

## Machinery Costs – Forecasting Custom Rates and More...

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## Motivation...

- Custom rate information is used by many different people and for many different reasons...
  - Producers
  - Custom operators
  - Extension agents\* and specialists
  - Researchers
  - Lenders
  - Government agencies

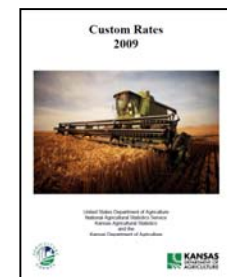
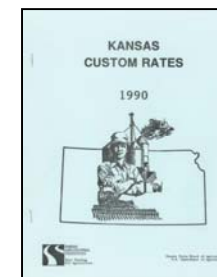
\* Several County Extension Ag Agents have indicated that the *Kansas Custom Rates* publication from Kansas Ag Statistics has historically been one of their most requested publications (second only to land values and rents information).

## Machinery cost categories

- Repair and maintenance
- Labor
- Depreciation (market, not tax depreciation)
- Interest (opportunity interest)
- Fuel and lubrication
- Taxes, insurance, and shelter
- Custom hire – a proxy for average machinery cost

## Custom rates background...

- Custom rates for machinery operations in Kansas have historically been reported by Kansas Agricultural Statistics based upon annual surveys\*



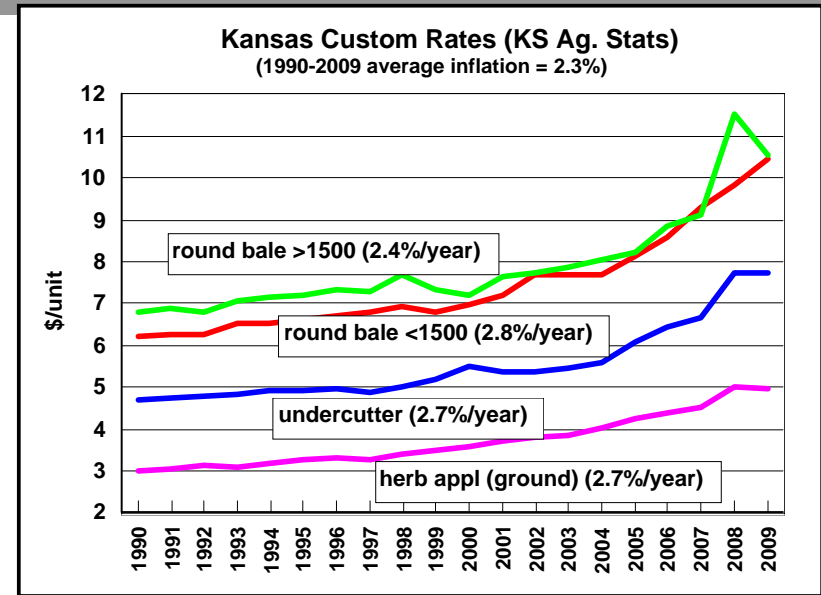
\* Survey is sent to farmers, ranchers, custom operators, co-ops and elevators and reported in Jan of the following year. Format of report has varied over time, but information reported has been relatively consistent. Historical publications for years 1973 through 2009 were obtained with the exception of 1986 when there was no report due to budget cuts.

## Custom rates background...

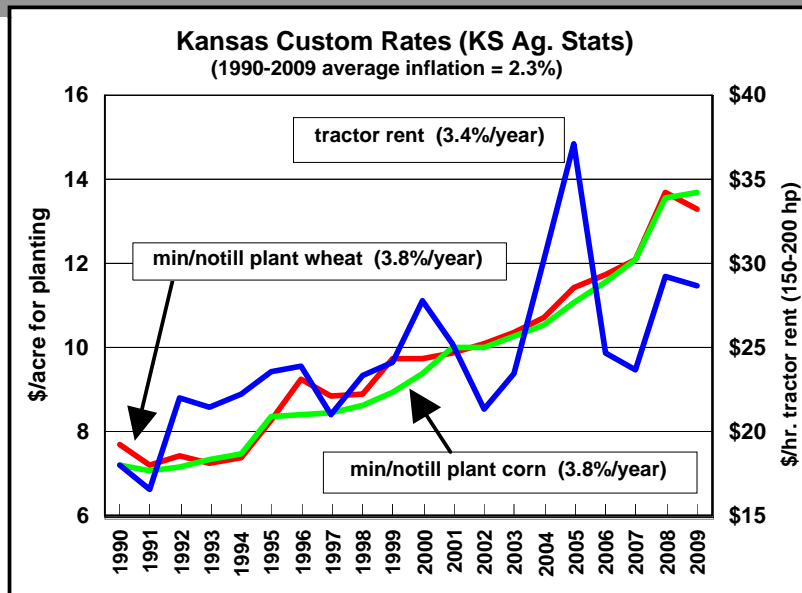
- Rates have been reported for many operations\*
  - Planting (10)
  - Tillage (11)
  - Chemical application (9)
  - Grain harvesting and hauling (10)
  - Silage harvesting (4)
  - Hay harvesting (18)
  - Feed processing/delivery (15)

\* Not all operations are reported in each year and some operations have a shorter history (e.g., net wrap bales). However, the 1990-2009 time period (20 years) is quite consistent with only a limited number of missing values.

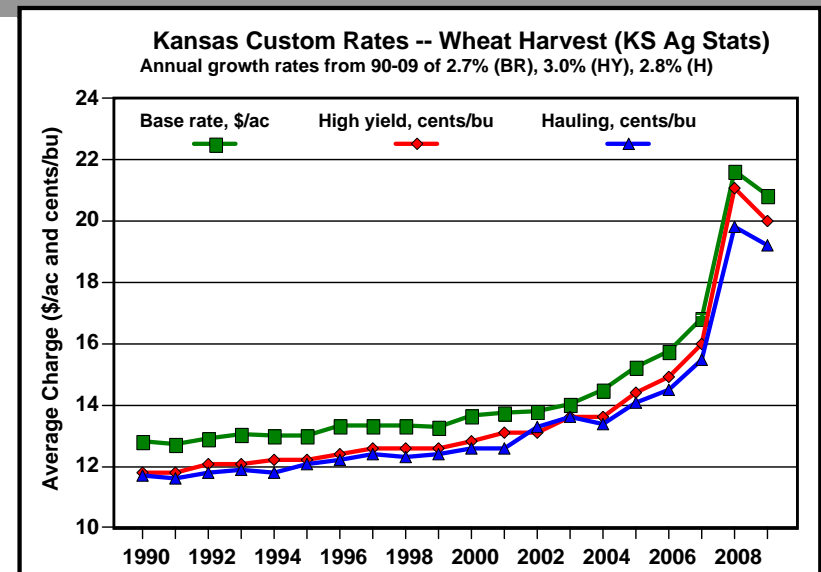
## Custom rates generally increase slightly over time...



## Some rates bounce around more than others...

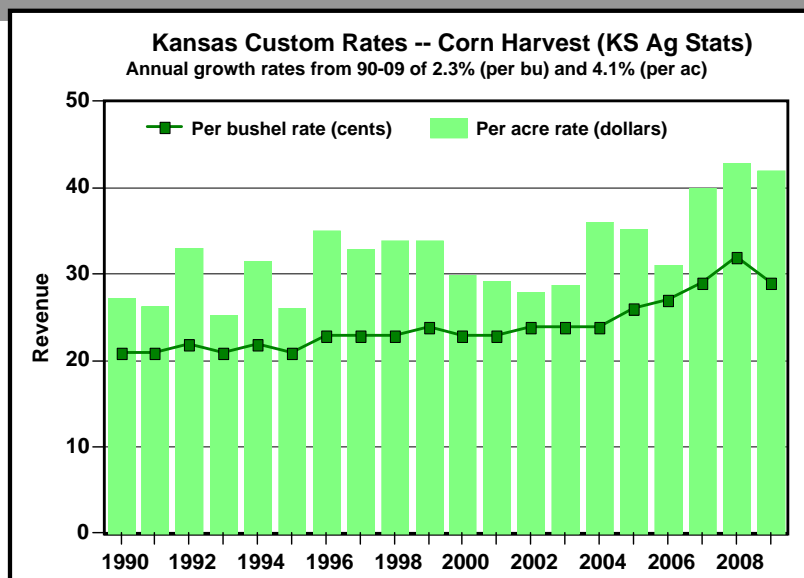


## Fuel prices impact average rates...



Harvest rates some of the best reported custom rates in Kansas

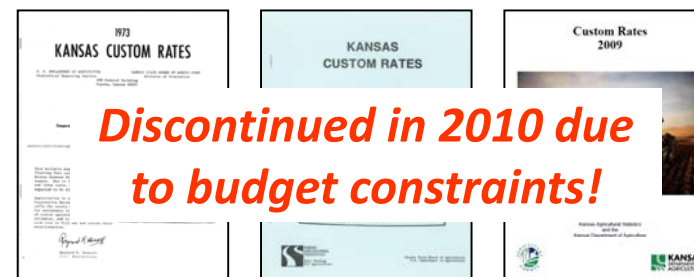
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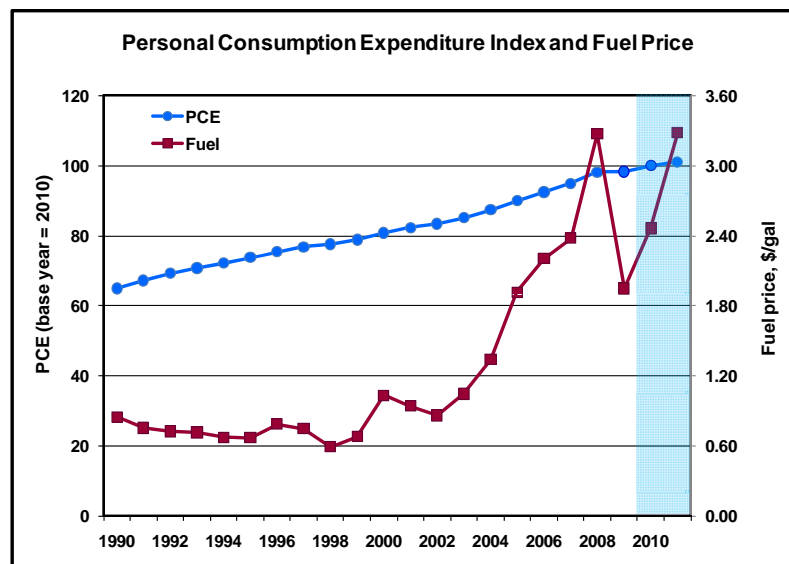
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## Drivers of custom rates?



## Models estimated (all models used state averages)...

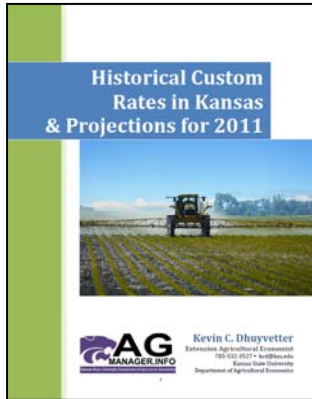
- Rates dimensioned in dollars (\$/ac, \$/ton, \$/bu)
  - ➔ Custom rate =  $b_0 + b_1(\text{pce}) + b_2(\text{fuel}) + b_3(\text{pce} \times \text{fuel})^*$
- Rates dimensioned in dollars (bushels, miles)
  - ➔ Custom rate =  $b_0 + b_1(\text{year})$
- In-sample “goodness of fit” measures
  - ➔  $R^2$  and Standard error

\* Also considered linear trend (e.g., year) in place of pce, various fuel prices (e.g., lagged, multi-year average), and non-linear effects. Model above was generally the best on average across 83 models estimated.

## Historical and predicted rates published in paper...

Predicted values in report were based on diesel price forecasts available at that point in time (as well as forecast for PCE).

**Problem** → If fuel prices change significantly, forecasts need to be updated.



Operation	Actual rates			Predicted rates (absolute vs. relative)				R <sup>2</sup>
	2007	2008	2009	2010	2011	\$/unit chg	% chg	
<b>Regular-Till</b>								
Small grains	\$9.54	\$11.09	\$11.14	\$11.10	\$12.48	\$1.38	12.5%	0.961
Sorghum	\$10.65	\$12.30	\$12.61	\$12.46	\$13.80	\$1.34	10.8%	0.959
Corn	\$10.91	\$12.51	\$12.52	\$12.46	\$13.48	\$1.03	8.2%	0.976
Soybeans	\$10.94	\$12.87	\$12.58	\$12.65	\$13.77	\$1.12	8.8%	0.977
Grass	\$12.60	\$14.65	\$14.02	\$14.11	\$15.41	\$1.30	9.2%	0.962
Alfalfa	\$11.35	\$13.75	\$12.68	\$13.24	\$14.36	\$1.12	8.5%	0.946
<b>Minimum-Till or No-Till</b>								
Small grains	\$12.10	\$13.73	\$13.31	\$13.49	\$14.05	\$0.56	4.2%	0.964
Sorghum	\$12.04	\$13.49	\$13.63	\$13.54	\$14.26	\$0.71	5.3%	0.970
Corn	\$12.09	\$13.57	\$13.70	\$13.63	\$14.29	\$0.66	4.8%	0.977
Soybeans	\$12.34	\$14.07	\$13.68	\$13.93	\$14.44	\$0.50	3.6%	0.974

Goodness of Fit

## People are looking at the information...

### Number of "hits" on www.AgManager.info

Month	Custom Rates (PDF)	Custom Rates (Dashboard)
January, 2011	1111	
February, 2011	654	
March, 2011	600	
April, 2011	588	239
May, 2011	531	232
June, 2011	784	254
July, 2011	855	212
August, 2011		
September, 2011		
October, 2011		
November, 2011		
December, 2011		
AVERAGE	732	234
TOTAL	5123	937

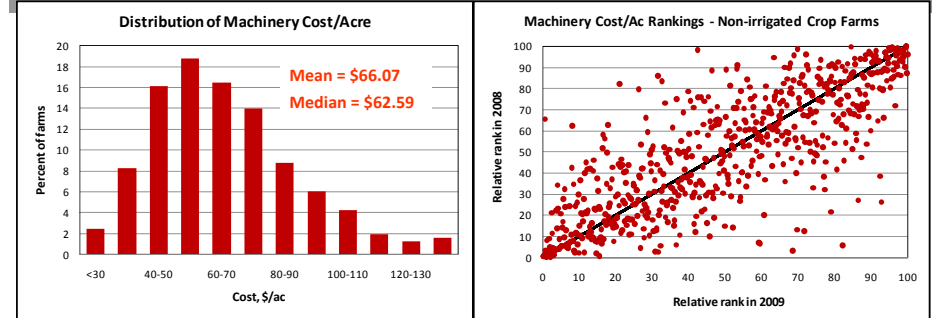
What about the future?

At this point, the plan is to update pce and fuel price and continue using models.

Ideally, we will get actual survey data back at some point in the future such that models can be re-estimated (i.e., not sure how far we want to go "out-of-sample" with predictions)

*and More...*

Information presented at 2010 R&P Conference...

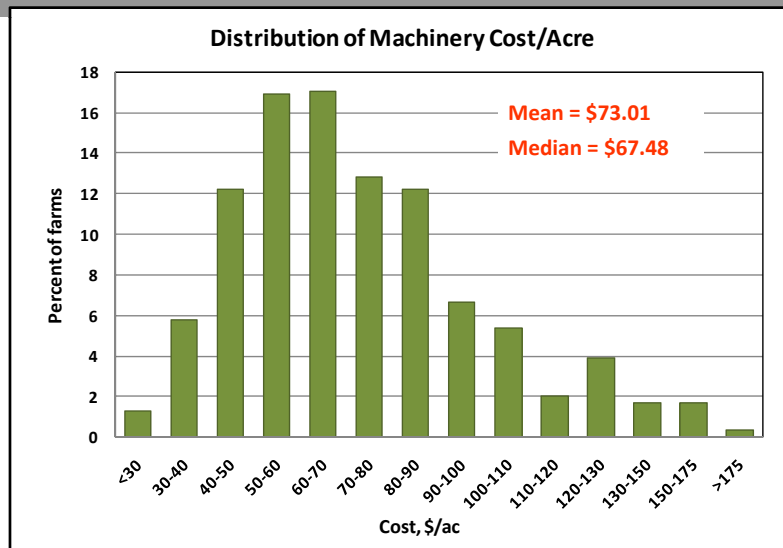


Source: KFMA non-irrigated crop farms having continuous data from 2005-2009 (minimum of 160 acres and machinery cost/acre > \$10/acre; costs do not include labor – total of 614 farms)

**Tremendous variability in machinery costs across producers and costs are quite persistent from year to year...**

*What is driving this variability?*

Different sample of farms, but similar variability...



Source: KFMA farms having continuous data from 2006-2010 and crop labor percentage ≥ 75% (minimum of 160 acres and machinery cost/acre > \$10/acre; costs do not include labor – total of 539 farms)

KFMA machinery costs definition...

- **Total Crop Machinery Cost (TCMC)**
  - Equal to the crop share of machinery repairs, gas-fuel-oil, auto expense, motor vehicle depreciation, listed property depreciation, and machinery and equipment depreciation plus crop machine hire expense plus an opportunity interest charge on crop machinery investment minus machine work income.\*
- **Machinery cost/acre = TCMC/total crop acres**

\* Note – labor associated with operating and servicing machinery is not included in total crop machinery cost.

## Can we explain variability in machinery costs?

- Cost/ac was estimated as a function of\*...
  - investment/acre
  - crop acres
  - region (SE is default)
  - % acres irrigated
  - % acres corn
  - % acres other row crop
  - % acres hay
  - no-till (when available)
  - custom income as % of value of production

\* Valentin and Wood (2002 Risk & Profit) estimated total machinery costs as a function of acres of various crops and machine work income.

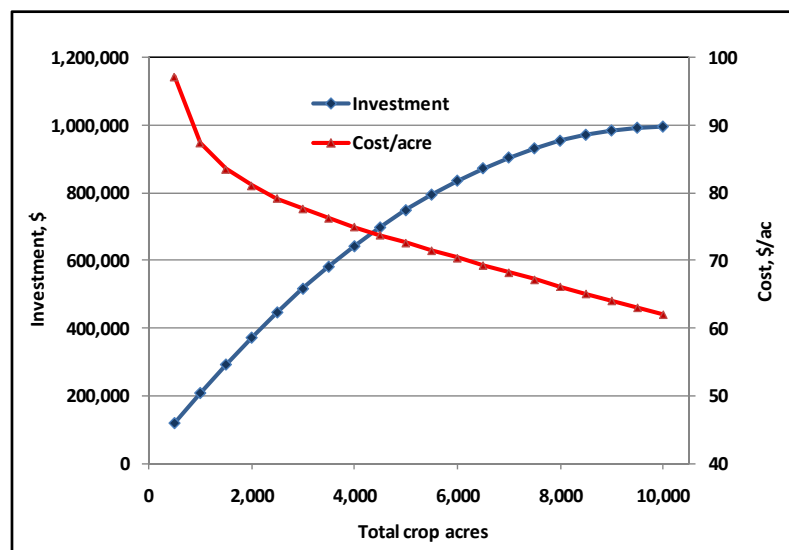
## Machinery cost model results...

Model of Machinery Cost/Acre (2006-2010 data)

Variable	Estimate	p-value
Intercept	22.61	<.0001
MachInvAcX	0.20	<.0001
TCAinv	3352.19	0.0005
NW	-0.21	0.9663
SW	0.28	0.9468
NC	9.91	0.0022
SC	10.18	0.0008
NE	-5.12	0.0810
IrrAcPctX	7.13	0.2240
CrnAcPctX	33.34	<.0001
OthAcPctX	3.18	0.6101
HayAcPctX	29.61	<.0001
NCntX	-8.79	0.0268
SCntX	-16.88	<.0001
NEntX	-3.56	0.3778
NWntX	-6.67	0.2246
MachHirePctX	-68.51	0.0034
Adjusted R-square	0.62	
RMSE	17.09	
Number of observations	539	



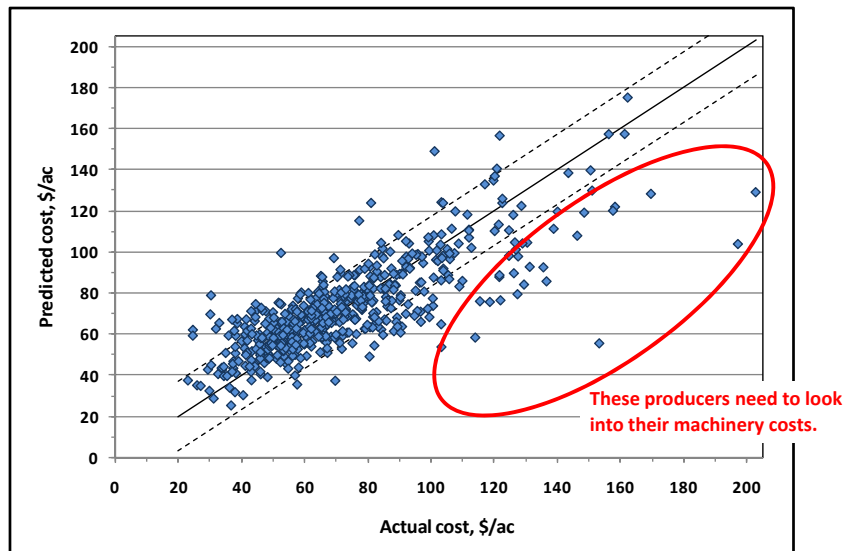
## Machinery investment and cost/acre vs. farm size...



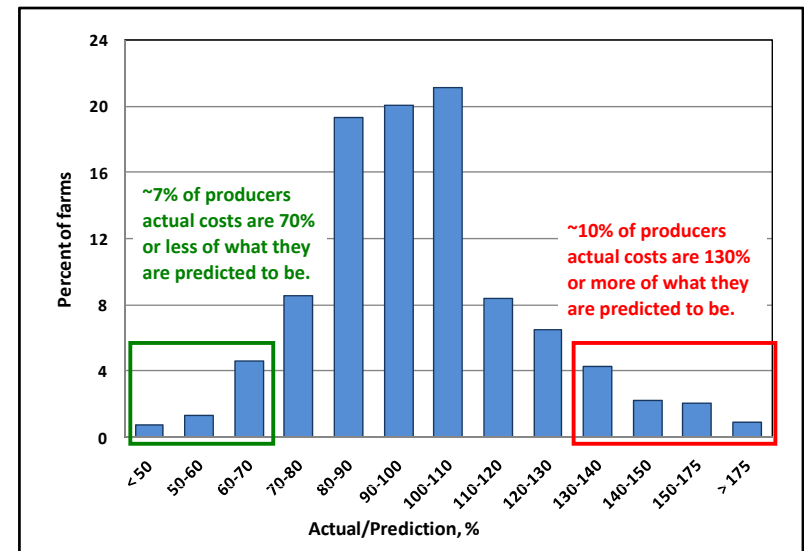
## Model can be used to calculate “expected” costs...

- Actual costs (KFMA value)
- Expected costs (i.e., model-predicted costs) (KFMA “x-variables” multiplied by model coefficients)
- Error (difference between actual and predicted values)
  - Actual – Predicted (absolute measure)
    - ➔ positive values are “bad” and negative values are “good”
  - Actual / Predicted (relative measure)
    - ➔ values > 1.0 are “bad” and values < 1.0 are “good”

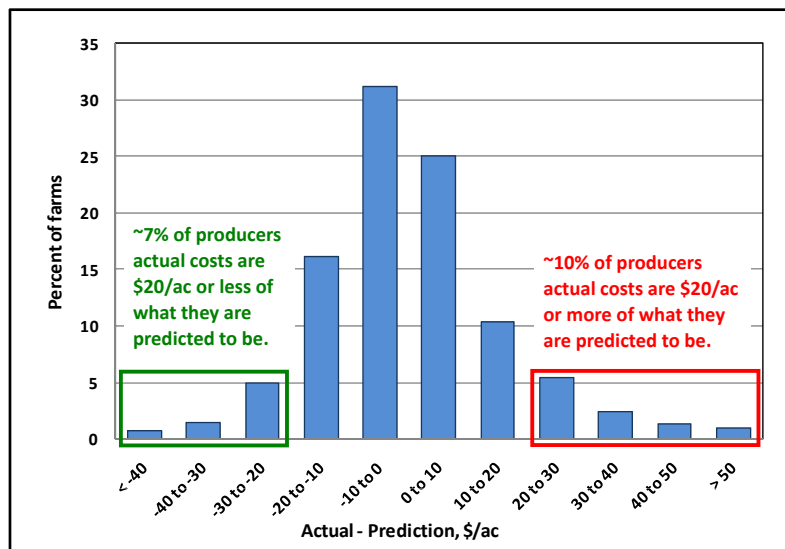
## Actual costs versus model-predicted costs...



## Actual costs versus model-predicted costs...



## Actual costs versus model-predicted costs...



## Summary of machinery cost model results...

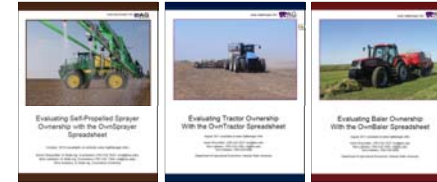
- Higher investment/acre leads to higher cost
- Larger farms have lower cost (primarily the result of having lower investment/acre)
- NC/SC farms have higher costs and NE farms have lower costs relative to SE region (other regions are similar to SE)
- Irrigated farms have slightly higher costs (only marginally statistically significant)
- Farms with higher proportion of acres in corn and hay have higher costs
- No-till farms (in 2010) in NC/SC regions had lower costs (similar for NE/NW farms but not statistically significant)
- Higher custom work income leads to lower cost

## Summary of machinery cost model results...

- Considerable variability in machinery costs across producers
- Characteristics of operation can explain much of that variability, but not all of it (i.e., “other stuff matters”)
- Investment per acre is an important variable in explaining differences
- Producers are encouraged to use available tools to help them make machinery investment decisions that best fit their operations

## Machinery decision-tools available from KSU...

- OwnSeries (Excel spreadsheets)
  - Sprayer, Tractor, Combine, Baler



Sprayer, Tractor, and Baler models recently updated. Combine model to be updated in near future. Models estimate the cost of owning and operating equipment given user input for annual usage, age, purchase price, tax rates, etc.

- Guidance and section controller calculators
  - Excel spreadsheets and web dashboard
- Excel spreadsheets for trucks and buildings
- KSU-MachCost – benchmarking spreadsheet
- Custom rate projections (web dashboard)



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1. 2010 Kansas Land Values and Cash Rents at the County Level - Kevin Dhuyvetter
2. Historical Custom Rates in Kansas & Projections for 2011 - Kevin Dhuyvetter
3. 2010 CHAMCO Harvest Report - Kevin Dhuyvetter and Terry Kastens
4. Differences Between High-, Medium-, and Low-Profit Producers: An Analysis of the KFMA Beef Cow-Calf Enterprise - Kevin Dhuyvetter
5. Grain Outlook Newsletter: July 2011 USDA WASDE Report - Feedgrains - Dan O'Brien

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Resources for 2011 Drought

The Economic Value of Soybean Meal and Hull Microbial Fermentation  
August 10, 2011 by Dan O'Brien

In The Cattle Markets  
August 8, 2011 by Glynn Tonsor,LMC

Livestock Outlook Radio Program  
August 8, 2011 by Glynn Tonsor,LMC

Livestock and Hay Charts  
August 8, 2011 by Glynn Tonsor and Heather O'Brien

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Impact of Mandatory Price Reporting on Hog Market Integration  
August 4, 2011 by Glynn Tonsor, Jason Franklin, and Joe Parrott

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Crop Basis Maps  
August 4, 2011 by Kevin Dhuyvetter

Updated Crop Basis Tool  
August 4, 2011 by Kevin Dhuyvetter

OwnTractor.xls = Excel decision tool for estimating tractor costs – Revised  
August 3, 2011 by Dhuyvetter, Llewellyn, and Kastens

OwnBaler.xls = Excel decision tool for estimating baler costs – Revised  
August 3, 2011 by Dhuyvetter, Llewellyn, and Kastens

Cattle Feeding Returns  
August 3, 2011 by Dan O'Brien

**AgManager.info Decision Tools**

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Title	Author	Excel	Corresponding Paper (PDF)	Web Dashboard	Audio (MP3) or Video (WMV)
<b>POLICY AND RISK MANAGEMENT DECISION TOOLS</b>					
WARAT - Water Allocation Risk Analysis Tool	Golden, Dhuyvetter, Toodie, Crosby				View
KSU ACRIC.xls (2010)	Danika	Download			
KSU-OptionStrategies	Dhuyvetter	Download			
AGR-Lite	Llewellyn and Barnaby	Download	Download		View
CRP Decision Tool	Herbel, Jones	Download	Download		
Kansas Grain Price Spread-Transportation Returns	O'Brien		View		
InsuranceSim	Kastens, Dhuyvetter, and Barnaby	Download	Download		
<b>CROP PRODUCTION ECONOMICS DECISION TOOLS</b>					
Guidance & Section Control Profit Calculator	Dhuyvetter, et al	Download	Dashboard Excel Tool	View	WMV (Dashboard) WMV (Excel)
KSU GPSguidance	Kastens, Dhuyvetter, and Kastens	Download			
Economics of Spraying Field Crops	Dhuyvetter, Jardine	Download			View
KSU-FertCostCalc	Dhuyvetter, Kastens	Download			View
KSU-CRP HAYORGRAZE	Taylor, Dhuyvetter, Kastens	Download	Download		View
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MACHINERY and BUILDING DECISION TOOLS					
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LAND LEASING AND PURCHASE DECISION TOOLS					
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Determining Pasture Rents in the Kansas Flint Hills (KSU-Graze.xls)	Dhuyvetter, Dumlal, and Tonsor	Download	Download	View	
Pricing DDGs in Feeder Nations	Tonsor	Download	Instructions Paper		
Break-even Analysis of Different Swine Operations	Tonsor	Download	Instructions Paper		
K-State Feeder Cattle Risk Management Tool	Dhuyvetter	Download			
FM Guides-Beef-(2010).xls	Dhuyvetter and Lewelyn	Download			

## Summary...

- Model-estimated custom rates, where rates are a function of fuel price and inflation, can help “fill the gap” of missing survey data in the short run
- Tremendous variability in machinery costs between producers exists
- Machinery costs tend to be fairly persistent implying that producers’ management abilities are important
- Tools exist to help producers make informed machinery investment decisions



For more information and decision tools related to farm management, marketing, and risk management go to [www.AgManager.info](http://www.AgManager.info)

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