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Payoffs to Farm Management: How Important Is Grain Marketing?

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Payoffs to Farm Management: How Important is Grain Marketing?

Heather Nivens and Terry L. Kastens^{*}

Economically, a well managed firm is one that consistently makes greater profits than competing firms in the industry. In terms of production agriculture, good management is demonstrated by profits that are persistently greater than those of similarly structured, neighboring farms. This research examined the effects of four management practices on profit per acre for nearly 1,000 Kansas farms over 1987-96. The four management practices were price management, cost management, technology adoption (less-tillage), and yield management. Of these four it was found that cost management and technology adoption had the greatest effect on profit per acre and a farm being able to differentiate itself from other neighboring farms. Yield was found to be moderately significant and price was found to have the smallest impact of all. Therefore, if producers wish to have continuously high profits their efforts are best spent in management practices over which they have the most control, namely, in the areas of cost control and technology adoption.

Introduction

The removal of target price payments wrought by the 1996 Freedom to Farm bill has increased farmers' interest in marketing issues. If this increased interest in marketing issues results in farmers "trying to pick high prices in the futures market," it could mean disappointment for those farmers. Empirical evidence supporting efficient grain futures suggests that it is difficult to garner profits trading futures (Garcia, Hudson, and Waller; Kolb, 1992, 1996; Kastens and Schroeder; Zulauf and Irwin; Tomek). Kastens and Schroeder found that Kansas City wheat futures are generally efficient, and that the efficiency has been increasing over the past 50 years. This implies that even if profitable futures trading or hedging strategies were possible in the past, such strategies likely became less profitable over time. Zulauf and Irwin note that "evidence exists that individuals can beat the market, although the number who can consistently do so is small. The primary attributes of these individuals are that they have superior access to information and/or possess superior analytical ability." (pg. 327) Zulauf et al. found that futures prices are unbiased predictors of harvest time prices. Therefore, only "unavoidable social loss exists" (pg. 381) in the futures market.

This does not mean there is no possibility for profits when trading in the futures market. Wisner et al. found that pre-harvest grain marketing (futures hedging) strategies might increase profit and/or decrease risk. Certainly, futures hedging should reduce the variability of prices received over the years, potentially diminishing net income variability (Zulauf et al.). Yet, despite years of both public and private educational efforts, producers' use of futures hedging has typically been less than expected for a number of reasons. For example, Sartwelle et al.

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found that more experienced and risk adverse producers relied on the cash market more than the futures market. Other contributing factors might be that price forecasters and market analysts that farmers turn to are not always consistent. Schroeder et al. found that extension and research economists tend to disagree about the marketing goals of the producer. Specifically, economists might be providing profit-maximizing information when the goal of the producer is to minimize risk. So, even if the extension economists are correct, they may not always provide the producer with useful information. Therefore the producer may be reluctant to rely on the marketing information provided by extension.

Besides listening to market information providers, producers likely learn and become more successful by observing and mimicking the management practices of successful farmer neighbors. However, the degree to which this education method is appropriate and feasible depends on being able to identify successful neighbors. That may be straightforward for production management practices but more difficult for less visible measures such as marketing practices. This research is a first step at identifying those successful neighbors – by identifying the management practices of producers who reap higher profits, that is, those who are good managers. The objective of this research is to examine several management traits, uncovering those that have been most important in determining profitability and in segregating producers by profitability.

Good Management

What is good management? As used in this research, good management, or economic success, is persistently achieving greater profits than one's neighbors across years. For agricultural producers, what defines economic success? Does it have to do with obtaining higher yields, lower costs, or higher prices? Or, is it related more closely to knowing when to adopt new technologies? The issue facing producers is where to focus their management efforts. As a producer, is it easier to lower your cost, or to increase your yield? Will profit be more affected by changing technology or by "picking" good prices? In short, some goals might be hard to achieve yet have large payoffs — producers must determine the tradeoffs.

Zulauf and Irwin asserted that the producers who survive would be the ones with the lowest cost of production. Of course, yields and technology also impact the per-unit cost of production, potentially clouding the issue. The objective of this research is to break apart these different aspects affecting per unit costs. In that regard, this work is related to non-parametric studies of management efficiency. Therefore, costs, yields, and technology are considered as separate variables impacting profitability. Here, the yield variable is similar to technical efficiency, and the cost variable is similar to allocative efficiency. The efficiency literature shows that increased efficiency increases economic profit, and allocative efficiency is often more important than other efficiency types (Yoder, Langemeier, and Delano). Therefore, an important way for less profitable farms to increase profits (overall efficiency) is by decreasing costs (increasing allocative efficiency). Featherstone, Langemeier, and Ismet found that profitability was positively correlated to technical, allocative, and scale efficiency. Rowland et al. report similar findings. This research, however, departs from that typically described in non-parametric

studies of management efficiency in that it considers crop marketing as another measure by which producers can distinguish themselves from their neighbors in order to be profitable.

The history of agricultural production has been one of constant adjustment to new technologies. Over time, producers vary in the degree to which they have adopted a particular technology. That fact alone surely causes producers to wonder if they are adopting a technology at the optimal rate. Consequently, it could be that farmers differentiate themselves from their neighbors by focusing on (or ignoring) new technologies. Empirical evidence suggests that farmers often adopt parts of the technological package instead of the whole (Leathers and Smale). This suggests that, although producers might test a new technology, they may not heavily invest in it until it has been proven. Therefore, economic profit could be a function of adoption rate. Regardless of how farmers adopt a new technology, it is an important variable that should be considered in a description of what causes differences in profits among producers.

If economies of scale exist in production agriculture, it is likely due to some technologies that are only feasible for larger farms. Thus, farm size could be a reasonable indicator of a broad class of technologies, or, more appropriately, their adoption rate.

Conceptual Model and Data

A conceptual model to describe good management is

- (1) $Profit = f(\text{prices, yields, costs, technology adoption, farm size})$,
where all variables are relative to one's neighbors. For example, the *yields* variable represents the degree to which a producer tends to have higher or lower crop yields compared to neighboring farms.

It is often difficult to distinguish management capability from mere luck, especially for farming, where profitability is heavily influenced by weather. Thus, it is important to conduct a study of management success from a multi-year standpoint. To that end, this study relies on the ten-year Kansas Marketing, Analysis, and Research (KMAR) data set, obtained by a yearly survey of farmers in the state of Kansas. The ten-year data set involves financial and production information from over 1,000 producers who have participated continuously in the farm management program for 10 years (1987-1996). The KMAR database information was augmented with data from Kansas Department of Agriculture's *Kansas Farm Facts* and the Kansas Farm Management Association's *The Enterprise Analysis Report 1996*.

Empirical Specification

The model conceptualized in (1) can be empirically specified as

- (2) $PROFIT_{ij} = \beta_0 + \beta_1 COST_{ij} + \beta_2 YIELD_{ij} + \beta_3 PRICE_{ij} + \beta_4 TECH_{ij} + \beta_5 SIZE_{ij} + \varepsilon_{ij}$,
where $PROFIT_{ij}$ is a measure of profit superiority for farm i , in region j , $COST_{ij}$, $YIELD_{ij}$, $PRICE_{ij}$, and $TECH_{ij}$ represent the ability of farm i in region j to demonstrate management

superiority in the stated category, $SIZE_{ij}$ indicates farm size, and ε_{ij} denotes an error term.¹

Although economic profits are zero in the long run for average producers, superior managers may reap positive economic profits in the long run. In the short run, differences in economic profits among managers are likely even larger. Because farms vary widely in scale of operation, we consider per acre, rather than per farm, profits. Our measure of profitability is

$$(2) \quad PROFIT_{ij} = \frac{\sum_t \Pi_{ijt}}{T}, \text{ where}$$

$$(4) \quad \Pi_{ijt} = NCIPA_{ijt} - \overline{NCIPA_{jt}}, \text{ and}$$

where $NCIPA_{ijt}$ is net crop income per acre for farm i in region j in year t , $\overline{NCIPA_{jt}}$ depicts the average net crop income per acre (across all farms in region j year t), and $PROFIT_{ij}$ is the average (over T years) of profit differenced from the expected profit for farm i in region j .

The cost variable in (2) is designed to capture the tendency for a farm to have higher or lower crop input costs than comparable farms. Crop input costs include machinery costs, seed, fertilizer, marketing, herbicide, fuel, rent (actual or opportunity), and labor (paid and unpaid) cost. Crop input costs are intrinsically different for different crops. For example, farms that grow irrigated corn should not be expected to have the same costs as those growing non-irrigated wheat. Thus what is needed is a measure of expected costs *given* a farm's crop mix. For that, we use enterprise budget values from the *Enterprise Analysis Report 1996*, along with each farm's crop mix of main crops (main crops are: irrigated and non irrigated wheat, corn, milo, soybeans, and alfalfa.)

Ultimately, to get at management superiority, actual costs must be compared to predicted, or expected, costs. Relevant actual costs are given by

$$(5) \quad ACC_{ijt} = TCE_{ijt} \times \left(\frac{MCA_{ijt}}{TCA_{ijt}} \right), \text{ where}$$

ACC_{ijt} is the actual crop cost assigned to the main crops for farm i in region j and year t .² ACC_{ijt} is the ratio of main crop acres, MCA_{ijt} , to total crop acres, TCA_{ijt} , times the total recorded crop expense for all crops on farm i in region j and year t , TCE_{ijt} .

The first step in deriving expected cost per main crop acre is developing an annual cost ratio that is needed for adjusting 1996 enterprise costs to other years:³

¹ To expedite understanding, the numerous variable definitions used in this section are collected in table 1.

² To focus on farms with a majority of acres in main crops, if MCA_{ijt} / TCA_{ijt} was less than .5 the observation was deleted (this criteria removed approximately 6 % of the total farm-year observations)

³ The annual enterprise report depicts average costs and returns for the KMAR subset reporting enterprise accounts. Insufficient historical enterprise reports caused us to use an adjusted 1996 report for years before 1996.

$$(6) \quad CCA_t = \frac{\sum_i \sum_j ACC_{ijt}}{\sum_i \sum_j MCA_{ijt}},$$

where CCA_t is the average crop cost ratio for the state across all farms and regions in year t , and other variables are as already defined. The next step in deriving expected cost per main crop acre depends on

$$(7) \quad MCE_{ijt} = \frac{\sum_k ECAC_{jk} \times AC_{ijkt}}{MCA_{ijt}},$$

where MCE_{ijt} is the expected main crop expense for farm i in region j in year t in 1996 dollars. $ECAC_{jk}$ is the 1996 enterprise budget cost data for region j and crop k .⁴ AC_{ijkt} is the acres planted for farm i in region j to crop k in year t . The expected cost in 1996 dollars is adjusted for other years using

$$PCC_{ijt} = MCE_{ijt} * \frac{CCA_{96}}{CCA_t}, \text{ where}$$

PCC_{ijt} is the predicted crop costs for farm i in region j and year t . It is an expectation of a farm's crop cost (per main crop acre) for each year, given the crops actually planted that year.

To make actual and predicted costs center on the same value for each region and year the following normalizing step is required:

$$(9) \quad RPCC_{ijt} = PCC_{ijt} + \overline{ACC}_{jt} - \overline{PCC}_{jt},$$

where $RPCC_{ijt}$ is the revised PCC_{ijt} value. Then, in order to express the cost per acre management variable, $COSTPA_{ijt}$, in "percent different from expected":

$$COSTPA_{ijt} = \left(\frac{ACC_{ijt}}{RPCC_{ijt}} - 1 \right) \times 100.$$

Finally, to arrive at the cost variable in (2), which depicts *persistent* management, the cost variable in (10) is averaged across years:

$$(11) \quad COST_{ij} = \frac{\sum_t COSTPA_{ijt}}{T}$$

Since different crops have intrinsically different yields per acre, comparing aggregated yield data without first normalizing for each crop would be inappropriate. So, crop yields were first determined by farm, region, crop and year:

$$(12) \quad YLDK_{ijk} = \frac{PROD_{ijk}}{AC_{ijk}},$$

where $YLDK_{ijk}$ is the yield for crop k for farm i in region j and year t , and defined in terms of

⁴ When region enterprise budget data were not available, state enterprise budgets were used.

production (*PROD*) per acre (*AC*).

Expected farm-level crop yields in Kansas vary widely geographically due to weather. It would be inappropriate to expect all farms in the same farm management region to have the same yield for a given crop. Thus, the expected yield for crop *k* of farm *i* in county *c* of region *j* in year *t*, $EYLDK_{icjkt}$, is taken to be the regional average (across farm) annual yield, as adjusted by county (where the farm is located) yields:

$$(13) \quad EYLDK_{icjkt} = \overline{YLDK}_{jkt} \times \frac{CYLD_{cjkt}}{\overline{CYLD}_{jkt}}, \text{ where}$$

\overline{YLDK}_{jkt} is the across-farms average yield for crop *k* in region *j* year *t*, $CYLD_{cjkt}$ is crop *k* yield for county *c* in region *j* in *t*, and \overline{CYLD}_{jkt} is the average county yield across all counties in region *j*.⁵ Then an appropriate “different from expected” yield variable is

$$IYLD_{ijkt} = \left(\frac{YLDK_{ijkt}}{\overline{YLDK}_{jkt}} - 1 \right) \times 100,$$

where the county subscript is dropped because it is no longer needed. To get at an overall (across main crops) measure of yield superiority, the yield index in (14) is weighted by crop acres to become a new yield variable YLD_{ijt} :

$$(15) \quad YLD_{ijt} = \frac{\sum_k IYLD_{ijkt} \times AC_{ijkt}}{MCA_{ijt}}$$

Finally to arrive at the across-years yield variable depicted in (2)

$$(16) \quad YIELD_{ij} = \frac{\sum_t YLD_{ijt}}{T}$$

Like the cost and yield measures in (2), the price measure also depends on actual and expected values. A measure of the expected value of main crop production for farm *i* in region *j* in year *t*, EV_{ijt} is

$$(17) \quad EV_{ijt} = \frac{\sum_k YLDK_{ijkt} \times AC_{ijkt} \times PR_{ckt}}{MCA_{ijt}},$$

where PR_{ckt} is a county price for the county where farm *i* is located, and for crop *k* in year *t*.⁶ Other variables in (17) have already been defined. As with costs and yields, a “different from expected” index is derived as

⁵ County yield data ($CYLD$) are from Kansas farm facts. Farm-level yield data ($YLDK$) are from the KMAR data set. Thus, \overline{YLDK}_{jkt} is an average across individual farms and \overline{CYLD}_{jkt} is an average across counties. Both averages are for crop *k* in farm management region *j* in year *t*.

⁶ Crop prices for crop reporting districts from *Kansas Farm Facts* were adjusted to each county using government farm program loan price differentials reported by the Kansas office of USDA's *Farm Services Agency*.

$$(18) \quad CPPA_{ijt} = \left(\frac{GV_{ijt}}{EV_{ijt}} - 1 \right) \times 100,$$

where $CPPA_{ijt}$ is the percent that farm i 's (in region j and year t) crop value is above or below the expected value, and GV_{ijt} is derived from KMAR–reported gross value of crop production.⁷ Again, to arrive at the across–years price superiority measure in (2):

$$(19) \quad PRICE_{ij} = \frac{\sum_t CPPA_{ijt}}{T}.$$

As representative of technology in general we considered a technology that has been especially important for Kansas farmers over the last 10-20 years – substituting chemicals for tillage. We first established a less tillage index (LT) as

$$(20) \quad LT_{ijt} = \frac{herb\$_{ijt} - mach\$_{ijt}}{herb\$_{ijt} + mach\$_{ijt}},$$

where $herb\$_{ijt}$ is the amount of money spent on herbicides, and $mach\$_{ijt}$ is the total crop machinery ownership and operation costs for farm i in region j year t . To get at an average, or expected, rate of adoption of this technology, we considered LT to be a linear function of time in a series of j regressions:

$$(21) \quad LT_{ijt} = \alpha_j + \beta_j t + \varepsilon_{ijt}.$$

The parameter estimates from these regressions were then used to determine the difference from the expected adoption rate for each farm (see figure 1 for an example):

$$(22) \quad TECHI_{ijt} = \frac{LT_{ijt} - \hat{\alpha}_j}{\hat{\beta}_j} - t,$$

where $TECHI_{ijt}$ is the number of years farm i in region j and year t was ahead of its neighbors, in terms of less-tillage adoption, in that year. Finally the technology variable consistent with that displayed in (2) is

$$TECH_{ij} = \frac{\sum_t TECHI_{ijt}}{T}$$

The final variable depicted in (2) has to do with farm size. What is relevant is not how absolutely large farm i is, rather how large it is relative to its neighbors. The annual difference–in–main–crop–acres variable, $DMCA_{ijt}$, is defined by

$$(24) \quad DMCA_{ijt} = MCA_{ijt} - \overline{MCA}_{ijt},$$

where \overline{MCA}_{ijt} is the average farm size (in terms of main crop acres) in region j and year t . The across–years farm size variable applicable to equation (2) is

⁷ KMAR – reported total crop value is adjusted for the proportion a farm's main crops acres are of total crop acres. Crop insurance indemnities and government program payments are excluded from total crop value.

$$(25) \quad SIZE_{ij} = \frac{\sum_t DMCA_{ijt}}{T}$$

Results

To examine persistence of management, the mean (across the 10 annual values, 1987-1996) for each management measure for each farm was tested to see if it was different from zero – using a simple 2-tail *t*-test at the 95% confidence level. The means, standard deviations, and percent of farms whose mean management measures were significantly different from zero are noted in table 2. Persistence is an important aspect of management. Traits associated with many farms being different from their neighbors are likely candidates for management focus. That is, to maintain or enhance positive economic profits, a farm must first differentiate itself from its neighbors, and in the right direction. In table 2 we see that over fifty percent of farmers had profits, costs and technology significantly different from zero. This implies that producers can and do “manage” these traits; whereas yields and prices must be less “manageable,” or at least less managed.

The Pearson’s correlation coefficients of the interactions between equation 2 variables are shown in table 3. From this table we see that only price is not significantly correlated with profit, technology and costs. We also see that price is negatively correlated with yields. Perhaps good production managers get lower prices because they focus on management aspects other than price. The fact that profit and price are not highly correlated might be a surprise. However, considering that it might be difficult for farm managers to control the prices they receive, it makes sense that profit would be more correlated with more controllable variables.

The regression estimates for equation 2 are reported in table 4. From this we can see that, holding other management measures constant (and farm size), those farms with 1% higher costs tend to have per acre profits that are lower by \$0.73. We can also see that all of the variables are highly significant except for price. It is worth noting that this regression seems to show that increasing a farm’s crop price by 1% would only increase profit by \$0.16 – a small value given that changes in price essentially go directly to the bottom line. Likely, this is a conditionally issue. For a variable like price, which we know should impact profitability but is not found to, and given that it is not generally correlated with other individual explanatory variables, it must be the case that it is systematically related to some combination of other explanatory variables. Farms that consistently get different prices than their neighbors must have offsetting impacts on profitability from other management traits. That is consistent with the idea that the farms that get higher prices than their neighbors must sacrifice something. Some farms might trade off price and yield (supported by the small but negative correlation between price and yield in table 3). Other farms might trade off price and cost. Such an explanation would be consistent with the zero impact of price of profitability as well as the generally zero correlation between price and

other explanatory variables.⁸

Apparently, it is easier (greater % different in table 2) for farmers to differentiate themselves from their neighbors in terms of rate of less-tillage adoption than in terms of yields. This seems to be reasonable given the control one has over tillage and chemical decisions; whereas the relative yield one obtains depends greatly on the weather, over which the producer has less control. Interestingly the model results in table 4 are consistent with economies of size in production agriculture. That is, after accounting for other management measures, the *SIZE* parameter estimate suggests that, for each 100 acres a farm is larger than neighboring farms, that farm receives an additional \$3/acre profit.

The rightmost column of table 4 shows the impact on profitability associated with being in the best third of each management category. For example, being in the highest third for yield management was associated with \$7.60/acre higher profits over being average (the top third, yield-wise, had 16% higher yields than the middle third, on average). Clearly, being in the best third for costs and less-tillage adoption was more valuable than being a good yielder, and especially more profitable than being in the top third, price-wise. If being in the best third of each category is assumed to happen with equal likelihood, then it can be asserted that it should be easier to generate higher profits by focusing management more on costs, less-tillage adoption, and yields, than by focusing on price.

Conclusion

This research sought to determine which management traits are most important in determining profitability and in segregating producers by profitability. After all, because average producers garner zero economic profits, producers must differentiate themselves from their neighbors, and in the right directions, in order to be profitable. To accomplish this, we examined nearly 1,000 Kansas farms over 1987-1996, devising measures that distinguish producers from their neighbors in terms of production costs, yields, prices received, and rate of technology (less-tillage) adoption.

Over the entire 10-year period, over half of the farms were significantly different than their neighbors in terms of cost management and less-tillage adoption. On the other hand, 37% of the farms were able to distinguish themselves from their neighbors in terms of crop yields and only 16% in terms of price. These results are consistent with yields being more random, or harder to affect, than costs and technology adoption, even over 10 years, and price being more random still. In that sense, costs and technology adoption appear more manageable than yields and prices. In a linear correlation framework, price was generally unrelated to other individual management traits and profitability. In a regression framework, having persistently low costs relative to neighboring farms, having persistently high yields, and persistently being ahead of one's neighbors in less-tillage adoption were each important drivers of profitability. Having

⁸ Interestingly, the regression model described in table 4, with the largest condition index at 1.8, did not demonstrate multicollinearity problems.

persistently higher prices than one's neighbors had only a small and statistically insignificant impact on profitability. When model impacts were computed for "being in the best third" of each management category, it appears that it should be easier for producers to enhance profits by focusing on costs, yields, and less-tillage adoption, than by focusing on price.

In commodity based crop production, with relevant futures markets that are generally efficient, it should not be surprising to find reduced payoffs to focusing management on price as opposed to other management factors. However, producers and economists who use this as an excuse to become complacent towards price management should keep a watchful eye to the future, as production becomes increasingly differentiated and less commodity-driven.

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Table 1: Variables and definitions

Variable	Definition
$PROFIT_{ij}$	The T year average of Π_{ijt}
Π_{ijt}	Difference in net crop income per acre and mean (across farms) net crop income per acre for farm i in region j and year t
$NCIPA_{ijt}$	Net crop income per acre
ACC_{ijt}	Actual crop costs assigned to all main crops
TCE_{ijt}	Total annual farm-level crop expense
MCA_{ijt}	Main crop (wheat, corn, soybeans, milo, and alfalfa) acres for farm i in region j and year t
TCA_{ijt}	Total crop acres
CCA_t	Annual ratio used for adjusting 1996 enterprise data to other years
MCE_{ijt}	Expected main crop expenses in 1996 dollars
$ECAC_{jk}$	Enterprise budget cost data in 96 for crop k region j
AC_{ijkt}	Number of acres planted for farm i in region j to crop k in year t
PCC_{ijt}	Predicted crop cost per main crop acre
$RPCC_{ijt}$	The mean-adjusted PCC_{ijt}
$COSTPA_{ijt}$	The “% different from expected” cost index
$COST_{ij}$	The T -year average $COSTPA_{ijt}$
$YLDK_{ijkt}$	Annual farm yield for crop k
$PROD_{ijkt}$	Annual farm production of crop k
$EYLDK_{icjkt}$	Expected annual yield for crop k of farm i in county c in region j
$IYLD_{ijkt}$	A “% different from expected” yield index
$CYLD_{cjkt}$	Annual crop yield for crop k in county c (<i>Kansas Farm Facts</i>)
YLD_{ijt}	The weighted-by-crop-acres average of $IYLD_{ijkt}$
$YIELD_{ij}$	The T -year average of YLD_{ijt}
EV_{ijt}	Expected value of crop production for farm i in region j and year t
PR_{ckt}	A county crop price based on <i>Kansas Farm Facts</i> data
GV_{ijt}	Gross value of crop production
$CPPA_{ijt}$	A “% different from expected” crop value, or price, index
$PRICE_{ij}$	The T -year average of $CPPA_{ijt}$
LT_{ijt}	Less-tillage index for farm i in region j and year t
$TECHI_{ijt}$	Number of years a farm is ahead of its neighbors in adoption of less-tillage

Table 2. Summary Statistics and Percent of Farms with Measures that are significantly different from zero; Kansas Farms 1987-1996

Variable	No. of Farms	Mean	Standard Deviation	% Different ^a
PROFIT (\$/acre)	1008	-2.45	95.09	51.07 %
COST (% different from expected)	981	3.61	49.54	54.06 %
YIELD (% different from expected)	1056	0.14	15.57	36.92 %
PRICE (% different from expected)	1039	0.61	14.58	16.04 %
TECH (no. of years a head of neighbors)	1072	-0.16	15.29	58.20 %
main crop acres	1075	754.50	562.64	N/A
SIZE	1075	0.00	549.01	N/A

^a Percent of farms whose mean (across 10 years) management measure significantly differs from zero based on a 2-tail *t*-test at the 95% confidence level.

Table 3. Pearson's Correlation Coefficients for Selected Variables; Kansas Farms 1987-1996

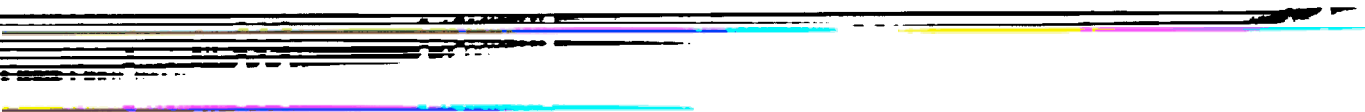
Variable	PROFIT	COST	YIELD	PRICE	TECH	SIZE
PROFIT		-0.47 **	0.16 **	0.01	0.33 **	0.35 **
COST			-0.06 *	0.03	-0.21 **	-0.26 **
YIELD				-0.09 *	0.18 **	0.22 **
PRICE					- 0.01	0.06 *
TECH						0.42 **
SIZE						

^a Significantly different from zero at the .01 and .001 level denoted with one and two asterisks, respectively.

Table 4: Regression Results; Kansas Farms 1987-1996

Variable	Parameter Estimate	P value	Impact on Profitability from Being in Best Third of Each Management Category (\$/acre)
Intercept	2.04	0.4089	
COST	-0.73 **	0.0001	\$20.57
YIELD	0.47 *	0.0051	\$7.60
PRICE	0.16	0.3476	\$1.82
TECH	0.97 **	0.0001	\$16.27
SIZE	0.03 **	0.0001	

^a Significantly different from zero at the .01 and .001 level denoted with one and two asterisks, respectively. N=980 and R²=0.3.



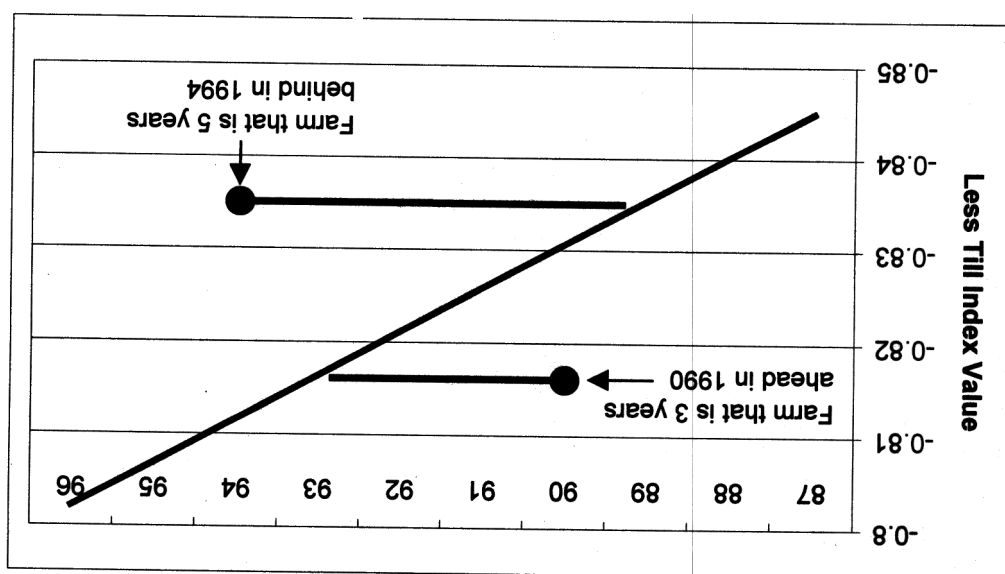


Figure 1. Rate of Less-tillage Adoption, North Central Kansas Example