaction was probably a data entry error. The $10.05 amount is the high cut off, because it was the lowest extremity on the high side of price. The other prices that were high were similar or near other prices around the same date. Another deletion within the data set included, transactions that had negative bushels. These transactions were deleted because they identify purchases rather than sales. If an elevator manager suggested the transaction be deleted, then it was deleted as well as transactions with missing data (such as a missing name, bushels, or price). Data are still included when the elevator manager could not easily determine a decision maker for that seller name. It is assumed that the same seller was the decision maker all 8 years for transactions where a name was included but decision maker could not be determined. Table I-2 shows all of the data errors were from the southern elevator.

Table I-2. Observations Deleted or Missing by Elevator

Reason	Southern	Central	Northern
<$1.50	19	0	0
>$10.05	20	0	0
Negative Bushels	34	0	0
Missing Data	297	18	55
Other	1	0	0

Many of the transactions for decision makers happen on the same day or on days close to each other. Since the number of transactions is a variable being examined, the transactions have been lumped into weeks. Thus, if there were 24 transactions within a specified seven-day period[1], they would count as one transaction. Therefore if a seller has two transactions, this means the seller traded in two different weeks.

[1] There are weekend sales during harvest.

Storage costs and interest costs are calculated the same for all elevators. The storage cost, set by the elevators, averages $.00085/day, which is $.0255/month. The interest cost is calculated at the prime rate for that year plus 2%. The prime rate is the prime rate charged by banks in June for that year, quoted from the Kansas City Federal Reserve Bank. Multiplying the interest rate by June wheat price and then dividing the product by 365 days gives interest cost per day. The June wheat price is the June price quote for wheat in Oklahoma for that year from the National Ag Statistics Service. The cost of carry is then figured per day. Table I-3 shows the interest, storage, and combined carrying costs per day.

Table I-3. Interest, Storage, and Carrying Costs

Year	Interest Rate[a]	Wheat Price $/bu[b]	Interest Cost/day cents/day[c]	Storage/day cents/day[d]	Cost of Carry/day cents/day[e]
92	8.50%	$3.27	.075	.085	.160
93	8.00%	$2.54	.070	.085	.155
94	9.25%	$3.07	.081	.085	.166
95	11.00%	$3.88	.096	.085	.181
96	10.25%	$5.48	.090	.085	.175
97	10.25%	$3.28	.090	.085	.175
98	9.75%	$2.62	.085	.085	.170
99	11.50%	$2.31	.101	.085	.186
00	9.00%	$2.50	.079	.085	.164

[a] Current year prime rate plus 2%
[b] First day of harvest wheat price for current year
[c] Product of interest rate and wheat price
[d] Average storage costs that elevators charge
[e] Sum of interest costs and storage costs

The selling prices net of interest and storage costs are

(1) $$netprice_{itd} = P_d - d\left(\frac{P_0(z_t + .02)}{365} + S_d\right)$$

where i is the producer, t is the year, d is the number of days after harvest, $netprice_{itd}$ is the net price, P_d is the price received on day d, P_0 is the harvest price for that year, z_t is the prime interest rate for that year, and S_d is the storage cost/day.

Procedures

The procedures include linear regression, style indicators (descriptive statistics), and performance persistence tests. The regression model estimates the effect on price of the degree of activeness. Style indicators measure activeness and timing of producers' marketing styles. The performance persistence tests use rank correlations across years to determine if some producers consistently receive a higher price than other producers.

<u>Regression Model</u>

The following regression is used to determine the effect of an active marketing style on price received:

$$lprice_{it} = \beta_0 + \sum_{j=1}^{8} \beta_{1j} year_{jt} + \beta_2 awk_{it} + \beta_3 activeness_i + \varepsilon_{it} \tag{2}$$

where i is the producer, t is the year, $lprice_{it}$ is the log of the bushel-weighted net price for producer i in year t ($aprice_{it}$), $year_t$ is a dummy variable for each year, awk_{it} is the yearly bushel-weighted mean weeks after harvest when wheat was sold by producer i, $activeness_i$ is the standard deviation of awk_{it} by producer, and ε_{it} is the error term.[2] The plots of error terms versus awk_{it} for the OLS model with $aprice_{it}$ as function of $year_t$, awk_{it}, and $activeness_i$ exhibited heteroskedasticity with variance increasing for either high

[2] Number of transactions, $trans_{it}$, and transaction standard deviation, $transsd_t$, were also considered but were not significant and were dropped from the model since theory to support their inclusion was weak.

or low values of awk_{it} and thus (2) is estimated using maximum likelihood. The plots are shown in figure 1. The plots demonstrated the need for a quadratic adjustment to the model. The error, ε_{it}, is defined to be heteroskedastic as

(3) $$\varepsilon_{it} \sim N(0, \sigma_i^2)$$

and the variance of ε_{it} (σ_i^2) is defined as

(4) $$\sigma_i^2 = \exp(\alpha_0 + \alpha_1 awk_{it} + \alpha_2 awk_{it}^2).$$

The coefficient of interest is β_3. If β_3 is positive, an active style yields a higher price received. Random effects need to be tested because the regression uses panel data and there is a possibility that some omitted variables may be constant over time, but differ between producers. To measure this, random effects are tested using a likelihood ratio test.

The standard deviation of mean week sold, $activeness_i$, is calculated as follows. First the bushel weighted mean week sold is

(5) $$awk_{it} = \sum_{w=1}^{48} (tvol_{itw} wk_{itw}) / tvol_{it}$$

where w is the week[3], $tvol_{itw}$ is the bushels sold by producer i in year t and week w, wk_{itw} is the weeks after harvest that the transaction occurred, and $tvol_{it}$ is total bushels sold by producer i in year t. The standard deviation of mean week is

(6) $$activeness_i = \sqrt{\frac{\sum_{t=1}^{n} (awk_{it} - \overline{awk_i})^2}{n-1}}$$

where n is the number of years and $\overline{awk_i}$ is the mean of awk_{it} for each producer. The higher the standard deviation, the more active is the producer's style. It is more active

[3] Based on four-week harvest, so 48 weeks in a marketing year. Harvest is week 1.

because each year the producer is selling in different weeks, whereas with a mechanical style a producer would sell more consistently in the same weeks forcing the standard deviation to be low.

The dependent variable in (2) is the natural log of the annual bushel weighted price by producer, $aprice_{it}$. The annual bushel-weighted mean price is

$$aprice_{it} = \sum_{d=1}^{w=365} (bu_{itd}\, netprice_{itd}) / tvol_{it} \tag{7}$$

where i is the producer, t is the year, d is the day, bu_{itd} is the bushels sold that day by a producer, and $tvol_{it}$ is yearly total volume of bushels sold per producer.

Style Indicators

The number of transactions per year is an alternative measure of classifying producers' marketing styles. Barber and Odean (2001) argued that some stock market investors trade too often and reduce their profits, however wheat producers are not charged for more frequent trading. Brorsen and Anderson suggest farmers may spread out their sales to reduce price risk. To measure if farmers are following the advice to spread sales, style indicators are used to measure timing of sales. The standard deviation of mean number of transactions, *transsd,* helps to determine if producers are changing their styles every year. It is calculated by

$$transsd_i = \sqrt{\frac{\sum_{t=0}^{n} (frequency_{it} - \overline{frequency_i})^2}{n-1}} \tag{8}$$

where $frequency_{it}$ is the annual number of weeks a producer has a transaction and $\overline{frequency_t}$ is the mean of $frequency_{it}$ for each producer. If the standard deviation is high then producers are not following a specific pattern, however if it is low then they could be following a specific pattern of selling the same amount of transactions every year.

To further investigate if a specific style is being followed; the standard deviation of week within a year for each producer, $separation_{it}$, is considered to measure producers' separation of transactions during the year. It assists in figuring out if producers' transactions for those who have more than one transaction are separated by a large or small amount of weeks. It is calculated by

$$separation_{it} = \sqrt{\frac{\sum_{w=1}^{48}(week_{itw} - awk_{it})}{w-1}} \tag{9}$$

where w is weeks after harvest (with four week harvest equal to week 1) and $week_{itw}$ is the week with a transaction for each producer for each year for every week.

Performance Persistence

Performance persistence is measured using rank correlations similar to Irwin, Martines-Filho, and Good and Harri and Brorsen. First the producers' prices are averaged over three years, producing seven three-year averages. Then the producers are ranked from 1 to p (p is the number of producers) based on their three-year price performance. Three-year price performance is the three-year average of each producer's $aprice_{it}$. If a producer is missing more than one year out of the three used to make the three-year average, then the observation is deleted. A correlation matrix is produced to measure the rank correlations between the seven three-year price performance ranks. The rank correlation, is the correlation between a three-year price performance rank and the consecutive three-year price performance rank. Out of the seven price performance ranks, there will be four rank correlations. These four rank correlations are averaged to establish a total average correlation, ρ.

The hypothesis of no performance persistence is tested using a parametric bootstrap similar to that of Harri and Brorsen. Standard procedures are not applicable because of the overlapping data. The null hypothesis tested is H_o: ρ = 0 against the alternative H_a: ρ > 0, where ρ is the average of the four correlations. The Monte Carlo simulation generates data from a random normal distribution with the same number of observations as the original data for each year. The simulation was done imposing no correlation. Next, the total average correlation for that sample set is found using the same method as the original data. This process is completed 10,000 times to develop 10,000 different average correlations, $\hat{\rho}$. The p-value is then found by taking the percentage of the simulated total average correlations that were greater than the original data's total average correlation:

(10) $$p - value = \sum_{m=1}^{q} I(\hat{\rho}_m > \rho) / q$$

where I is 1 if the argument is true and 0 if false, $\hat{\rho}_m$ is the average correlation calculated from the m^{th} replication, and q is the number of Monte Carlo replications.

Results

Regression Model

Estimates of the regression in equation (2) are shown in tables I-4, I-5, and I-6.

Table I-4. Wheat Price Parameter Estimates for the Southern Elevator

Parameter	Estimate	t-value	Pr > |t|
Intercept	1.16420	58.51	<. 0001
1992	.06030	2.47	.0138
1993	.02545	1.02	.3075
1994	.02698	1.11	.2686
1995	-.00685	-.29	.7751
1996	-.07795	-3.22	.0013
1997	.01730	.72	.4738
1998	.02952	1.18	.2388
1999	.02697	1.03	.3031
2000	0		
Awk	-.00592	-10.82	<. 0001
Activeness	.00130	1.21	.2266
χ^{2a}	28.45		<. 0001

[a] Tests the null hypothesis of no heteroskedasticity, using a likelihood ratio test.

Table I-5. Wheat Price Parameter Estimates for the Central Elevator

Parameter	Estimate	t-value	Pr > |t|
Intercept	.9236	127.98	<. 0001
1992	.2052	26.83	<. 0001
1993	.1588	21.77	<. 0001
1994	.2820	37.60	<. 0001
1995	.5930	82.07	<. 0001
1996	.5023	66.84	<. 0001
1997	.2006	26.65	<. 0001
1998	-.0252	-3.40	.0007
1999	-.1907	-23.93	<. 0001
2000	0		
Awk	-.00170	-9.38	<. 0001
Activeness	.00004	.09	.9301
χ^{2a}	281.72		<. 0001

[a] Tests the null hypothesis of no heteroskedasticity, using a likelihood ratio test.

Table I-6. Wheat Price Parameter Estimates for the Northern Elevator

Parameter	Estimate	t-value	Pr > |t|
Intercept	.9573	103.84	<. 0001
1992	.1724	18.82	<. 0001
1993	.1668	20.14	<. 0001
1994	.2796	33.42	<. 0001
1995	.6047	75.37	<. 0001
1996	.4598	58.84	<. 0001
1997	.1781	22.59	<. 0001
1998	NA	NA	NA
1999	-.2204	-27.62	<. 0001
2000	0		
Awk	-.00134	-5.37	<. 0001
Activeness	-.00009	-.14	.8849
χ^{2a}	182.77		<. 0001

[a] Tests the null hypothesis of no heteroskedasticity, using a likelihood ratio test.

The null hypothesis of no heteroskedasticity was rejected in each case. The null hypothesis was H_0: $\alpha_1 = \alpha_2 = 0$ and the likelihood ratio statistic has a χ^2_α distribution under the null. The parameter estimates for the variance equation (4) are presented in table I-7. They show that error variance is larger at the beginning and end of the marketing season, which is likely due to including a fixed effect for year in the model.

Table I-7. Estimates of the Multiplicative Variance Equation by Elevator

Alphas	Explanatory Variable	Southern	Central	Northern
Intercept		.0427	.0146	.0168
Average Week Sold	awk_{it}	-.0451	-.1527	-.1863
Average Week Sold Squared	awk_{it}^2	.0013	.0040	.0043
LR Statistic[b]	χ^2	28.45	281.72	182.77

[b] The null hypothesis is homoskedasticity H_o: $\alpha_1 = \alpha_2 = 0$.

The parameter estimates for the regression in each region show that the activeness of a producer’s style is not related to price. Producer’s who attempt to beat the market by actively trading are not successful. However, the parameter of awk_{it} shows that the later a producer sells wheat, the lower the expected price received. Oklahoma's harvest is early in the marketing year and is closer to export markets than most wheat-producing states. Therefore, as Benirschka and Binkley argue, the returns to storage in Oklahoma should be low. When awk_{it} was regressed as a function of $activeness_i$, the relationship was significant and positive. This could be interpreted, as farmers who have an active style tend to store longer and thus receive a lower price. But, a producer always selling at harvest would have activeness of zero. A producer who sells later will be unlikely to always sell the same week and thus be measured as being more active.

The model was also estimated including random effects for each producer. The test showed no random effects, which provides further evidence that the marketing style a particular producer uses, makes little difference.

Style Indicators

Figure 2 shows histograms for average week[4] producers sell wheat. At the southern elevator most wheat was sold at harvest and then sales quickly dropped off as the marketing year progressed. However, the northern and central elevators experienced a growth in sales with a peak at week eighteen. At the central elevator, sales slowly declined through the marketing year, while the northern elevator's sales remained steady and then quickly dropped three-quarters of the way through the marketing year. Southern producers market their wheat close to harvest, while producers at the central and northern elevators market wheat throughout the year. The southern producers have higher negative returns to storage than the northern and central producers, according to the first

[4] Week 1 is harvest and is four weeks long. Week 2 would be the fifth week after harvest started.

regression. This may explain why more southern producers sell at harvest. Earlier sales at locations closer to the Gulf are consistent with Benirschka and Binkley.

Figure 3 shows standard deviation of each producer's average week they sell wheat ($activeness_i$). This measures whether a producers is selling at the same time every year or is actively changing when he markets his wheat. The histogram for the southern elevator shows that 20 percent of the producers sell wheat within the same 2 weeks of their yearly mean marketing week. Thus showing that southern producers market their wheat close to the same time every year. The other histograms for the northern and central elevator show that producers have a more active style, changing their average sale week from year to year. These producers are changing the timing of their sales yearly rather than consistently marketing their wheat in the same month or week every year. This activeness is probably related to producers holding a portion of wheat in some years and not storing any in others, or some other active style. The producers selling with a standard deviation of 2 weeks or less are likely to be producers who always sell at harvest.

Figure 4 shows $frequency_{it}$ for all three elevators. These histograms show how many weeks producers sell wheat. The histograms illustrate producers usually market wheat one week per year. In fact, at every elevator over 50% of producer have only one transaction. The histograms also show that only around 10% of producers have more than 3 weeks with transactions. At all the elevators there were producers that had more than 10 weekly transactions per year, but at the northern elevator there is a slight increase.

Figure 5 shows *transsd*$_i$, standard deviation of *frequency*$_{it}$. The histograms reveal that producers tend to have the same number of transactions each year. At every elevator nearly 80% of all producers have a standard deviation of one week. This means that producers do not vary the number of weeks in which they sell wheat. From figures 4 and 5, it can be interpreted that producers will typically have 1 transaction week every year and will not change the number of transactions from year to year by more than one week of transactions. Producers are not as active with their 'number of weeks with transactions' as they are with the weeks when they choose to make these transactions.

Figure 6 explains the separation of sales during the year for the producers, this is the variable *separation*$_{it}$. The histograms show how far apart the transactions are within a year. It can easily be seen that once producers decide to market wheat they sell it all very quickly. In fact, when looking at the histogram they sell within 2 weeks of the mean marketing week for that year. This means that producers are not spreading out their sales during the year, instead they typically have their wheat sold within 4 weeks of the mean transaction week after harvest for that year. This illustrates that producers are making little use of spreading sales to reduce price risk. The histogram reflects that there are many producers with only one transaction per year.

At the southern elevator, producers favor selling at harvest; while at the other two elevators, producers favor selling later. Producers at all the elevators typically sell close to the same number of weeks every year. Nearly 90% of producers have less than 4 weeks with a transaction. Even though producers appear to be less active when examining weeks with a transaction, it is not true for average week wheat is sold. Producers appear to change the timing of their sales regularly. Therefore, producers are less active with respect to number of weeks they sell wheat, but more active with respect to the weeks they market their wheat in.

Performance Persistence

For the performance persistence test, the null hypothesis is H_o: $\rho=0$ and is tested against the alternative H_a: $\rho>0$, where ρ is the average correlation. In table I-8 the p-value and average correlations for the elevators are shown. Because the p-values are large there is not enough evidence to reject the null hypothesis

Table I-8. Average Correlation and P-Values

Elevator	Average Correlation	p-Value
Southern	.0180228	.3748
Central	-.08661	.9706
Northern	-.168387	.9963

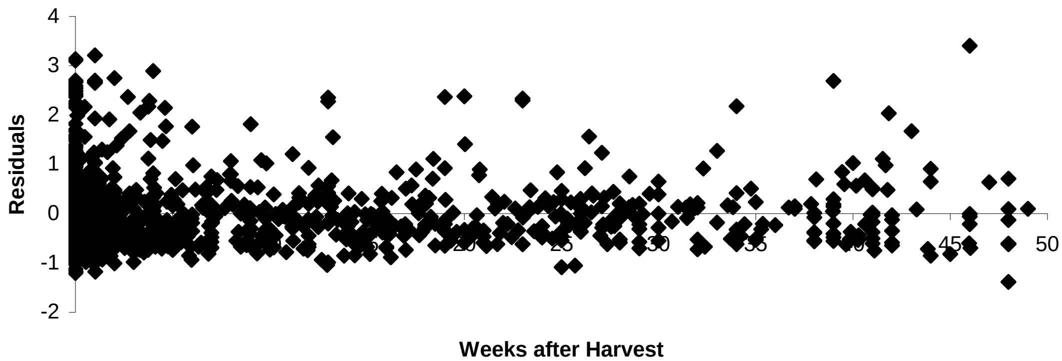
of no correlation. From this, it can be concluded that producers do not have performance persistence. This conclusion of no performance persistence is consistent with the efficient markets theorem of farmers receiving an average price over time.

Conclusion

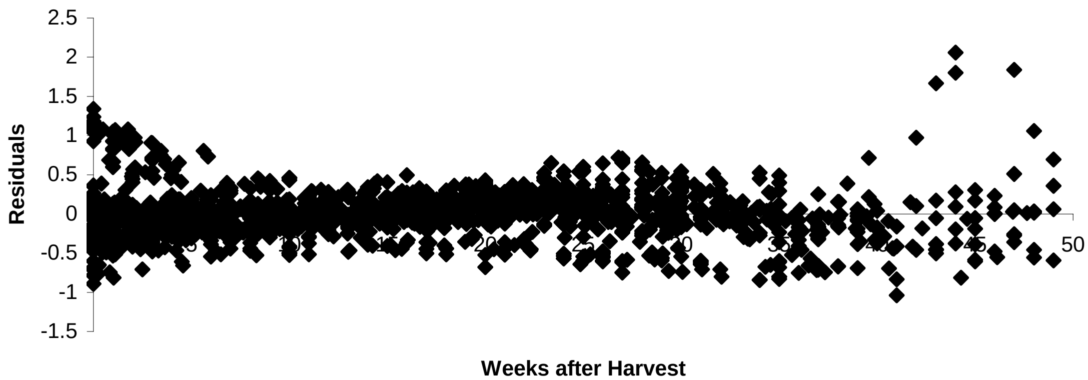
The paper measured the extent to which the styles used by producers are either active or mechanical. In most cases producers appear mechanical (not changing their marketing style from year to year) with respect to number of sales and active (changing their marketing style from year to year) with respect to timing of sales. Southern producers appear to use a basic overall mechanical style, with sales occurring at or near harvest every year. The producers at the other elevators have a more active style. The results did not reveal any differences in net price received between producers that used an active style, with respect to market timing, and those that used a mechanical style. Time had a negative effect on price, but this is possibly due to assuming full cost of carry. Some producers may not have the same cost of carry. A producer's actual cost of carry could be higher or lower than the one used in this study, and therefore could alter the effect time has on net price received.

Producer performance persistence was tested using a bootstrap. The test showed no evidence of performance persistence. The lack of performance persistence and insignificance of the activeness variable on price received supports the efficient market hypothesis. In conclusion, from the research done in this paper, there does not appear to be any benefit for producers to fight the market. In addition, when including the storage and interest cost applied in this paper, time appears to have a negative effect on price and thus there is some evidence that producers store too long.

Southern Elevator



Central Elevator



Northern Elevator

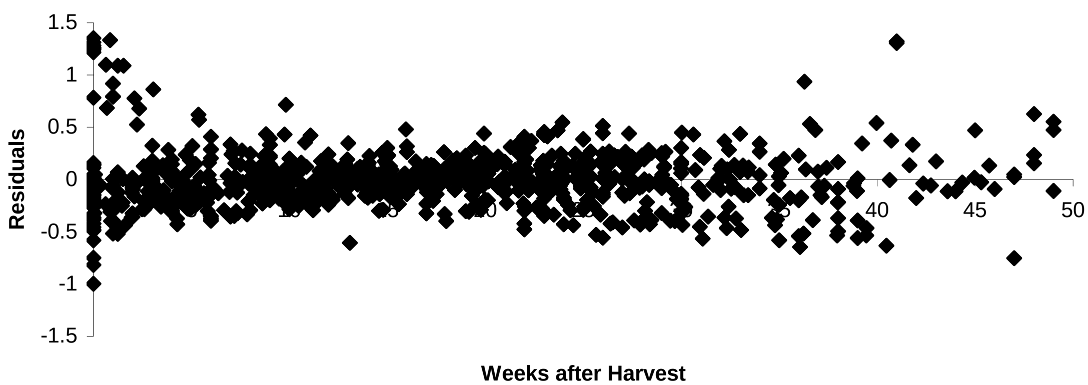


Figure I-1. Elevator Residual Plots

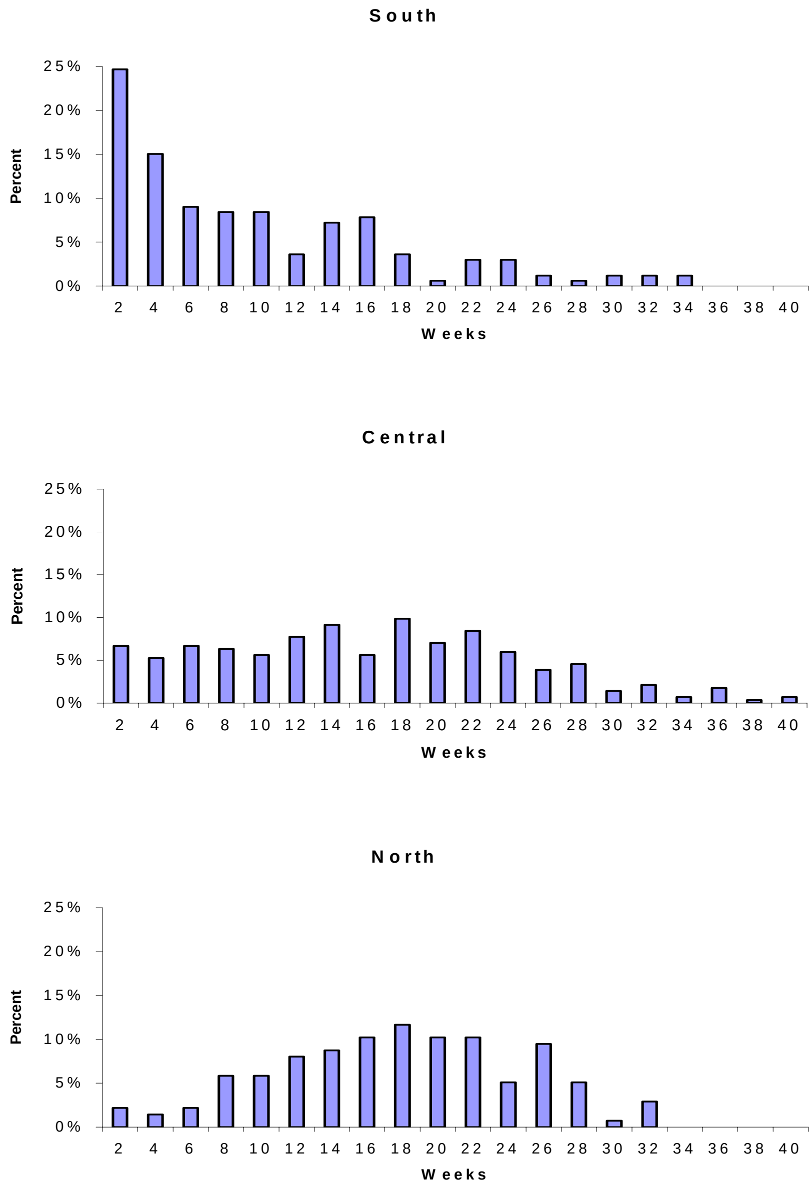


Figure I-2. Histograms of average sales date (*awk*$_{it}$)

Note: Harvest is 4 weeks long, and thus the 2 represents the first 5 weeks of the crop year. Weeks is the mean number of weeks after harvest (with the four week harvest being week 1) that a producer sold wheat in a particular year. Percent is the percent of producers with an average sale week in the 2 week interval.

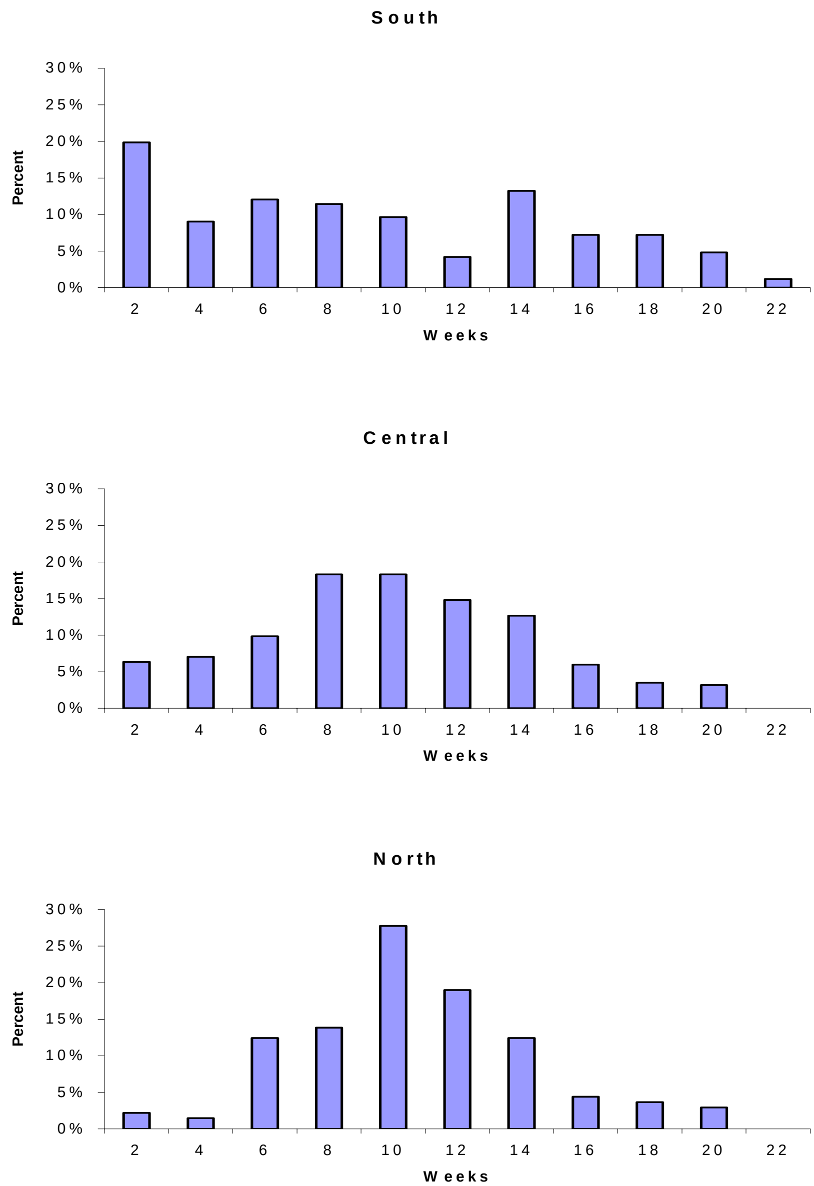
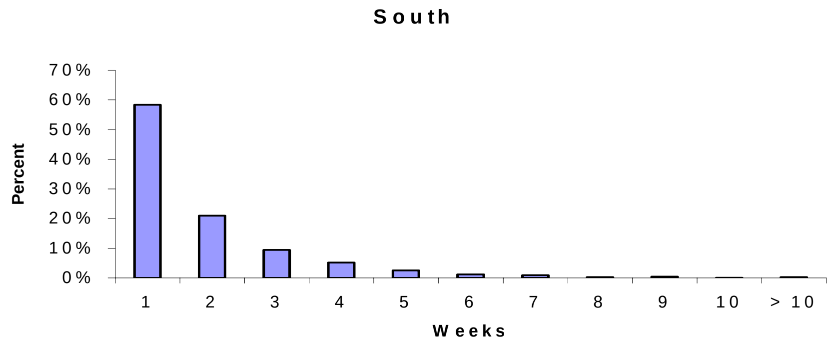
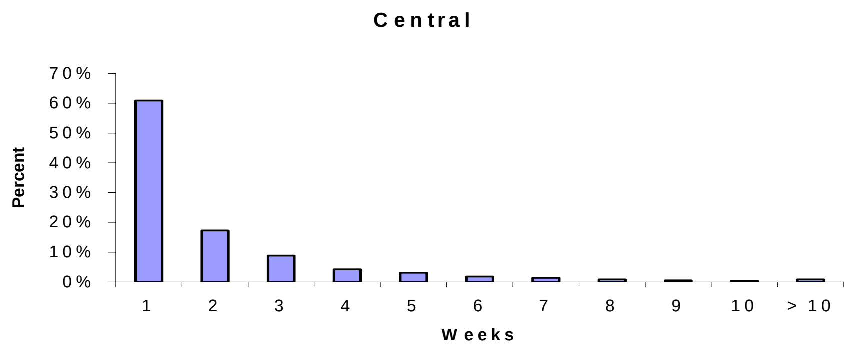


Figure I-3. Standard Deviation of *awk_{it} (activeness$_i$)*

Note: The weeks represent the number of weeks in which a producer may deviate from the mean week that a producer markets their wheat. If weeks is equal to 4 then the producer will market their wheat within greater than 2 weeks and less than or equal to 4 weeks of the mean. Percent represent the percentage of producers with that specific standard deviation of mean week.





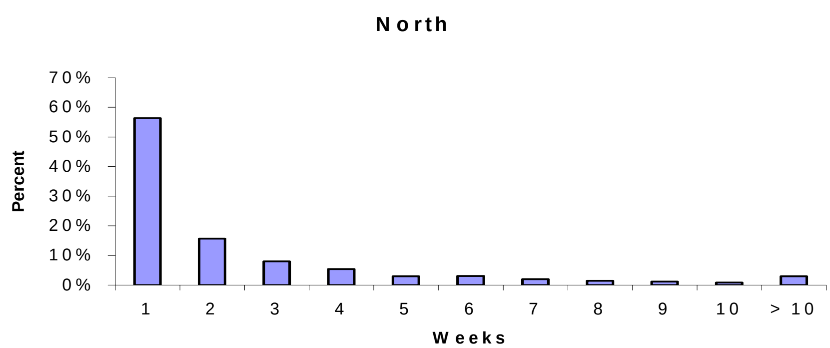


Figure I-4. Producer Average Number of Sale Weeks (*$frequency_{it}$*)

Note: Weeks represent the mean number of weeks that a producer has a transaction for all years. If weeks is equal to 1 then a producer will average no more than 1 week with a transaction. If weeks is equal to 2 then a producer will average more than 1 week with a transaction, but no more than 2 weeks. Percent is the percent of producers that have an average number of transactions for that 1 week interval.

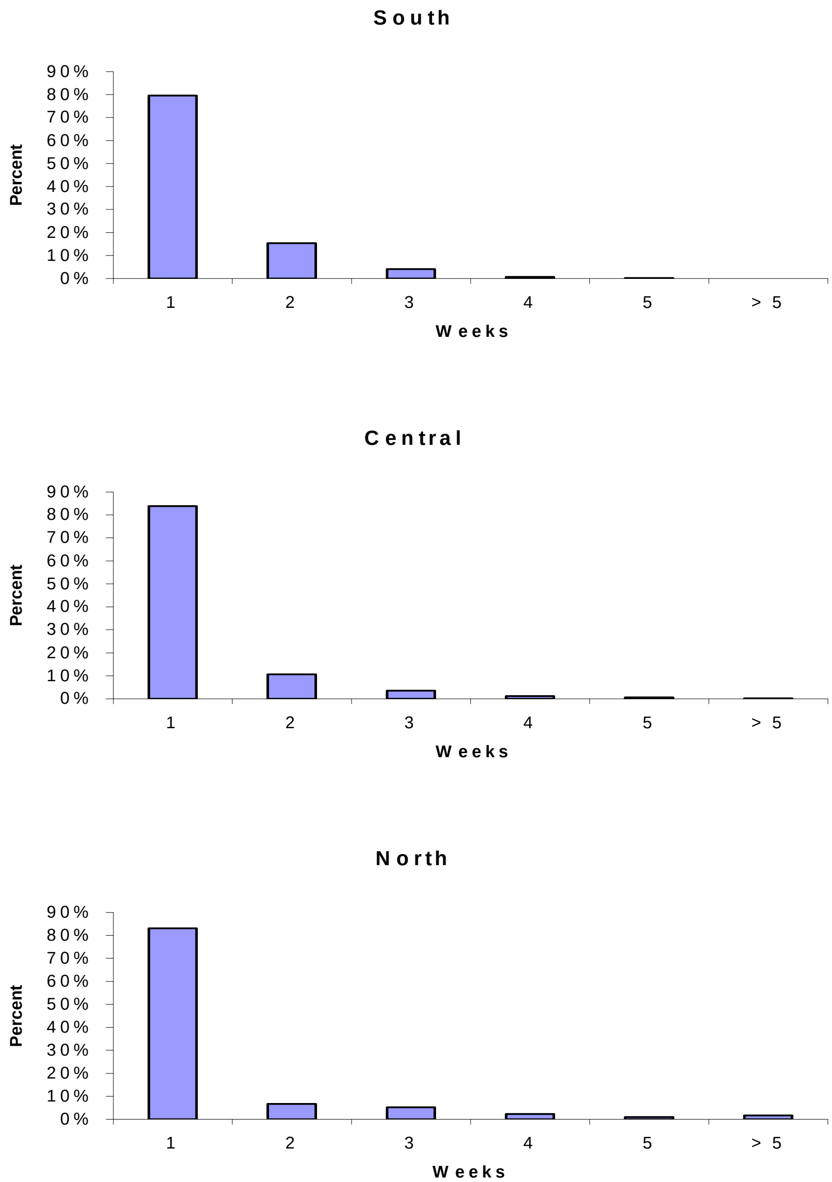
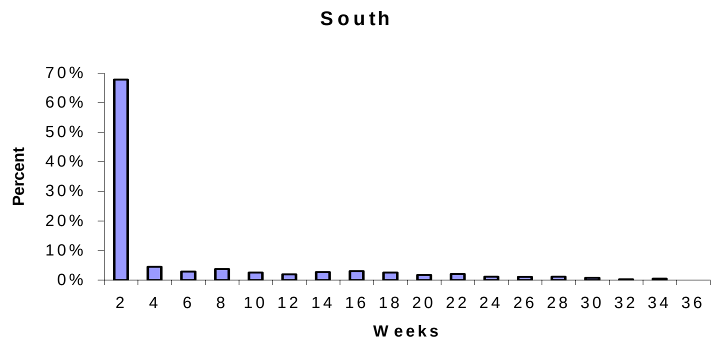
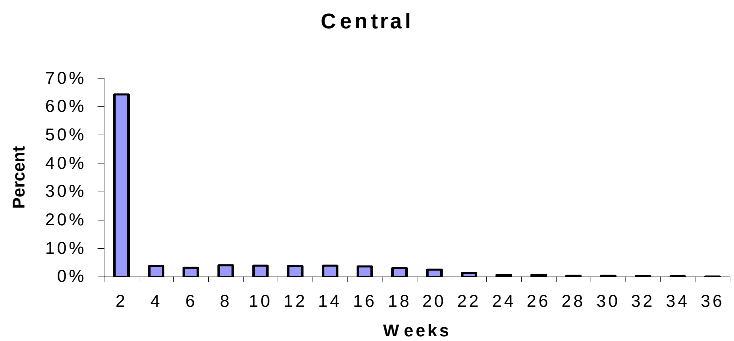


Figure I-5. Standard Deviation of Average Number of Sale Weeks (*transsd*$_i$)

Note: Weeks is number of weeks with a transaction that a producer may deviate from the mean number of weeks with a transactions from year to year. If weeks is equal to 1 then a producer will deviate 1 week or less from the mean number of weeks with a transaction. Percent is the percentage of producers that have that number of weeks as their standard deviation for number of weeks with a transaction.





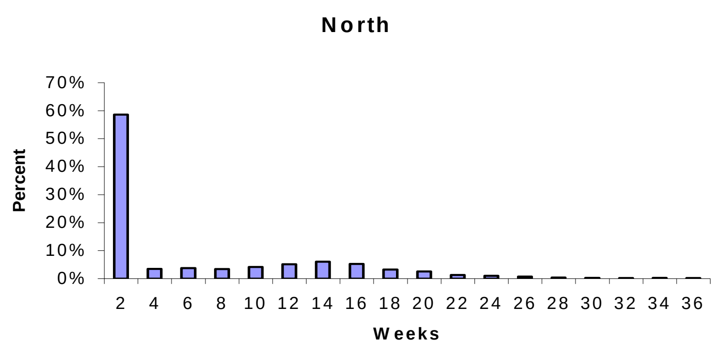


Figure I-6. Separation

Note: Weeks measures how far apart a producer's week with a transaction are for every year. If week is equal to 4 then a producer will sell his wheat every year between greater than 2 week and less than or equal to 4 weeks of their average sale week for that year. Percent is the percentage of producers that fall within that 2 week interval for that year.

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Essay II

Gender Differences in Marketing Styles

Introduction

Recent studies have found differences in how men and women approach economic decisions. Barber and Odean found that men trade stocks more often than women and as a result men receive lower returns than women. It was also found that men exhibited overconfidence in believing that they could outperform others through their own decisions. Literature supports the theory that men are more confident than women in their decisions (Masters; Stinerock, Stern, and Solomon; Zinkhan and Karande). Barber and Odean call the strength of men's confidence overconfidence. Overconfidence has also been found in surveys of farmer price expectations (Eales et al.; Kenyon) where farmers overestimate the accuracy of their own price forecasts. In these surveys the farmers were mostly males.

There is a large quantity of literature over differences in gender decision making (Chaganti; Hudgens and Fatkin; Johnson and Powell; and Powell) and in differences of each gender's ability to process and react to information (Stinerock, Stern, and Solomon; Hyde). Estes and Hosseini find that gender is the most important factor explaining investment decision confidence. One characteristic that men and women differ in that is of particular importance is risk tolerance. When women and men make decisions under uncertainty, women are more conservative and appear less confident (Hudgens and Fatkin; Johnson and Powell; Sexton and Bowman-Upton; and Zinkhan and Karande). In short, the literature shows women to be less confident in their decisions and approach uncertainty with greater caution than men.

Slusher addressed gender differences in marketing of agricultural crops. He used actual farmer transactions and found that gender had little affect on the mean price received. However, women's price fluctuations from year to year were smaller than that of men and suggest that women avoided risky marketing strategies, much like other literature on gender would suggest. Slusher also found that males were more likely to store across crop years. Slusher's data included nine women, only 7% of the sample, and so they are not definitive. Yet Slusher's results do suggest the intriguing possibility that women are better marketers than men.

Brorsen and Irwin call for studies of farmer marketing to use actual data (resembling Slusher's research) to understand what producers are doing. There is a voluminous literature using normative models such as optimal hedging strategies (Harwood et al.; McNew and Musser; Musser, Patrick, and Eckman; Simmons; and Zuniga, Coble, and Heifner), tests of market efficiency (Brorsen; Kastens and Schroeder; McKenzie and Holt; Shiller; Simmons; Zulauf and Irwin), and price forecasting (Just and Rausser; Norwood and Schroeder; O'Brien, Hayenga, and Babcock; Robledo, Zapata, and McCracken; Tomek), but there is relatively little positive research on farmers actual marketing decisions. Only a handful of studies have examined actual producer data (McNew and Musser; Slusher). With actual farmer data, specific factors such as gender, time, economies of size, and number of sales may help explain differences in net price received by producers.

In this article, actual farmer transactions are examined from three grain elevators. These data are used to form three regression models. First a regression model is developed to test gender differences in frequency of sales. The second regression model is designed to measure gender differences in length of storage after harvest. Then the article uses the data for a third model to determine if differences in net price per bushel received by wheat producers on the cash market can be explained by gender, in addition to that explained by (a) frequency of weekly sales, (b) average week of sales after harvest, and (c) total annual volume sold by the producer.

The number of transactions a producer has per year, frequency of sales, could be related to a producer's risk tolerance. If men are overconfident in their ability to predict the market, then they should have fewer sales than women, because spreading sales theoretically reduces risk. Spreading sales or increasing number of transactions, bears no price penalty because of no per transaction charges by the elevator. Through examining the actual farmer data it can be determined if men are more active traders (having many transactions per year) or if they are more confident in their decisions with fewer transactions per year. The frequency variable in the paper will also be measured in the third regression to see how well it explains price differences between producers.

The efficient market theorem states that market prices reflect all available information (Fama). Therefore, in the absence of transaction costs expected returns will be the same no matter when grain is sold. The only theoretical way that farmers can out perform the market is to get information first or to have superior analytical ability. More than likely, farmers will have neither. If the theory does not hold then large producers would be justified in purchasing private information (e.g. subscribing to market advisory services) to receive a higher price. If larger producers receive a higher price it could be evidence against the efficient market hypothesis or it could be due to pecuniary economies of scale.

It has also been found that sometimes people hold their losing investments too long and sell their winners too soon (Odean). The behavioral finance literature argues that myopic loss aversion can cause investors to hold on to losing positions (Brorsen). Men's overconfidence could also make them more prone to myopic loss aversion, which in turn could lead male producers to store too long in anticipation of a turn around in the market, letting carrying costs eat up their profits.

Individual Producer Transaction Data

Data are from three grain elevators located in the north, south, and center of western Oklahoma. The data are from the harvest of 1992 through the spring of 2001 (nine crop years). The data contain all individual transactions of wheat sales at each elevator. Each transaction has the seller, number of bushels, price per bushel, and date. However, each seller's name was not always spelled correctly and some sellers operated under a variety of names. To remedy this problem, elevator managers were asked to identify the primary marketing decision maker and their gender for each sale. This was done by giving the elevator managers a spreadsheet containing the seller names, and then they identified the primary decision maker for each sale.

Many of the transactions for decision makers happen on the same day or on days close to each other. Since the number of transactions is a variable being examined, the transactions have been lumped into weeks. Thus, if there were 24 transactions within a specified seven-day period[5], they would count as one transaction. Therefore if a seller has two transactions, this means the seller traded in two different weeks.

Local harvest dates differ. The southern elevator's harvest is assumed to be May 25 thru June 21, the central elevator's harvest is assumed to be June 1 thru June 27, and the northern elevator's harvest is assumed to be June 12 thru July 7. Storage costs and interest costs used are determined the same way for all elevators. The storage cost, set by the elevators, averages $.00085/day, which is $.0255/month. The interest cost is calculated at the prime rate for that year plus 2%. The prime rate is the prime rate charged by banks in June for that year, quoted from the Kansas City Federal Reserve Bank. Multiplying the interest rate by June wheat price and then dividing the product by

Table II-1. Interest, Storage, and Carrying Costs

Year	Interest Rate	Wheat Price $/bu	Interest Cost/day cents/day	Storage/day cents/day	Cost of Carry/day cents/day
92	8.50%	$3.27	.075	.085	.160
93	8.00%	$2.54	.070	.085	.155
94	9.25%	$3.07	.081	.085	.166
95	11.00%	$3.88	.096	.085	.181
96	10.25%	$5.48	.090	.085	.175
97	10.25%	$3.28	.090	.085	.175
98	9.75%	$2.62	.085	.085	.170
99	11.50%	$2.31	.101	.085	.186
00	9.00%	$2.50	.079	.085	.164

[5] There are weekend sales during harvest.

365 days gives interest cost per day. The June wheat price is the June price quote for wheat in Oklahoma for that year from the National Agricultural Statistics Service. The cost of carry is then figured per day. Table II-1 shows the interest, storage, and combined carrying costs per day.

The selling prices net of interest and storage costs are

$$netprice_{itd} = P_d - d\left(\frac{P_0(z_t + .02)}{365} + S_d\right) \quad (11)$$

where i is the producer, t is the year, d is the number of days after harvest, $netprice_{itd}$ is the net price, P_d is the price received on day d, P_0 is the harvest price for that year, z_t is the prime interest rate for that year, and S_d is the storage cost/day.

In table II-2 the descriptive statistics for each elevator are given. Average price is the actual average price that producers received over 9 years of data. The average net price is the adjusted average price that producers received over the 9 years of data. The price is adjusted for carrying costs, which includes interest and storage costs. Harvest price is the average price that producers received at harvest, which is a four-week period defined differently for each elevator. Beginning harvest dates for the southern, central, and northern elevators are May 25, June 1, and June 12 respectively. Average week is the average week that producers chose to market their wheat for all years.

In table II-2, it is interesting to see that harvest price at each elevator is higher than the net price (average price including carrying costs), implying a negative return to storage. This agrees with past literature (Benirschka and Binkley) that there is an early demand for wheat in southern areas like Oklahoma where wheat is harvested earlier than in northern markets. The southern elevator also has a higher net price and an earlier average week of sales than the other elevators.

Table II-2. Descriptive Statistics for Each Elevator

Descriptive Statistics	South	Central	North
Average price received ($/bu.)	3.41	3.33	3.43
Average net price received ($/bu.)	3.35	3.13	3.20
Harvest price ($/bu.)	3.47	3.21	3.45
Number of observations	14,434	6,613	4,765
Average week[a]	5	16	18

[a] Harvest is 4 weeks long and considered to be week 1.

In table II-3, the descriptive statistics by gender and elevator are given. The mean week wheat sold after harvest and bushel weighted mean net price are both bushel weighted. Table II-3 shows that the central elevator has the most women producers. At all elevators, men sell more bushels and make more transactions than women.

Table II-3. Gender Descriptive Statistics of Sales by Oklahoma Wheat Producers

Elevator	Gender	# Producers	Mean Week Wheat Sold after Harvest	Mean Number of Weekly Transactions	Bushel Weighted Mean Net Price ($/bu.)	Average Number of Bushels Sold (1000 bu.)
South	Male	154	8.66	2.05	3.05	61.90
	Female	12	8.43	1.58	3.03	28.07
Central	Male	205	14.34	2.51	2.89	38.93
	Female	69	16.89	1.52	2.83	16.52
North	Male	100	17.21	3.73	2.99	76.28
	Female	8	16.14	2.73	3.16	36.76

A number of errors were also corrected, and some transactions were deleted from the data set. First, the northern elevator is missing transactions from 5/1/98 to 6/1/99. Second, if the price per bushel was less than $1.50, the observation was deleted. The reason for deletion was that the transaction was probably for wheat cleanings or a data entry error. If the price per bushel was greater than \$10.05, it was deleted. The reason for deletion was that the transaction was probably a data entry error. The \$10.05 amount is the high cut off, because it was the lowest extremity on the high side of price. The other prices that were high were similar or near other prices around the same date. Another deletion within the data set included, transactions that had negative bushels. These transactions were deleted because they identify purchases rather than sales. If an elevator manager suggested the transaction be deleted, then it was deleted as well as transactions with missing data (such as a missing name, bushels, or price). If the elevator manager could not determine a decision maker or sex of the decision maker, the observation was deleted. It is also assumed that the same seller was the decision maker all 9 years for transactions where a name was included but decision maker could not be determined.

Procedures

The first two regressions determine if gender differences exist for average week of sales after harvest and frequency of sales, and a third regression model is used to determine if differences in net price per bushel received by western Oklahoma wheat producers on the cash market can be explained by (a) gender, (b) frequency of weekly sales, (c) average week of sales after harvest, and (d) total annual volume sold by the producer.

The first regression will determine if women and men differ in their marketing styles in terms of choosing how often to sell. The first regression is

$$\sqrt{frequency_{it}} = \beta_0 + \sum_{j=1}^{8} \beta_{1j} year_{jt} + \beta_2 male_i + \beta_3 tvol_{it} + \varepsilon_{it} \tag{12}$$

where i is the producer, t is the year, $frequency_{it}$ is the s number of different weeks producer i sold wheat in year t, $year_t$ is a dummy variable for each year, $tvol_{it}$ is the total volume producer i sells in year t, $male_i$ is a dummy variable that accounts for producer i being male or female, and ε_{it} is the error term. The square root transformation of the dependent variable is used to adjust for the nonnormality in residuals found without the transformation. The Anderson-Darling test is used to test the null hypothesis of normality under a normal distribution. The Anderson-Darling test statistic of 48.28 is greater than the critical value of .752 at the 95% confidence level (D'Agostino and Stephens, Table 4.7, p. 123). Therefore this suggests that the null hypothesis of normality is rejected. The OLS model with $frequency_{it}$ as the dependent variable showed heteroskedasticity and therefore the error term, ε_{it}, has been redefined. The error, ε_{it}, is defined to be heteroskedastic as

$$\varepsilon_{it} \sim N(0, \sigma_{it}^2) \tag{13}$$

and the variance of ε_{it} (σ_{it}^2) is defined as

$$\sigma_{it}^2 = \exp(\alpha_0 + \sum_{j=1}^{8} \alpha_{1j} year_{jt} + \alpha_2 male_i + \alpha_3 tvol_{it}) . \tag{14}$$

The heteroskedastic model is estimated using maximum likelihood.

The second regression seeks to determine if men or women store wheat longer than the other. The equation is

$$\sqrt{awk_{it}} = \beta_0 + \sum_{j=1}^{8} \beta_{1j} year_{jt} + \beta_2 male_i + \beta_3 tvol_{it} + \varepsilon_{it} . \tag{15}$$

where awk_{it} is the yearly bushel-weighted mean weeks after harvest when wheat was sold by producer i. The Anderson-Darling test is again used to test the null hypothesis of normality under a normal distribution. The Anderson-Darling test statistic of 26.80 is greater than the critical value of .752 at the 95% confidence level (D'Agostino and Stephens, Table 4.7, p. 123). Therefore this suggests that null hypothesis of normality is rejected. A square root transformation is again used to handle nonnormality. Because the OLS model with awk_{it} as the dependent variable exhibited heteroskedasticity the error term, ε_{it}, has been redefined. The error, ε_{it}, is defined to be heteroskedastic as

(16) $$\varepsilon_{it} \sim N(0, \sigma_{it}^2)$$

and the variance of ε_{it} (σ_{it}^2) is defined as

(17) $$\sigma_{it}^2 = \exp(\alpha_0 + \sum_{j=1}^{8} \alpha_{1j}\, year_{jt} + \alpha_2 male_i + \alpha_3 tvol_{it}) .$$

The heteroskedastic model is estimated using maximum likelihood. The average week, awk_{it}, is calculated as follows

(18) $$awk_{it} = \sum_{w=1}^{48} (tvol_{itw} wk_{itw}) / tvol_{it}$$

where w is the week[6], $tvol_{itw}$ is the bushels sold by producer i in year t and week w, wk_{itw} is the weeks after harvest that the transaction occurred, and $tvol_{it}$ is total bushels sold by producer i in year t.

The third regression is:

(19) $$lprice_{it} = \beta_0 + \sum_{j=1}^{8} \beta_{1j}\, year_{jt} + \beta_2 tvol_{it} + \beta_3 awk_{it} + \beta_4\, frequency_{it} + \beta_5 male_i + \varepsilon_{it}$$

where i is the producer, t is the year, $lprice_{it}$ is the log of $aprice_{it}$ the bushel-weighted net price for producer i in year t and ε_{it} is the error term.[7] To test for normality the Anderson-Darling test is again used. The Anderson-Darling test statistics for the

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[6] Based on four-week harvest, so 48 weeks in a marketing year.

[7] Number of transactions, $frequency_{it}$, and the standard deviation of number of transactions were also considered but they were not significant and were dropped from the model since theory to support their inclusion was weak.

southern, central, and northern elevators are 14.84, 3.18, and 2.61. They are all greater than the critical value of .752 at the 95% confidence level (D'Agostino and Stephens, Table 4.7, p. 123). Therefore this suggests that null hypothesis of normality is rejected. The plots of error terms versus awk_{it} for the OLS model with $aprice_{it}$ as function of $year_t$, $tvol_{it}$, awk_{it}, $frequency_{it}$, and $male_i$ indicated heteroskedasticity with variance increasing for either high or low values of awk_{it}. The error, ε_{it}, is defined to be heteroskedastic as

$$\varepsilon_{it} \sim N(0, \sigma_{it}^2) \tag{20}$$

and the variance of ε_{it} (σ_{it}^2) is defined as

$$\sigma_{it}^2 = \exp(\alpha_0 + \alpha_1 awk_{it} + \alpha_2 awk_{it}^2 + \alpha_3 tvol_{it} + \alpha_4 frequency_{it} + \alpha_5 gender_i). \tag{21}$$

The heteroskedastic model is estimated using maximum likelihood.

Two other misspecification tests, tests for random effects and nonlinearity, are used. Random effects need to be tested because the regression uses panel data and there is a possibility that some omitted variables may be constant over time, but differ between producers. To measure this, random effects are tested using a likelihood ratio test. The test illustrated no random effects at the 95% level and therefore provides evidence that including additional producer characteristics would offer little explanatory power.

Two nonlinearity tests were done. The first test was done by adding the log term of the $tvol_{it}$ variable and squared term of the awk_{it} variable and testing the new variable's significance. However, the additional terms were not statistically significant at the 95% level. The second test is a RESET test done by adding the squared predicted value of the dependent variable into the regression. The p-value results for the test for nonlinearity for the southern, central, and northern elevators are .6323, .4612, and .4583 respectively. Thus we fail to reject the null hypothesis of linearity.

The dependent variable in (8) is the log of annual bushel weighted price by producer, $lprice_{it}$. The annual bushel-weighted mean price is

$$lprice_{it} = \log\left(\sum_{d=1}^{d=365}(bu_{itd}\, netprice_{itd})/tvol_{it}\right) \quad (22)$$

where i is the producer, t is the year, d is the day, bu_{itd} is the bushels sold that day by a producer, and $tvol_{it}$ is yearly total volume of bushels sold per producer.

Results

The descriptive statistics show the distribution of gender between elevators and their means with respect to time of sales, frequency, and bushels sold. Less than 10% of producers are women at the southern and northern elevators. However women make up 25% of the producers at the central elevator. The low number of women producers was also a problem in Slusher's paper where only 7% of producers were women. Only results for the central elevator are presented, since it is the only elevator with enough observations on women to yield tests with enough power to reject the null hypothesis. The small number of women at the southern and northern elevators led to the gender coefficients in being insignificant in all cases for these elevators. Note that the frequency models agreed in sign; however for the mean week of sales after harvest the estimates for the model had opposite signs for gender and were not significant for the north and south elevators.

The regression results for the regression with $frequency_{it}$ as the dependent variable and volume and gender as the independent variables are given in table II-4. The total volume sold each year by producer, $tvol_{it}$, is significant and positive. Essentially this means that the more a producer has to sell the more often they will sell. From the table it can be seen that women have fewer sales. The explanation for women selling less frequently is not clear.

Table II-4. Central Elevator Number of Transactions Regression Model

Parameter	Estimate	t-value	Pr > |t|
Intercept	.934	38.88	<. 0001
1992	.137	3.95	<. 0001
1993	.138	4.08	<. 0001
1994	.179	5.17	<. 0001
1995	.309	8.13	<. 0001
1996	.173	5.43	<. 0001
1997	.172	5.24	<. 0001
1998	.104	3.06	.0023
1999	.048	1.52	.1296
2000	0		
Male	.120	6.82	<. 0001
Total Volume	.0629	21.30	<. 0001

Table II-5 shows the regression with average week of sale after harvest, awk_{it}, as the dependent variable and gender and volume as the independent variables. The volume variable is again significant and positive. This can be interpreted, as the higher the volume a producer sells, the later the average week they market their wheat. This is similar to the frequency variable. The more wheat a producer markets during a marketing year, the more transactions they will have and the later the bushel weighted average week they sell in will be. The gender variable is negative and significant. The negative coefficient is interpreted as men are selling earlier than women. This means women are storing longer. Possible explanations for women storing longer include psychological ones such as women are less decisive or economic ones such as the women could be older widows who are net lenders and thus it could pay for them to store longer. While data on age was not available here, women in Slusher’s study had an average age of 61.

Table II-5. Central Elevator Producer Sale Week after Harvest Regression Model

Parameter	Estimate	t-value	Pr > |t|
Intercept	3.088	19.07	<. 0001
1992	.434	2.20	.0277
1993	.404	2.12	.0340
1994	.513	2.66	.0078
1995	.351	1.86	.0625
1996	.663	3.47	.0005
1997	.453	2.39	.0172
1998	.401	2.13	.0333
1999	.842	4.28	<. 0001
2000	0		
Male	.377	-3.65	. 0003
Total Volume	.022	3.28	.0010

Unlike the previous two models, the price regression model will examine all elevators because gender is only one of the independent variables and the coefficients on the other variables are also of interest. Table II-6 shows the likelihood ratio statistics for the null hypothesis of homoskedasticity and the α's for equation (6). For each region H_0 is rejected at the 99% level, and thus shows the model with heteroskedasticity is the preferred model.

In table II-6, the estimates of the coefficients in the variance equation for the third regression model are given. All of the estimates in table II-6 are significant except for the gender estimates for all the elevators and total volume estimate for the northern elevator. The variance of the error is a measure of risk and thus the coefficients show the effects of the variables on risk. Frequency can be interpreted as producers can reduce risk by increasing the number of sales for that year. Table II-4 shows that men have a higher number of transactions per year, which would suggest men are using a risk minimization strategy. The average sale week after harvest for each elevator also have the same sign; however, when the variable is squared the sign is different for the elevators and between the variables and therefore there is some discrepancy of the effect timing of sales has on risk.

Table II-6. Estimates of the Multiplicative Variance Equation by Elevator

Alphas	Explanatory Variable	Southern	Central	Northern
Intercept		.0585	.0157	.0180
Average week sold	awk_{it}	-.0338*	-.1255*	-.1562*
Average week sold squared	awk_{it}^2	-.0010*	.0035*	.0038*
Total volume	$tvol_{it}$	-.0111*	-.0119*	-.0012
Number of transactions	$frequency_{it}$	-.0978*	-.1026*	-.0827*
Gender	$male_i$	-.1342	-.0164	-.0735
LR statistic[a]	χ^2	80.82	319.24	157.03

[a] The null hypothesis H_o: $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = 0$ with a χ^2 critical value of 15.1 at the .01 significance level.
* Significant estimates with a χ^2 critical value of 3.84 at the .05 significance level, given in table II-10.

Estimations of the regression in equation (4) that is defined by (5) and (6), are shown in tables II-7, II-8, and II-9. Each elevator has different results. The $tvol_{it}$ estimate is only significant at the southern elevator and is negative. This offers support for the efficient market hypothesis since it is inconsistent with economies of size in information gathering. The only estimate that is significant at all the elevators is that which is related to time and storage, awk_{it}. This estimate is negative and thus shows that the longer a producer stores, the lower the expected price received. This implies that producers should have negative returns to storage. Because Oklahoma is one of the closer wheat producing states to the gulf, it holds consistent with Benirschka and Binkley who argue that areas close to the market should expect low returns to storage because their grain is a higher value and thus their opportunity cost of storage is higher. In addition, the Oklahoma wheat harvest is in June, which is before the seasonal lows in July that occur during the Kansas wheat harvest.

Table II-7. Southern Price Regression Model

Parameter	Estimate	t-value	Pr > |t|
Intercept	1.1864	39.86	<. 0001
1992	.0536	2.23	.0256
1993	.0278	1.15	.2519
1994	.0288	1.18	.2400
1995	-.0136	-.57	.5677
1996	-.0700	-2.96	.0031
1997	.0247	1.05	.2956
1998	.0373	1.53	.1271
1999	.0383	1.46	.1454
2000	0		
TVol	-.0008	-6.02	<. 0001
Awk	-.0059	-11.43	<. 0001
Frequency	.0042	1.83	.0668
Male	-.0210	-.85	.3930

Table II-8. Central Price Regression Model

Parameter	Estimate	t-value	Pr > |t|
Intercept	.9264	132.77	<. 0001
1992	.2030	26.76	<. 0001
1993	.1466	20.31	<. 0001
1994	.2750	36.81	<. 0001
1995	.5885	82.73	<. 0001
1996	.5175	68.43	<. 0001
1997	.1974	26.45	<. 0001
1998	-.0258	-3.55	.0004
1999	-.1881	-23.58	<. 0001
2000	0		
TVol	-.0001	-.54	.5875
Awk	-.0017	-9.58	<. 0001
Frequency	-.0000	.01	.9881
Male	-.0015	-.35	.7229

Table II-9. Northern Price Regression Model

Parameter	Estimate	t-value	Pr > |t|
Intercept	.9563	79.69	<. 0001
1992	.1674	17.15	<. 0001
1993	.1583	17.86	<. 0001
1994	.2738	31.21	<. 0001
1995	.6091	71.57	<. 0001
1996	.4678	55.91	<. 0001
1997	.1773	21.60	<. 0001
1998	0	NA	NA
1999	-.2188	-25.38	<. 0001
2000	0		
TVol	.0002	1.81	.0713
Awk	-.0012	-4.62	<. 0001
Frequency	-.0011	-1.83	.0681
Male	.0024	.26	.7986

Number of sales, $frequency_{it}$, is not significant at any of the elevators, and signs also differ across the elevators. It can be deduced that having a large or low number of sales per year does not have an effect on the expected price received. This is expected because elevators do not charge transaction costs. Even though the week of sale after harvest regression shows women at the central elevator store longer the price regression model does not show any direct differences between genders[8].

Conclusion

There were three objectives examined in this article: (1) to measure the gender differences with regard to time, (2) to measure gender differences with regard to frequency of sales, and (3) to determine the extent to which gender, time, frequency of sales, and volume had on differences in net price received.

[8] Because of this an alternative regression was also run with price as a function of gender and volume:

$$lprice_{it} = \beta_0 + \sum_{j=1}^{8} \beta_{1j} year_{it} + \beta_2 tvol_{it} + \beta_3 male_i + \varepsilon_{it}$$

Gender was not significant in this model either.

Barber and Odean found that men trade more than women in financial markets. This article found it also to be true for wheat cash markets, however, in wheat markets there is no direct costs to more frequent trading so the more frequent trading does not lead to lower returns. Men are also marketing their wheat about two weeks earlier than women. It also can be revealed in the frequency regression and the average sale week after harvest regression, that the larger a producer is, the later they will sell and the higher the number of weekly transactions.

Volume of sales was also not significant at two of the three elevators for the price regression, leading to the conclusion that total volume does not explain the differences in prices received. This means that a large farmer and small farmer should get the same price at the elevator and that the number of transactions should not increase or decrease the net price a producer will receive.

The estimates for the multiplicative variance for price regressions show that increasing number of transactions reduces risk and men have a higher number of transactions. Thus making men appear to be more risk averse. This contradicts the research that suggests men are more confident in their decisions (Hudgens and Fatkin; Johnson and Powell; Sexton and Bowman-Upton; and Zinkhan and Karande). However, men's confidence in their marketing ability may actually play a factor in why they have a higher number of transactions. Men may attempt to beat the market and try to find the highs in the market, which results in men unknowingly reducing their exposure to price risk. However, number of sales, $frequency_{it}$, is not significant in the price regression and does not affect the net price received by a producer.

The clearest finding in this article, especially from the price regression, relates to storage. From every elevator's price regression, time appears to have a negative effect on price. This may only be true for Oklahoma wheat farmers because of their early harvest and their close proximity to the gulf. This is in agreement with Benirschka and Binkley because the market usually demands the earlier harvested wheat from Oklahoma and other areas closer to the gulf. However, it does appear to maintain that markets are efficient. It is imperative to realize that this anomaly could be a direct result of the cost of carry, or opportunity costs, which are used in this article. It is also important to note, that even though men sell earlier, from the average sale week after harvest regression, that there is still little difference in the price that men receive and price that women receive in the price regression.

In the price regression there does not appear to be any direct differences in the net price received by gender. But, because women store longer there is an indirect effect that suggests women receive a lower price since they store longer.[9] Women also do not have as many transaction weeks as men, but because number of transactions does not affect the net price received there is no indirect causality with respect to price. In conclusion, there are some differences between men and women on how they market their wheat, but the differences are small. The research does not support the hypothesis that women are better marketers.

[9] The regression with gender and volume as a function of price did not show that gender was significant determinant in net price received.

Table II-10. Test Statistics for the Estimates of the Multiplicative Variance Equation

Alphas	Explanatory Variable	Southern	Central	Northern
Average week sold	awk_{it}	8.78	81.30	87.55
Average week sold squared	awk_{it}^2	13.66	127.37	92.88
Total volume	$tvol_{it}$	15.08	4.86	0.08
Number of transactions	$frequency_{it}$	13.92	31.87	13.11
Gender	$male_i$	3.16	0.18	0.58

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VITA

Lewis Theophilus Cunningham III

Candidate for the Degree of

Master of Science

Thesis: EXPLAINING DIFFERENCES IN PRICES RECEIVED BY FARMERS: TESTING THEORY BASED ON ACTUAL FARMER TRANSACTIONS

Major Field: Agricultural Economics

Biographical:

Personal Data: Born in Fredericksburg, Texas, On June 18, 1979, the son of Jack and Elaine Cunningham

Education: Graduated from Plainview High School, Ardmore, Oklahoma in May 1997; received Bachelor of Science degree in Agricultural Economics and Accounting from Oklahoma State University, Stillwater, Oklahoma in May of 2002; received Bachelor of Science degree in Finance from Oklahoma State University, Stillwater, Oklahoma in May of 2002. Completed requirements for the Master of Science degree with a major in Agricultural Economics at Oklahoma State University in July of 2004.

Experience: Raised on farm near Springer, Oklahoma and worked as farm labor and assistant manager throughout high school and undergraduate; has summer internships at Iowa Grain Company, Chicago, Illinois as runner and research (1998) and at Goldenbelt Feeders Inc., St. John, Kansas as temporary cattle supervisor (1999); partner in Cunningham Trucking (1995-present); employed by Oklahoma State University, Department of Agricultural Economics as a graduate research assistant and teaching assistant (2002-present)

Name: Lewis Theophilus Cunningham III Date of Degree: December, 2004

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: EXPLAINING DIFFERENECES IN PRICES RECEIVED BY FARMERS: TESTING THEORY BASED ON ACTUAL FARMER TRANSACTIONS

Pages in Study: 53 Candidate for the Degree of Master of Science

Major Field: Agricultural Economics

Scope and Method of Study: Years of research have been dedicated to determining the best time for producers to sell their commodities. Researchers have developed basis models, market efficiency tests, hedging/risk models, price forecasting models, and many other models in an attempt to help producers. There is a vast amount of material on how economists believe that a rational producer should act and react in the market place. However, there is little research on how producers actually sell commodities. Essay I (Cash Marketing Styles and Performance Persistence of Wheat Producers) first measures the extent to which producers display an active or mechanical marketing style using individual farmer sales. Next, tests of performance persistence are conducted to determine if there is any advantage to an active marketing style.

Recent research in behavioral finance has found differences between men and women and how they make marketing decisions. Past research in agricultural economics suggests the possibility that women may be better marketers. Essay II (Gender Differences in Marketing Styles) uses actual farmer transactions to measure differences between how and when men and women market their wheat.

Findings and Conclusions: The results for Essay I show that southern Oklahoma wheat producers tend to have a mechanical marketing style, while at other locations producers appear to have a more active style. The results show no evidence of performance persistence and thus suggest that there is no advantage to using an active marketing style. The results for Essay II show that women sell later in the marketing year and mostly sell all their grain at one time. While there is no direct effect of gender on price received, by storing longer women are receiving a slightly lower net price. Thus, the research does not support the hypothesis that women are better marketers.

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