

# Understanding & Estimating Machinery Costs

Presented at U.S. AgBank Appraisal Seminar  
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Kevin C. Dhuyvetter (kcd@ksu.edu --- 785-532-3527)  
Terry L. Kastens (tkastens@ksu.edu --- 785-532-5866)

Department of Agricultural Economics, Kansas State University

## Purpose of machinery talks

- Develop an understanding of the costs associated with owning and operating machinery
- Trying to reduce decisions to numbers
  - Custom hire
  - Own vs. rent
  - Lease vs. purchase
  - Trading strategies
- ... targeting the decision tools:
  - *OwnSpray.xls*
  - *OwnTractor.xls*
  - *OwnCombine.xls*
  - *KSU-MachCost.xls*



## **Understanding machinery costs**

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### **Machinery cost categories**

- **Repair and maintenance**
- **Labor**
- **Depreciation (market, not tax depreciation)**
- **Interest (opportunity interest)**
- **Fuel and lubrication**
- **Taxes, insurance, and shelter**
- **Custom hire**

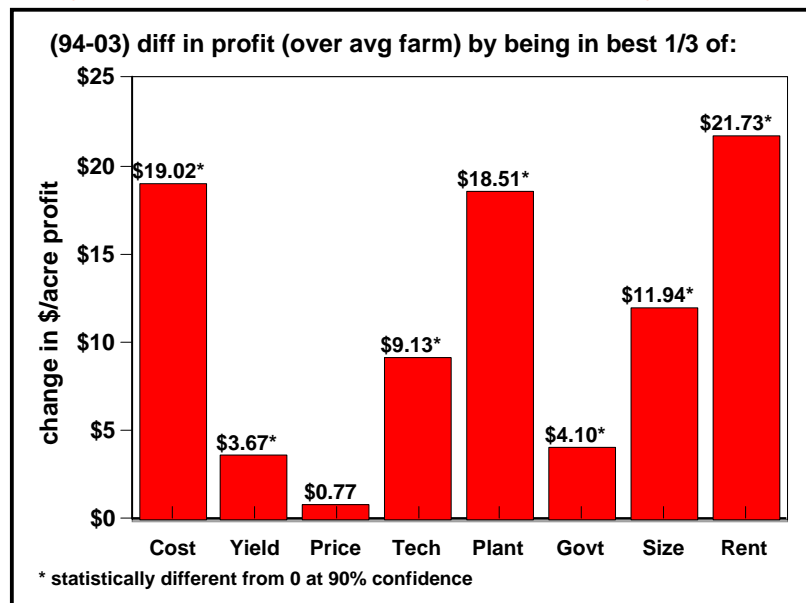
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## Why Producers Need to Know

- **Selecting Profit-maximizing Crop Mix**
  - must prorate to crops
- **Dealing with Technological Change (no-till)**
  - alternative systems use machinery less intensively
- **Benchmarking**
- **Banking (tracking market value & deprec.)**
- **Minimizing Costs of Production**
  - owning vs. leasing vs. custom hire
  - optimal trade decisions

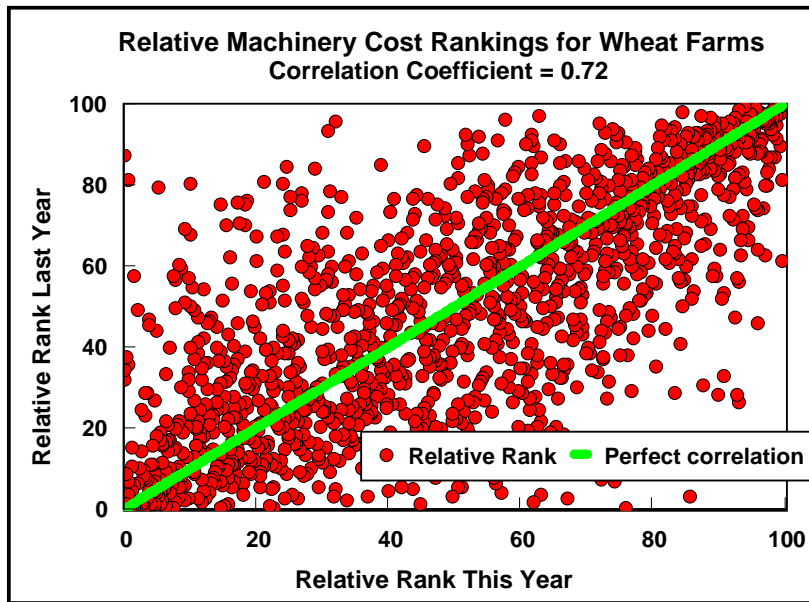
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### Study of ~900 farms in KFMA at Kansas State University

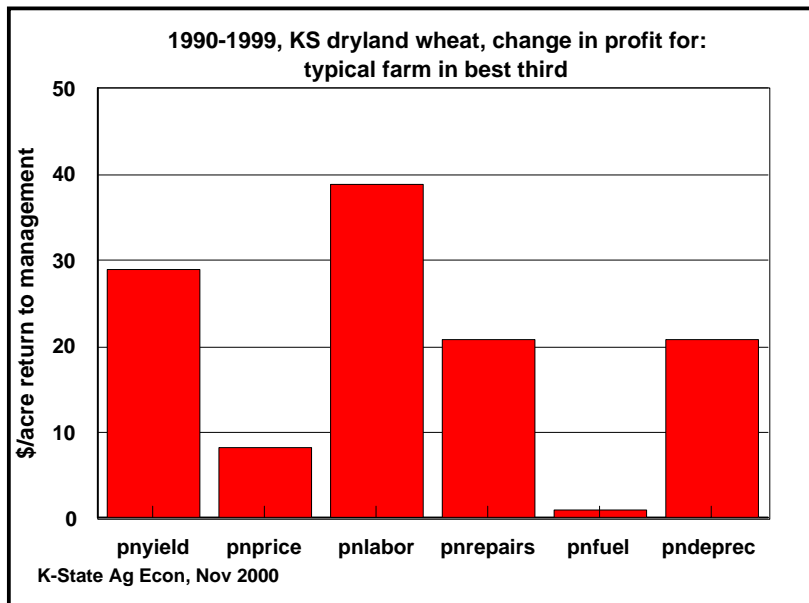


**Machinery large part of costs, but other stuff matters too**

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Relative machinery costs are somewhat repeatable



Being a good machinery operator matters to the bottom line

## How important are farm machinery costs for Kansas farmers?

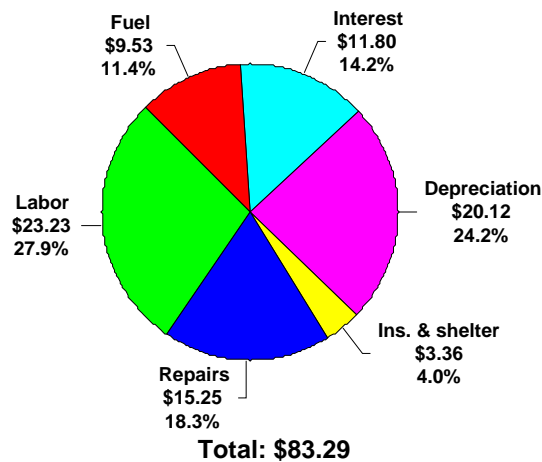
### Kansas Farm Management Association Enterprise Analysis Nonirrigated Crops -- State Averages, 2001-2003

	Corn	Sorghum	Wheat	Soybean	Alfalfa	Total Ac
Number of Farms	105	194	327	170	57	
Average Acres	328	318	585	327	103	1,660
Costs, \$ per Acre						Wtd Avg
Seed	\$26.07	\$8.76	\$5.75	\$21.69	\$8.15	\$13.62
Fertilizer	32.42	20.12	17.08	3.86	8.75	17.57
Herb-Ins	22.35	18.78	4.55	16.93	10.73	13.61
Crop Ins	5.05	3.08	3.45	3.98	0.16	3.59
<b>Machinery</b>	<b>68.90</b>	<b>53.39</b>	<b>54.88</b>	<b>62.21</b>	<b>79.03</b>	<b>60.30</b>
Other	19.15	15.90	15.68	17.93	20.84	17.17
Land	35.40	17.39	20.50	25.31	39.05	24.94
Interest	17.90	12.52	11.17	14.83	16.06	13.78
Total Cost	\$227.24	\$149.93	\$133.05	\$166.74	\$182.76	\$164.59
<b>Machinery, %</b>	<b>30.3%</b>	<b>35.6%</b>	<b>41.2%</b>	<b>37.3%</b>	<b>43.2%</b>	<b>36.6%</b>

Note – A portion of interest cost should also be allocated to machinery costs  
Costs reflect operator's costs on owned and rented land

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### Machinery Costs Per Acre, Kansas, 2001 Source: 182 KFMA Members (Beaton)



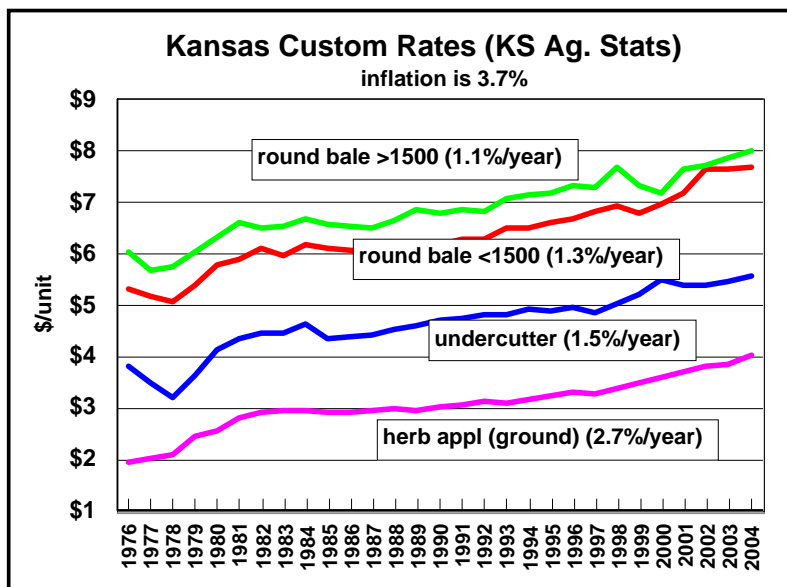
Custom hire cost has been allocated to individual categories

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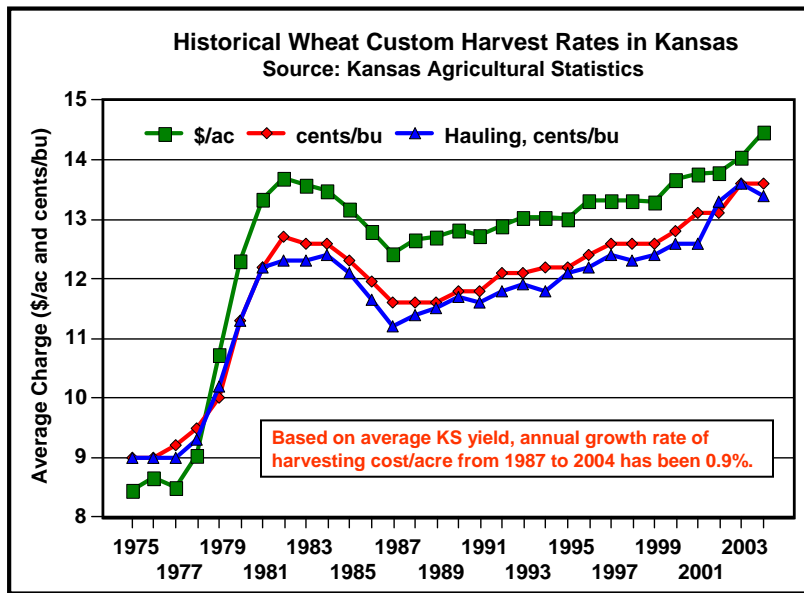
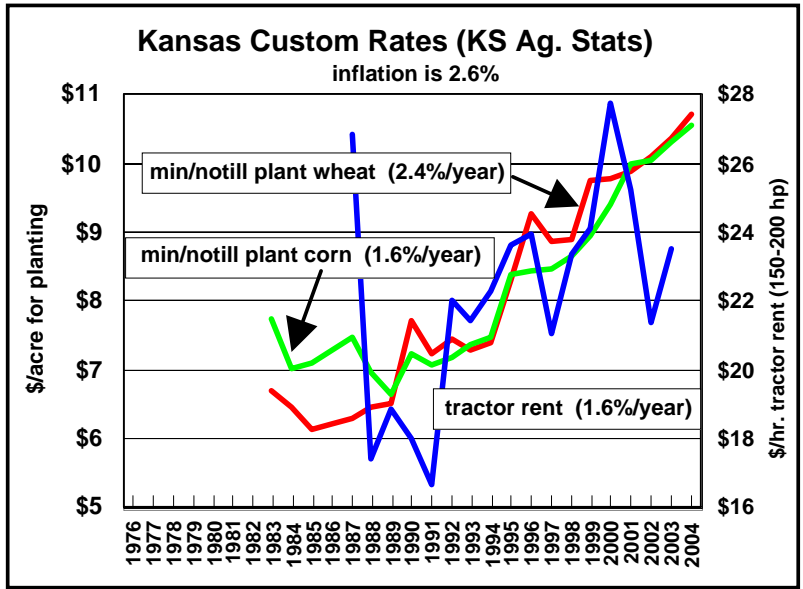
## Machinery cost categories

- Repair and maintenance
- Labor
- Depreciation (market, not tax depreciation)
- Interest (opportunity interest)
- Fuel and lubrication
- Taxes insurance and shelter
- Custom hire
  - Leads to published and “accepted” custom rates

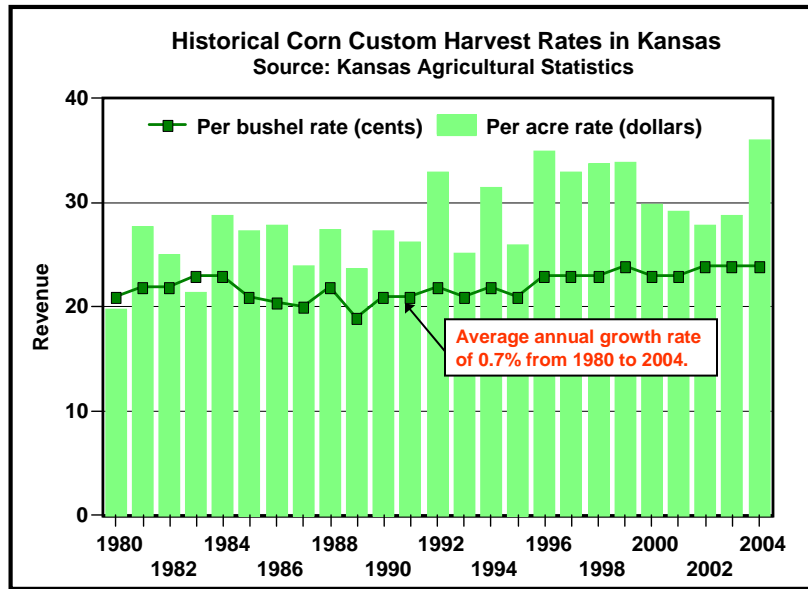
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## Flat rate vs. per bushel charge



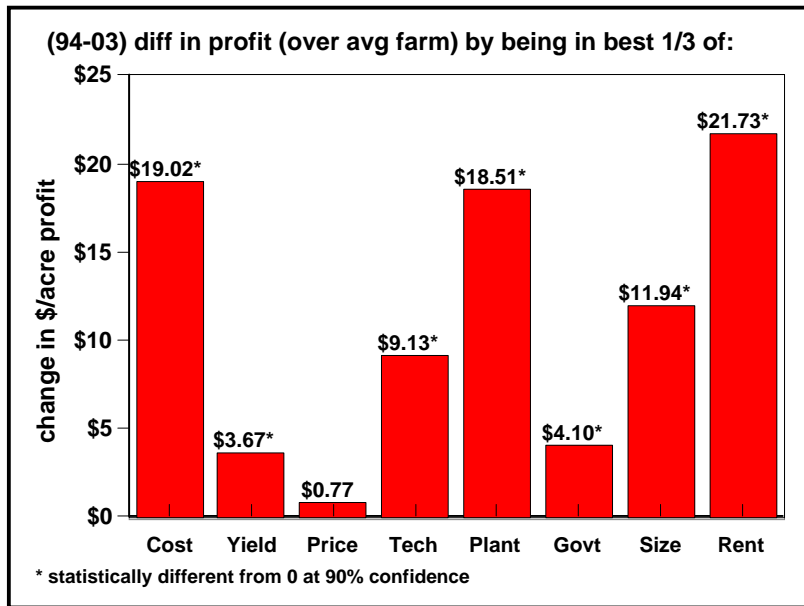
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## Economies of size



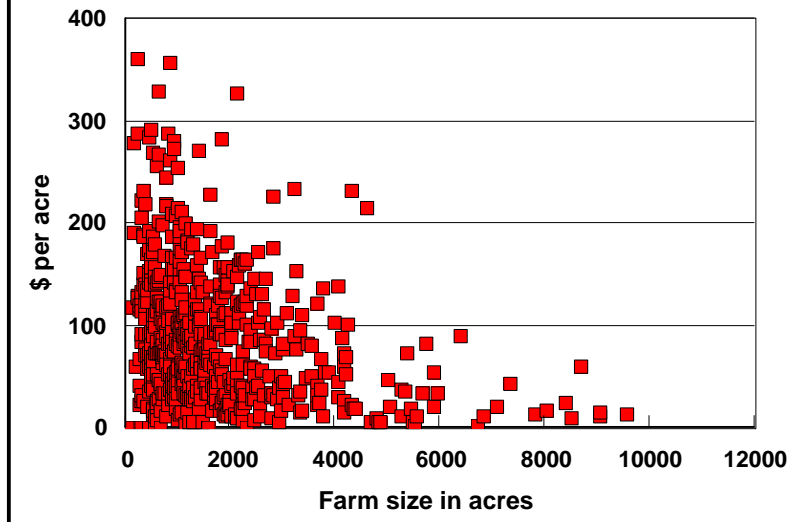
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Study of ~900 farms in KFMA at Kansas State University

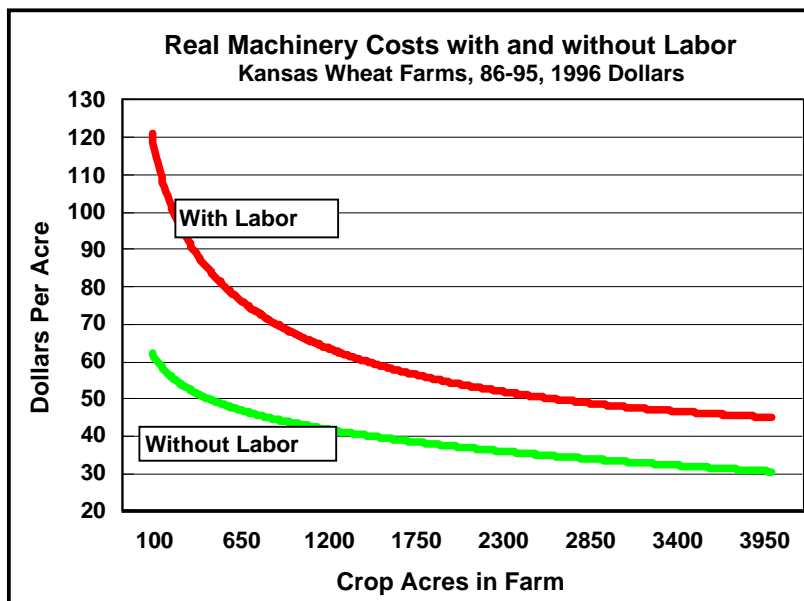
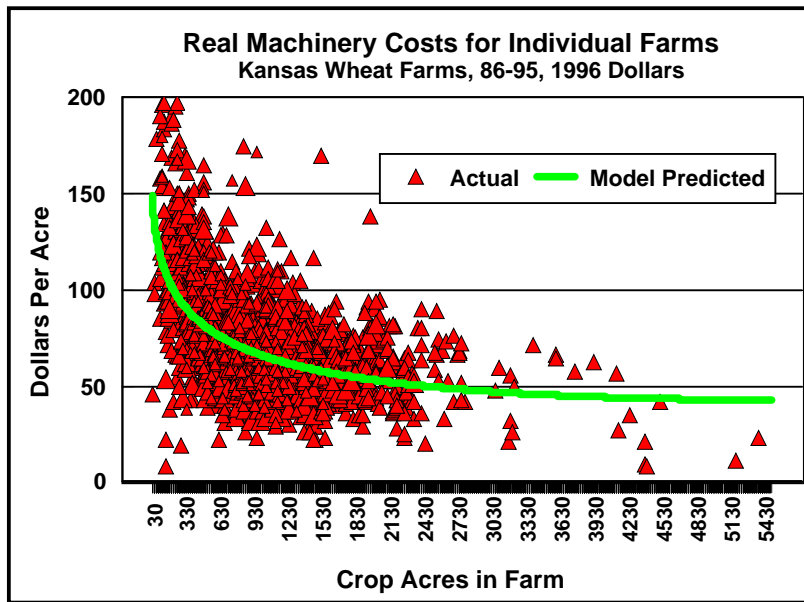


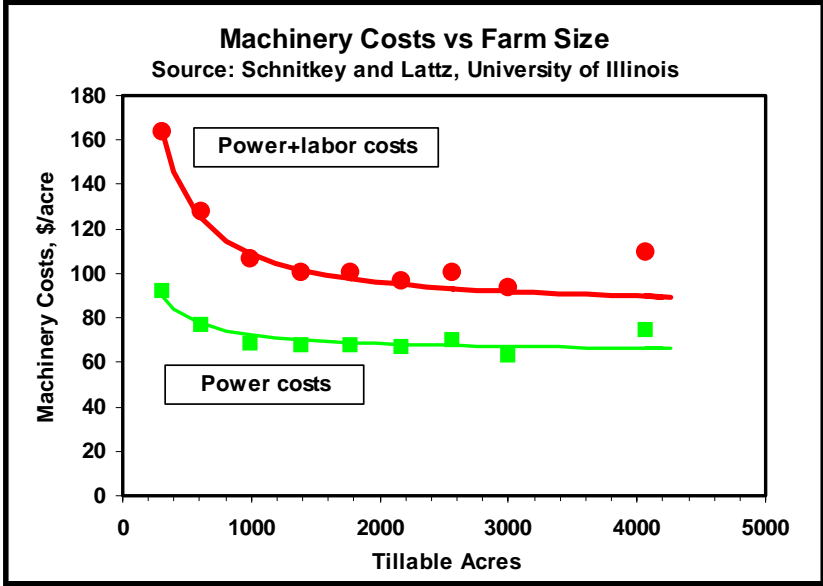
After accounting for other factors, size still quite important

Machinery investment per acre by farm size  
617 farms, KFMA, 1999

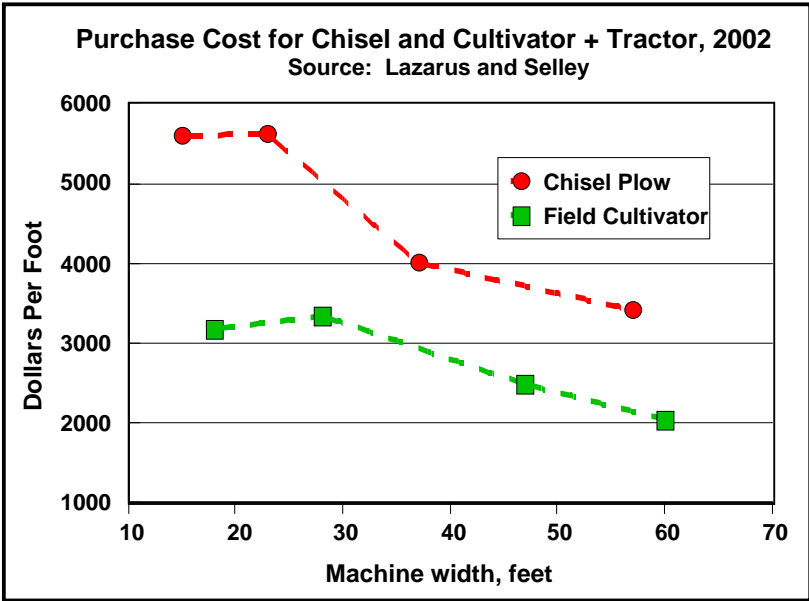


Large farms don't have as much invested in machinery





Pattern is very similar to Kansas data



**Purchase cost per unit of machinery does not always fall with larger equipment, but other factors also come into play in the machinery size decision...**



**... timeliness needs to be factored in to the decision.**

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## **Benchmarking machinery costs**



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**Cost benchmarking is an important task  
when targeting improvement**

**Internal benchmarking**

**vs.**

**External benchmarking**

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**2004 Harvest Year Report  
for USCHI's  
Custom Harvester Analysis  
and Management Program  
(CHAMP)**

**Kevin Dhuyvetter and Terry Kastens  
Agricultural Economists  
AgAnalysis+ and  
Kansas State University**



**email: [kdhuyvet@aganalysisplus.com](mailto:kdhuyvet@aganalysisplus.com)  
[tkastens@aganalysisplus.com](mailto:tkastens@aganalysisplus.com)**



**Custom Harvester Analysis and Management Program (CHAMP)**  
**2004 Harvest Year**  
**Individual Firm Report**

Happy Harvesters Inc.  
 Box 999  
 Wheat Country, KS 99999

	Firm Value	Survey Average Value	Firm Value per Combine	Survey Avg. of Value per Combine	Firm Value per per Acre	Survey Avg. of Value per per Acre	Firm Value per per Hour	Survey Avg. of Value per per Hour
Number of Machines Operated	3.0	4.73	-----	-----	-----	-----	-----	-----
Value of Combines	\$428,000	\$630,126	\$142,667	\$136,790	\$21.54	\$21.01	\$255.22	\$247.09
Value of Platforms	\$81,000	\$133,477	\$27,000	\$28,173	\$4.08	\$4.23	\$48.30	\$49.47
Value of Other Equipment	\$325,000	\$502,764	\$108,333	\$122,673	\$16.35	\$18.23	\$193.80	\$215.31
Value of Other Assets	\$120,000	\$161,796	\$40,000	\$32,996	\$6.04	\$5.21	\$71.56	\$61.95
<b>Total Assets</b>	<b>\$954,000</b>	<b>\$1,428,162</b>	<b>\$318,000</b>	<b>\$320,632</b>	<b>\$48.01</b>	<b>\$48.69</b>	<b>\$568.87</b>	<b>\$573.81</b>
Total Acres Covered	19,872	31,725	6,624	6,872	1.0	1.0	11.85	11.81
Combine Rent Acres	223	1,638	74	121	0.011	0.021	-----	-----
Small Grains Percent	76.3	70.6	-----	-----	-----	-----	Combine Efficiency	-----
Total Fields Harvested*	132	230	44.0	55.7	150.5	138.0	sep hrs/engine hrs	-----
Total Separator Hours in 2004	1,677	2,649	559	587	0.084	0.086	74.8%	76.0%


  
  
 U.S. Custom Harvesters Inc.

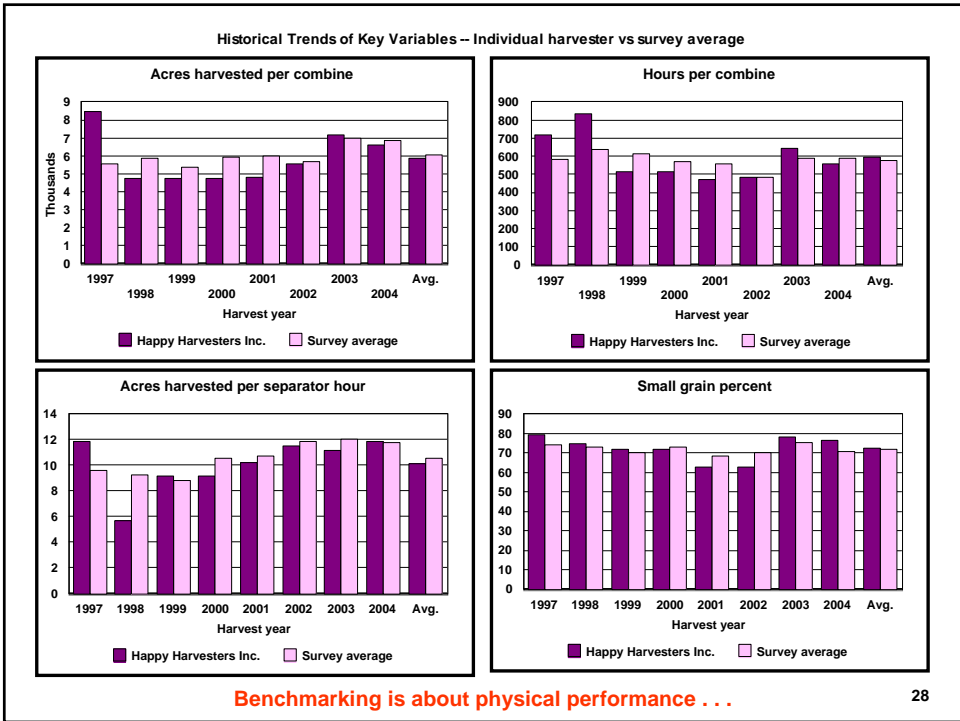
  

									% of Total Revenue	
	Firm	Survey Avg.	Firm	Survey Avg.	Firm	Survey Avg.	Firm	Survey Avg.	Firm	Survey Avg.
<b>INCOME AND EXPENSE</b>										
Harvest Revenue	\$452,089	\$700,740	\$150,696	\$158,954	\$22.75	\$22.94	\$269.58	\$271.35	98.3%	97.6%
Combine Rent Revenue	\$2,027	\$19,061	\$676	\$1,428	\$0.10	\$0.24	\$1.21	\$3.02	0.4%	1.0%
Other Revenue	\$5,873	\$13,732	\$1,958	\$2,509	\$0.30	\$0.32	\$3.50	\$3.84	1.3%	1.4%
<b>Total Revenue</b>	<b>\$459,989</b>	<b>\$733,533</b>	<b>\$153,330</b>	<b>\$162,891</b>	<b>\$23.15</b>	<b>\$23.51</b>	<b>\$274.29</b>	<b>\$278.21</b>	<b>100.0%</b>	<b>100.0%</b>
Labor (paid and unpaid)	\$111,514	\$155,339	\$37,171	\$35,172	\$5.61	\$5.04	\$66.50	\$59.41	24.2%	21.4%
Travel	\$20,989	\$28,753	\$6,996	\$6,895	\$1.06	\$1.01	\$12.52	\$11.82	4.6%	4.3%
Fuel and Lubrication	\$68,312	\$96,563	\$22,771	\$22,542	\$3.44	\$3.20	\$40.73	\$37.97	14.9%	13.6%
Repair and Maintenance	\$38,121	\$71,751	\$12,707	\$17,113	\$1.92	\$2.41	\$22.73	\$28.47	8.3%	10.2%
Insurance	\$27,038	\$37,010	\$9,013	\$8,621	\$1.36	\$1.30	\$16.12	\$15.29	5.9%	5.5%
Telephone and Utilities	\$7,759	\$11,458	\$2,586	\$2,517	\$0.39	\$0.36	\$4.63	\$4.21	1.7%	1.5%
Other Expenses	\$16,834	\$54,962	\$5,611	\$11,548	\$0.85	\$1.54	\$10.04	\$18.22	3.7%	6.5%
Market Depreciation	\$52,500	\$125,180	\$17,500	\$28,995	\$2.64	\$4.14	\$31.31	\$49.21	11.4%	17.6%
Interest on Assets (assigned)	\$56,626	\$84,771	\$18,875	\$19,032	\$2.85	\$2.89	\$33.77	\$34.06	12.3%	12.3%
<b>Total Expense</b>	<b>\$399,693</b>	<b>\$665,787</b>	<b>\$133,231</b>	<b>\$152,434</b>	<b>\$20.11</b>	<b>\$21.89</b>	<b>\$238.34</b>	<b>\$258.65</b>	<b>86.9%</b>	<b>93.1%</b>
<b>Total Operating Profit</b>	<b>\$60,296</b>	<b>\$67,746</b>	<b>\$20,099</b>	<b>\$10,457</b>	<b>\$3.03</b>	<b>\$1.62</b>	<b>\$35.95</b>	<b>\$19.56</b>		

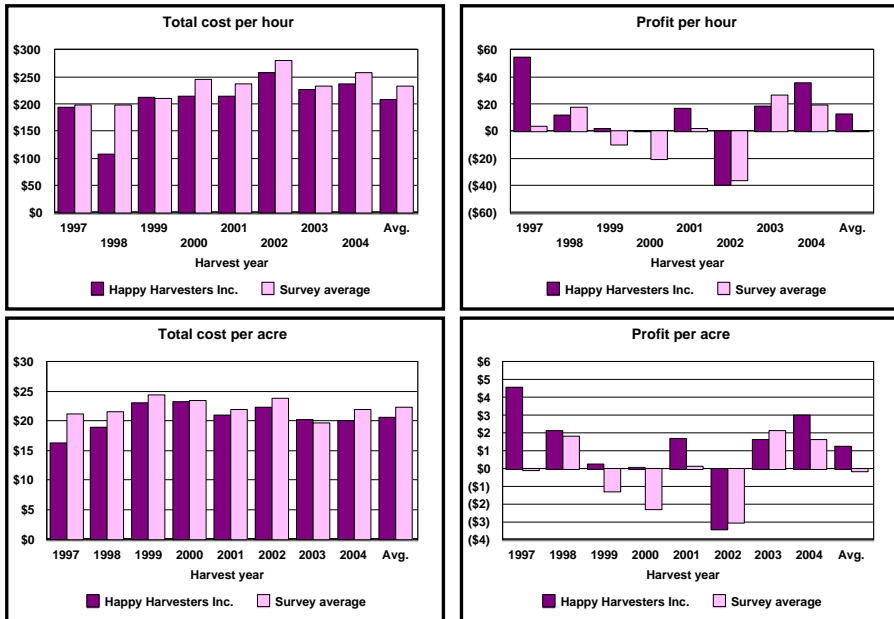
Debt-to-Asset Ratio (end of year) 33.6% 42.2% Insurance as percent of equipment value => 3.2% 2.9%  
 Return on Assets 12.3% 9.9%  
 Return on Equity (based on IS) 15.4% xxx Operating profit + interest charged on equity divided by beginning of year equity.  
 Return on Equity (based on BS) 12.9% xxx Change in balance sheet equity divided by the beginning of year equity.  
 Expense/\$100 Revenue \$86.89 \$33.16

\* Value used per acre for Total Fields Harvested represents the average field size in acres.  
 Note: Some reported values were modified from those reported on the survey due to arithmetic and other data entry errors.

  
 AgAnalysis+  
 www.aganalysisplus.com

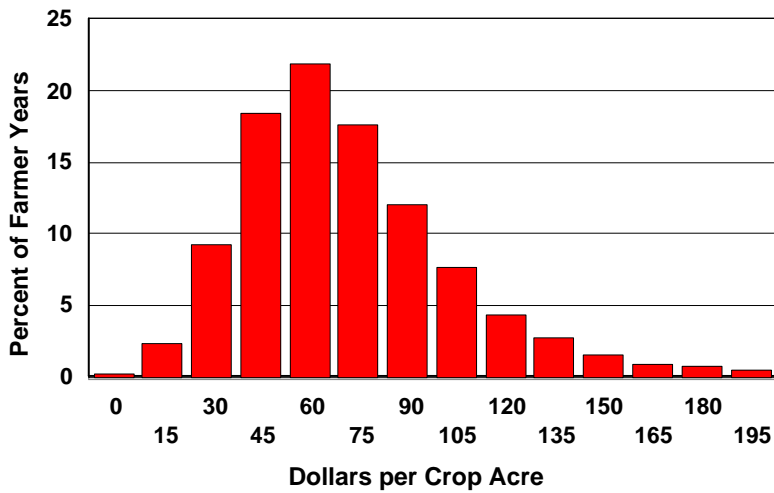


Historical Trends of Key Variables -- Individual harvester vs survey average



Benchmarking is about economic performance

Frequency of Annual Machinery Cost, 992 Kansas Farms 1986-1995; 1996 dollars; mean = \$78.75; median = \$73.38



Machinery costs are highly variable across farms

## Machinery costs are highly variable across farms ...

Kansas Farm Management Association Enterprise Analysis Nonirrigated Crops -- State Averages, 2001-2003						
	Corn	Sorghum	Wheat	Soybean	Alfalfa	
Number of Farms	105	194	327	170	57	
Average Acres						Total Ac
High profit farms	481	432	692	443	112	2,160
Mid profit farms	306	313	679	310	130	1,739
Low profit farms	196	208	382	228	66	1,080
Machinery Costs, \$/acre						Wtd Avg
High profit farms	\$54.32	\$42.85	\$47.58	\$50.04	\$61.30	\$49.35
Mid profit farms	\$60.73	\$51.68	\$49.26	\$60.38	\$76.77	\$55.76
Low profit farms	\$91.65	\$65.61	\$67.79	\$76.19	\$99.00	\$75.38
<b>High less low, \$</b>	<b>-\$37.33</b>	<b>-\$22.76</b>	<b>-\$20.21</b>	<b>-\$26.16</b>	<b>-\$37.70</b>	<b>-\$26.03</b>
<b>High less low, %</b>	<b>-40.7%</b>	<b>-34.7%</b>	<b>-29.8%</b>	<b>-34.3%</b>	<b>-38.1%</b>	<b>-34.5%</b>

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## Machinery costs are important in explaining profitability differences across farms ...

Kansas Farm Management Association Enterprise Analysis Nonirrigated Crops -- State Averages, 2001-2003						
	Corn	Sorghum	Wheat	Soybean	Alfalfa	
Machinery Costs, \$/acre						Wtd Avg
High profit farms	\$54.32	\$42.85	\$47.58	\$50.04	\$61.30	\$49.35
Mid profit farms	\$60.73	\$51.68	\$49.26	\$60.38	\$76.77	\$55.76
Low profit farms	\$91.65	\$65.61	\$67.79	\$76.19	\$99.00	\$75.38
<b>High less low, \$</b>	<b>-\$37.33</b>	<b>-\$22.76</b>	<b>-\$20.21</b>	<b>-\$26.16</b>	<b>-\$37.70</b>	<b>-\$26.03</b>
<b>High less low, %</b>	<b>-40.7%</b>	<b>-34.7%</b>	<b>-29.8%</b>	<b>-34.3%</b>	<b>-38.1%</b>	<b>-34.5%</b>
<b>Differences between high profit farms and low profit farms in ...</b>						
<b>Net returns</b>	<b>\$91.29</b>	<b>\$73.01</b>	<b>\$65.97</b>	<b>\$78.23</b>	<b>\$165.55</b>	<b>\$80.90</b>
<b>Total costs</b>	<b>-\$89.28</b>	<b>-\$62.37</b>	<b>-\$46.46</b>	<b>-\$57.36</b>	<b>-\$75.84</b>	<b>-\$61.92</b>
<b>Cost/net returns</b>	<b>97.8%</b>	<b>85.4%</b>	<b>70.4%</b>	<b>73.3%</b>	<b>45.8%</b>	<b>76.5%</b>
<b>Mach/total costs</b>	<b>41.8%</b>	<b>36.5%</b>	<b>43.5%</b>	<b>45.6%</b>	<b>49.7%</b>	<b>42.0%</b>
<b>Mach/net returns</b>	<b>40.9%</b>	<b>31.2%</b>	<b>30.6%</b>	<b>33.4%</b>	<b>22.8%</b>	<b>32.2%</b>

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### Machinery Costs NW KS Wheat Enterprises

	<u>KFMA 95</u>	<u>Farm A 97</u>
Labor (hired & unpaid)	\$17.23	\$27.00
Gas/Fuel/Oil	\$ 6.03	\$ 7.57
Repair & Maintenance	\$11.43	\$ 9.19
Personal Property Tax	\$ 0.53	\$ 0.49
General Insurance	\$ 1.97	\$ 1.89
Utilities	\$ 1.69	\$ 1.48
Auto Expense	\$ 0.72	\$ 0.00
Economic Depreciation	\$ 8.71	\$12.91
Net Machine Hire	\$11.93	\$ 0.82
Interest (9% assign)	<u>\$ 8.97</u>	<u>\$11.40</u>
<b>Total</b>	<b>\$69.21</b>	<b>\$72.75</b>

Machine hire makes it hard to compare

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### Machinery Costs NW KS Wheat Enterprises combine tax, insurance, utilities; prorate auto expense and machine hire

	<u>KFMA 95</u>	<u>Farm A 97</u>
Labor (hired & unpaid)	\$21.08	\$27.31
Gas/Fuel/Oil	\$ 7.38	\$ 7.66
Repair & Maintenance	\$13.99	\$ 9.29
Tax, Insurance, Shelter	\$ 5.13	\$ 3.90
Economic Depreciation	\$10.66	\$13.06
Interest (9% assign)	<u>\$10.97</u>	<u>\$11.53</u>
<b>Total</b>	<b>\$69.21</b>	<b>\$72.75</b>

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## Machinery Costs NW KS Wheat Enterprises using custom rates (1997) approach

	<u># operations</u>	<u>\$/operation</u>
Undercutter (V-Blade)	4	\$ 4.68
Offset Disk	1	\$ 4.38
NH3 Application	1	\$ 6.16
Drill	1	\$ 5.61
Harvest 40 bu.	1	<u>\$19.87</u>
Total		\$54.74

Where's the rest of the costs?

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## Research comparing whole-farm costs with custom rates...

- Custom rates are an important benchmark
- Based on KFMA database and cooperator surveys for the year 2001
- Compare actual costs with what they might be expected to be, where expectations are based on published custom rates
- Custom rate ratio =  $\frac{\text{Actual costs}}{\text{Expected costs}}$



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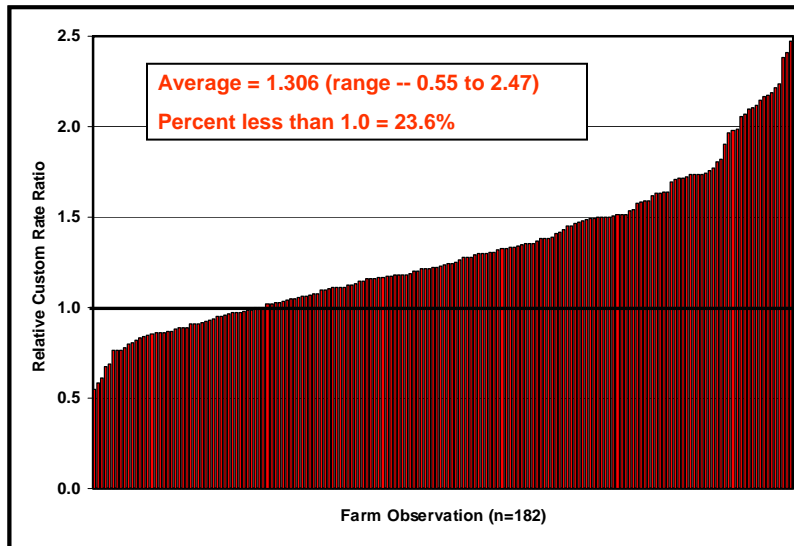
## Summary Statistics

	Average	Low Quartile <sup>1</sup>	High Quartile <sup>1</sup>
<b>Machinery costs</b>			
Total crop machinery cost/acre (dollars)	\$83.29	\$53.92	\$121.74
<b>Acres</b>			
Harvested acres (acres)	1,188	1,405	982
<b>Machinery cost components</b>			
Machinery labor cost	25.0%	30.8%	24.6%
Insurance	0.9%	0.9%	0.8%
Shelter	1.8%	1.6%	2.0%
Repair	16.4%	15.9%	16.2%
Fuel, gas and oil	10.3%	10.7%	9.6%
Auto	1.0%	1.3%	0.9%
Depreciation	21.7%	14.0%	24.3%
Machine hire expense	10.2%	12.0%	9.5%
Opportunity interest	12.7%	12.8%	12.1%

<sup>1</sup> Quartiles when sorted by Total crop machinery costs per acre.

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## Relative custom rate ratio



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## Conclusions of this research

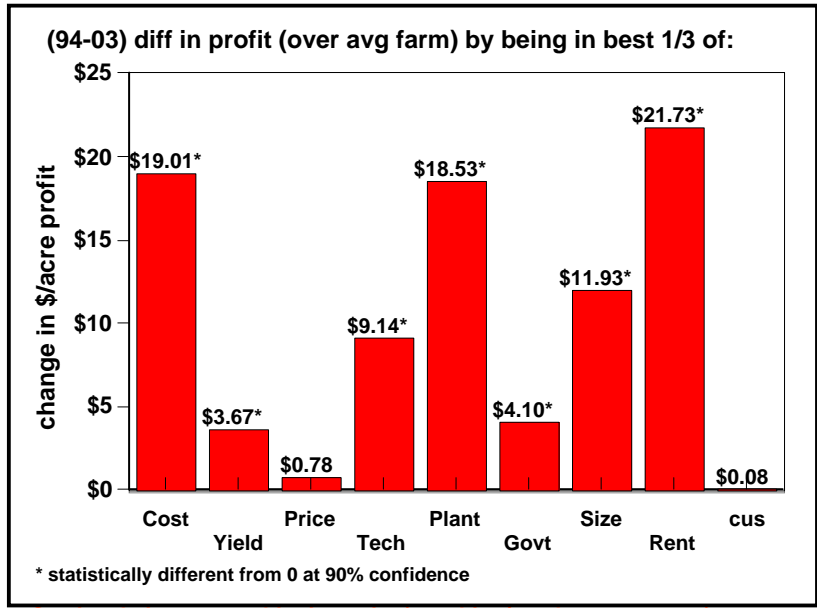
- Published custom rates need to be increased by approximately 25% (for a farm with 1,000 harvested acres)
- Economies of size exist (i.e., scale factor adjustment decreases as farm size increases)
- Thoughts...
  - Consider hiring it done
  - Consider the opportunity to do custom work
- Excel spreadsheet (*KSU-MachCost*) that can be used to estimate and benchmark farm specific machinery costs (at [www.agmanager.info](http://www.agmanager.info))

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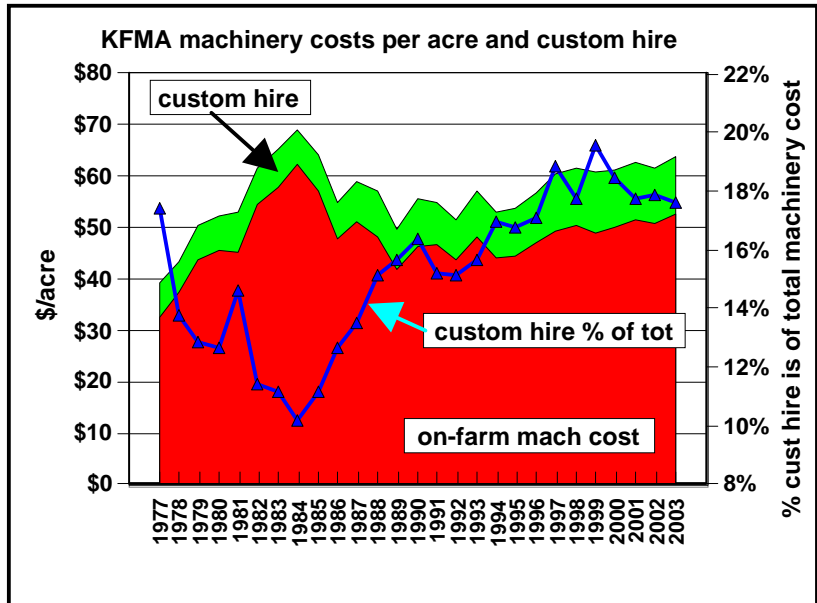
## Implications for custom operators?

- It does appear many farms would be better off hiring farming operations rather than doing them in house
  - Is that really true?
- Are farms using more custom work today?
  - i.e., is the overall demand increasing?
- Are bigger or smaller farms hiring custom work?
  - Where is the best market segment?

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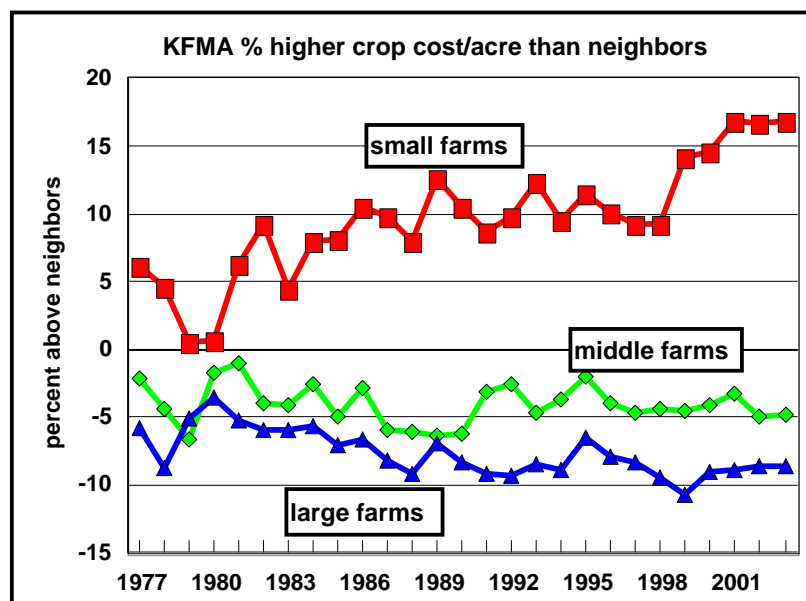
Cus is relative custom hire intensity (cust hire / total crop expense).  
 Custom hire doesn't of itself make you profitable.



Maybe a slight temporal increase in demand for custom hire . . .

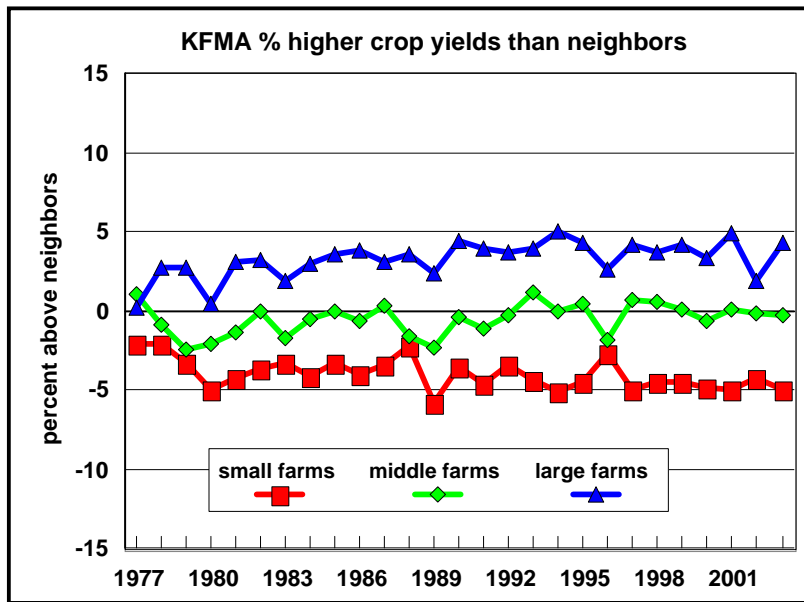
- Some management features have showed trends over time related to big vs. small farmers
- Has that been true regarding custom hire?

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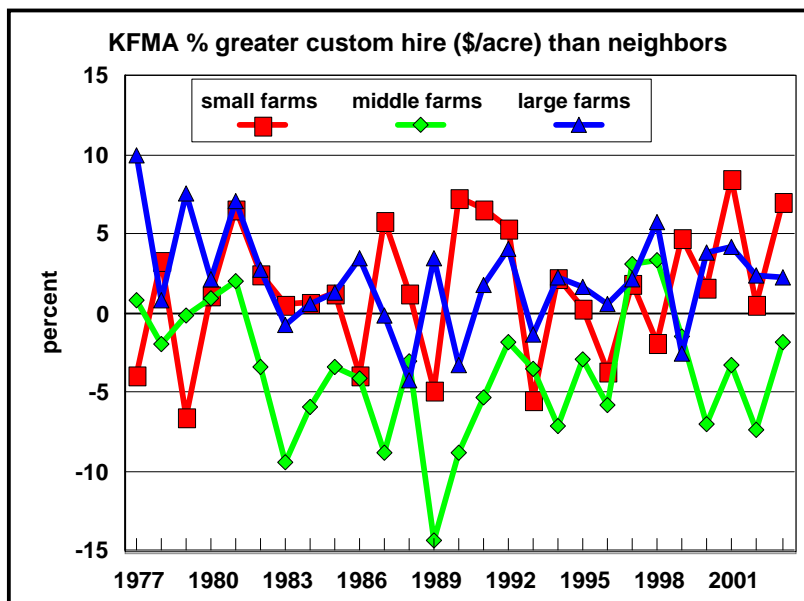


Example of one factor that showed a very distinct trend across farm size

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Example of one factor that showed a smaller trend across farm size



Small and large farms tend to spend more \$/acre in cust hire than avg size.

## **Additional thoughts on custom work**

- **Doug Karre, Frenchman Valley Coop (Dec 8)**
  - Customers are small and big farms, not middle
  - Profitable in its own right; related seed and fertilizer sales is an added bonus
- **We're wondering. . .**
  - History showed cust hire by big and small farms
  - With increasing size-polarization of farms, the big and small will be all that's left – increased demand
- **Things to consider:**
  - Make custom services profitable in their own right
    - Not just machinery but also agronomic or other services
  - Keep thinking about bi-polarization

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## **Make custom operations profitable in their own right ...**

- Custom operations are very similar to farms in that returns are highly variable between operations and cost management is very important (rates charged tend to be very competitive)
- In order to be profitable, you need to be better than average --- which leads to the importance of benchmarking

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## Crop Machinery Investment, Kansas, 2003, \$/a

2003	as is	as is	"if don't hire custom work"		\$custom-to-mkt investment factor
	/cropland	/crop	/cropland	/crop	
NW	\$87	\$117	\$104	\$139	1.9
SW	\$90	\$135	\$106	\$159	1.7
NC	\$117	\$117	\$131	\$131	1.6
SC	\$123	\$128	\$141	\$147	1.9
NE	\$145	\$146	\$156	\$157	1.7
SE	\$149	\$130	\$164	\$143	1.8
KS	\$119	\$128	\$134	\$145	1.8

For benchmarking, multiply the factor times the \$/year of custom machine work you hire (NET of what you do for others) to estimate the additional machinery investment you might have if you did the work in house. Don't forget machine hire embedded in bundled charges (e.g., herbicide application).

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## External benchmarking will become harder over time ...

- Some farms do more custom hire
- Some farms rent machines
- Some farms do less tillage
- Some farms raise specialty crops

... external benchmarking may need to be done on broader categories (internal benchmarking will still be important but it is also affected by these factors)

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## Lease versus purchase



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## Lease vs. Purchase ...



### *Considerations that affect decision:*

- Capital outlay
- Cash-flow requirements
- Repairs and maintenance (terms of lease)
- Control over use and timeliness of operation
- Risk of obsolescence
- Income tax deductions and credits



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## Lease vs. Purchase ...

- Lease type
  - Operating lease vs. capital lease (low buyout)
- Assuming a true operating lease, then the lease vs. purchase decision basically becomes a tax and time value of money decision.
- How do we analyze the lease vs. purchase decision?

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## Measures of investment worth ...

- Payback method
- Simple rate of return
- Discounted cash flow measures
  - Internal rate of return (IRR)
  - Net present value (NPV)

54

## Net present value analysis ...

Method of analyzing or comparing investments that explicitly considers the time value of money in cash flows.

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## Time Value of Money

$$V_n = V_0 * (1 + i)^n$$

where,

$V_n$  = future value ( $FV_0$ )

$V_0$  = present value ( $PV_0$ )

$i$  = interest rate

$n$  = years in the future

56

## Time Value of Money

$$FV_0 = PV_0 * (1+i)^n$$

rearranging terms gives ...

$$PV_0 = \frac{FV_0}{(1+i)^n}$$

where,

$$1 / (1+i)^n = \text{discount factor (rate)}$$

57

## Time Value of Money

$$FV_0 = PV_0 * (1+i)^n$$

rearranging terms gives ...

$$PV_0 = \frac{FV_0}{(1+i)^n}$$

substituting yearly cash flows ( $CF_n$ ) for  $FV_0$  gives ...

$$PV_0 = \sum_{n=0}^{n=N} \frac{CF_n}{(1+i)^n}$$

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## Present Value

$$FV_0 = PV_0 * (1+i)^n$$

$$PV_0 = \frac{FV_0}{(1+i)^n}$$

$$PV_0 = \sum_{n=0}^{n=N} \frac{CF_n}{(1+i)^n}$$

-----  
example using flows (CF): 2, 4, 3 and i=10%

$$PV_0 = \frac{2}{1.10^0} + \frac{4}{1.10^1} + \frac{3}{1.10^2} = 2 + 3.64 + 2.48 = 8.12$$

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## Present value discount factor ...

$$PV \text{ factor} = 1/(1+i)^n$$

where:  $i$  = interest rate

$n$  = year

Example discount factor with interest rate of 10%

$$PV \text{ discount factor in year 1} = 1/(1+.10)^1 = 0.9091$$

$$PV \text{ discount factor in year 2} = 1/(1+.10)^2 = 0.8264$$

$$PV \text{ discount factor in year 3} = 1/(1+.10)^3 = 0.7513$$

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**NPV, Self-finance vs. Loan w/ Balloon**  
**\$1000 purchase year 0, sold for \$500 in year 3**  
**discount factor = 0.10**

yr.	self finance		loan w/ balloon	
	cash flow	disc.val	cash flow	disc.val
0	-\$1000.00	-\$1000.00	\$ 0.00	\$ 0.00
1	\$ 0.00	\$ 0.00	-\$ 100.00	-\$ 90.91
2	\$ 0.00	\$ 0.00	-\$ 100.00	-\$ 82.64
3	\$ 500.00	\$ 375.65	-\$ 600.00	-\$ 450.79
NPV		-\$ 624.34		-\$ 624.34

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**Net present value analysis ...**

- In general, the NPV of an investment should be based on the after-tax cash flow.
- The discount factor should be the after-tax cost of capital, regardless of whether you use pre- or after-tax cash flows.

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## Marginal tax rate ...

Example of a marginal tax rate:

<i>Federal rate</i>	<i>15.0%</i>
<i>Self-employment</i>	<i>15.3%</i>
<i>State rate</i>	<i>5.0%</i>
<hr/>	
<i>Marginal tax rate</i>	<i>35.3%</i>

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## Discount rate ...

- Does it make sense to charge equity capital less than the lender charges for borrowed capital?
- Which source of capital has the higher risk?
- We typically recommend the same rate of return be charged to equity and borrowed capital in calculating the discount rate.

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## Discount rate ...

Example of an after-tax discount rate given interest rate on borrowed and equity capital are equal:

$$\frac{\text{Interest rate} \times (1 - \text{tax rate})}{\text{After-tax discount rate}}$$

$$8\% \times (1 - 35.3\%) = 5.18\%$$

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## NPV and lease vs. purchase example ...

Cash purchase, loan (declining payments), loan (equal payments), and two different leases.

### Comparison of Different Purchasing Methods

Purchase price	\$100,000	Lease years	5
Interest rate	9.0%	Lease #1 factor	0.215
Loan years	5	Lease #1 buyout	15.0%
Downpayment	30.0%	Lease #2 factor	0.245
Tax rate	35.3%	Lease #2 deposit	10.0%
Discount rate	5.82%	Lease #2 downpymt	10.0%
Section 179	\$24,000 (maximum allowable)		

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## NPV and lease vs. purchase example ...

CASH PURCHASE						
Tax rate		35.3%		Purchase price		\$100,000
Discount rate		5.82%		Depreciation years	7	
				Section 179		\$24,000
(1)	(2)	(3)	(4)	(5)	(6)	(7)
				After tax	P.V.	After tax
Year	Payment	Tax dep.	Tax red.	cash flow	Factor	cash flow
						P.V.
0	\$100,000	0	0	(\$100,000)	1.000	(\$100,000)
1		\$32,140	\$11,345	11,345	0.945	10,721
2		14,539	5,132	5,132	0.893	4,583
3		11,423	4,032	4,032	0.844	3,403
4		9,310	3,286	3,286	0.797	2,621
5		9,310	3,286	3,286	0.754	2,476
6		9,310	3,286	3,286	0.712	2,340
7		9,310	3,286	3,286	0.673	2,211
8		4,659	1,645	1,645	0.636	1,046
9					0.601	
10					0.568	
Total	\$100,000	\$100,000	\$35,300			(\$70,599)

Lease/purchase analysis depends on setting up a spreadsheet, tracking cash flows and which ones have tax implications, discounting with PV factors, and then comparing bottom lines

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## NPV and lease vs. purchase example ...

CREDIT PURCHASE (declining payment)								
Tax rate		35.3%	Purchase price	\$100,000	Downpayment		30.0%	
Discount rate		5.82%	Depreciation years	7	Loan years		5	
			Section 179	\$24,000	Interest rate		9.0%	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Prin. or down payment	Interest	Total pymt.	Tax dep.	Tax red.	After-tax cash flow	P.V. Factor	After-tax cash flow P.V.
0	\$30,000	0	\$30,000	0	0	(\$30,000)	1.000	(\$30,000)
1	14,000	\$6,300	20,300	\$32,140	\$13,569	(6,731)	0.945	(6,360)
2	14,000	5,040	19,040	14,539	6,911	(12,129)	0.893	(10,831)
3	14,000	3,780	17,780	11,423	5,367	(12,413)	0.844	(10,475)
4	14,000	2,520	16,520	9,310	4,176	(12,344)	0.797	(9,843)
5	14,000	1,260	15,260	9,310	3,731	(11,529)	0.754	(8,687)
6				9,310	3,286	3,286	0.712	2,340
7				9,310	3,286	3,286	0.673	2,211
8				4,659	1,645	1,645	0.636	1,046
9							0.601	
10							0.568	
Total	\$100,000	\$18,900	\$118,900	\$100,000	\$41,972			(\$70,599)

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## NPV and lease vs. purchase example ...

CREDIT PURCHASE (ammortized payment)								
Tax rate		35.3%	Purchase price	\$100,000	Downpayment		30.0%	
Discount rate		5.82%	Depreciation years	7	Loan years		5	
			Section 179	\$24,000	Interest rate		9.0%	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Year	Prin. or down payment	Interest	Total pymt.	Tax dep.	Tax red.	After-tax cash flow	P.V. Factor	After-tax cash flow P.V.
0	\$30,000	0	\$30,000	0	0	(\$30,000)	1.000	(\$30,000)
1	11,696	\$6,300	17,996	\$32,140	\$13,569	(4,427)	0.945	(4,184)
2	12,749	5,247	17,996	14,539	6,984	(11,012)	0.893	(9,833)
3	13,897	4,100	17,996	11,423	5,480	(12,517)	0.844	(10,562)
4	15,147	2,849	17,996	9,310	4,292	(13,704)	0.797	(10,928)
5	16,511	1,486	17,996	9,310	3,811	(14,186)	0.754	(10,689)
6				9,310	3,286	3,286	0.712	2,340
7				9,310	3,286	3,286	0.673	2,211
8				4,659	1,645	1,645	0.636	1,046
9							0.601	
10							0.568	
Total	\$100,000	\$19,982	\$119,982	\$100,000	\$42,354			(\$70,599)

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## NPV and lease vs. purchase example ...

FINANCIAL LEASE #1							
Tax rate		35.3%	Purchase price	\$100,000	Buyout (%)		15.0%
Discount rate		5.82%	Lease factor	0.215	Dep. years		3
			Lease years	5	Sec. 179		\$15,000
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Year	Lease payment	Buyout	Tax dep.	Tax red.	After tax cash flow	P.V. Factor	After tax cash flow P.V.
0	\$21,500			0	(\$21,500)	1.000	(\$21,500)
1	21,500			\$7,590	(13,911)	0.945	(13,145)
2	21,500			7,590	(13,911)	0.893	(12,422)
3	21,500			7,590	(13,911)	0.844	(11,738)
4	21,500			7,590	(13,911)	0.797	(11,092)
5		\$15,000		7,590	(7,411)	0.754	(5,584)
6			15,000	5,295	5,295	0.712	3,770
7			0			0.673	
8			0			0.636	
9			0			0.601	
10						0.568	
Total	\$107,500	\$15,000	\$15,000	\$43,243			(\$71,711)

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## NPV and lease vs. purchase example ...

<b>FINANCIAL LEASE #2 (Deposit is Buyout*)</b>							
Tax rate	35.3%	Purchase price	\$100,000	Deposit	10.0%		
Discount rate	5.82%	Lease factor	0.245	Dep. years	3		
Lease years	5	Downpymt	0.1	Sec. 179	\$10,000		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Year	Lease payment & deposit*	Buyout*	Tax dep.	Tax red.	After tax cash flow	P.V. Factor	After tax cash flow P.V.
0	\$20,000			0	(\$20,000)	1.000	(\$20,000)
1	24,500			\$3,530	(20,970)	0.945	(19,816)
2	24,500			8,649	(15,852)	0.893	(14,155)
3	24,500			8,649	(15,852)	0.844	(13,376)
4	24,500			8,649	(15,852)	0.797	(12,640)
5		\$10,000		8,649	8,649	0.754	6,517
6			10,000	3,530	3,530	0.712	2,514
7			0			0.673	
8			0			0.636	
9			0			0.601	
10						0.568	
<b>Total</b>	<b>\$108,000</b>	<b>\$10,000</b>	<b>\$10,000</b>	<b>\$41,654</b>			<b>(\$70,957)</b>

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## NPV and lease vs. purchase example ...

### Comparison of Different Purchasing Methods

Financing Alternative	Total Cash Outlay	Total Tax Reduction	After-Tax P.V.
Cash purchase	\$100,000	\$35,300	\$70,599
Finance with loan (declining payments)	\$118,900	\$41,972	\$70,599
Finance with loan (equal payments)	\$119,982	\$42,354	\$70,599
Financial lease	\$122,500	\$43,243	\$71,711
Financial lease (security deposit = buyout)	\$118,000	\$41,654	\$70,957

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## NPV and lease vs. purchase example ...

### Comparison of Different Purchasing Methods

Purchase price	\$100,000	Lease years	5
Interest rate	9.0%	Lease #1 factor	0.215
Loan years	5	Lease #1 buyout	15.0%
Downpayment	30.0%	Lease #2 factor	0.245
Tax rate	35.3%	Lease #2 deposit	10.0%
Discount rate	5.82%	Lease #2 downpymt	10.0%
Section 179	\$24,000 (maximum allowable)		

Financing Alternative	Total Cash Outlay	Total Tax Reduction	After-Tax P.V.
Cash purchase	\$100,000	\$35,300	\$70,599
Finance with loan (declining payments)	\$118,900	\$41,972	\$70,599
Finance with loan (equal payments)	\$119,982	\$42,354	\$70,599
Financial lease	\$122,500	\$43,243	\$71,711 <b>-\$1,112</b>
Financial lease (security deposit = buyout)	\$118,000	\$41,654	\$70,957 <b>-\$358</b>

Might we change some of the terms (i.e., blue numbers) to alter results?

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## Impact of purchase price on NPV ...

### Comparison of Different Purchasing Methods

Financing Alternative	Purchase Price	Difference From Cash	After-Tax P.V.
Cash purchase	\$100,000	base	\$70,599
Finance with loan (declining payments)	\$100,000	\$0	\$70,599
Finance with loan (equal payments)	\$100,000	\$0	\$70,599
Financial lease	\$98,449	(\$1,551)	\$70,599
Financial lease (security deposit = buyout)	\$99,496	(\$504)	\$70,599

Clearly, the terms of the lease impact the NPV analysis

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## **Lease vs. Purchase ...**

### *Why lease?*

- Financially advantageous
- Lower initial cost
- Continually have “new” equipment
- Only financing available
- Less risk of equipment becoming obsolete

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## **Lease vs. Purchase ...**

### *The games people play ...*

- off balance sheet financing
- improved reported earnings
- increased return on assets
- lower level decision making
- capital budget constraints

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## **Lease vs. Purchase ...**

- **Because of the many factors affecting the economics of leases vs. purchases, it is important for producers to compare the financing alternatives that exist for their unique situation.**
- **In other words, there is no one method of financing that will necessarily be best for all producers every time.**

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## **Lease versus purchase examples**

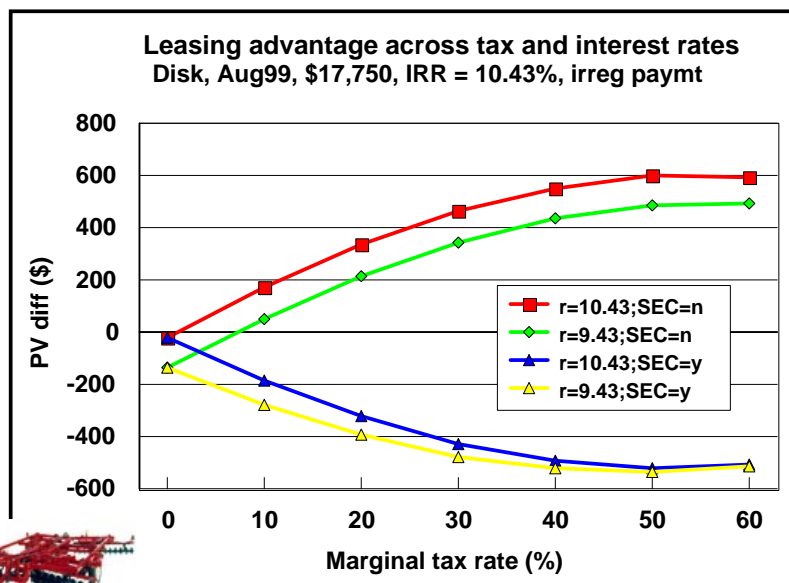


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## Lease vs. purchase examples ...

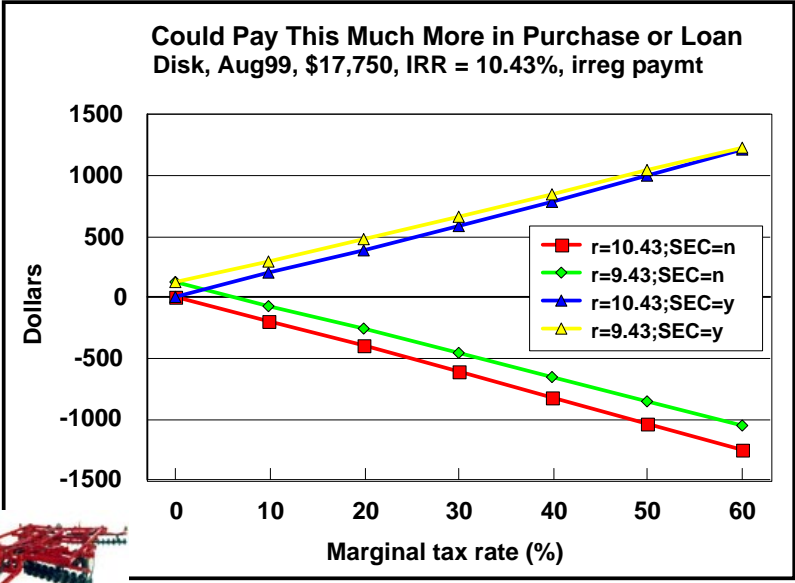
- Farm Credit -- Wichita, KS (1999)
  - Disk
  - Over the road trailer
  - Grain bin
  - Semi truck
  
  - Discount (loan) rates considered
    - equal to lease internal rate of return (IRR)
    - one percent lower than lease IRR
  
  - Marginal tax rate 0-60%, with and w/o Sec. 179
    - Sec. 179 maxed out at \$19,000 at the time
    - Bonus first-year depreciation did NOT exist at the time

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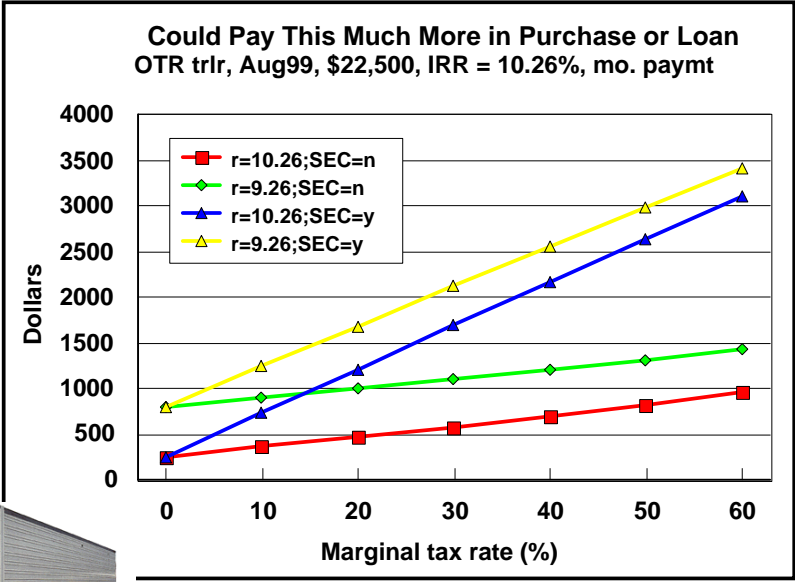


Section 179 tax advantage is important

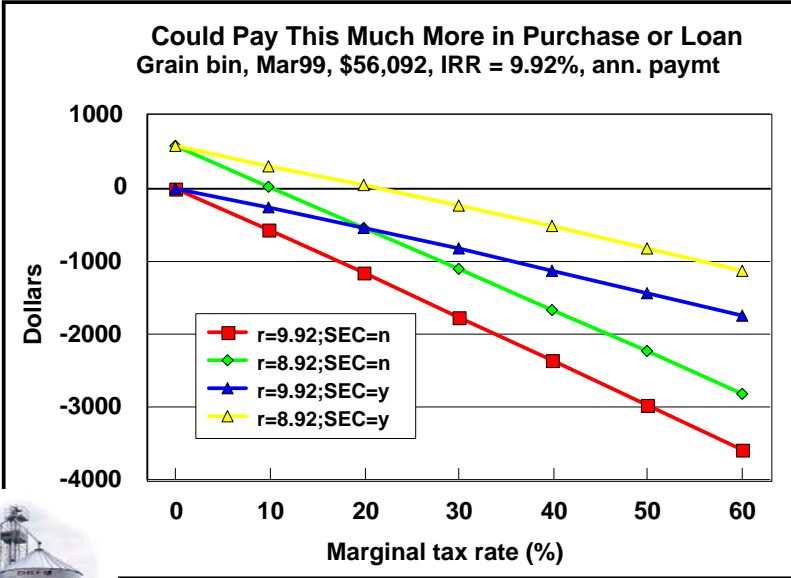
80



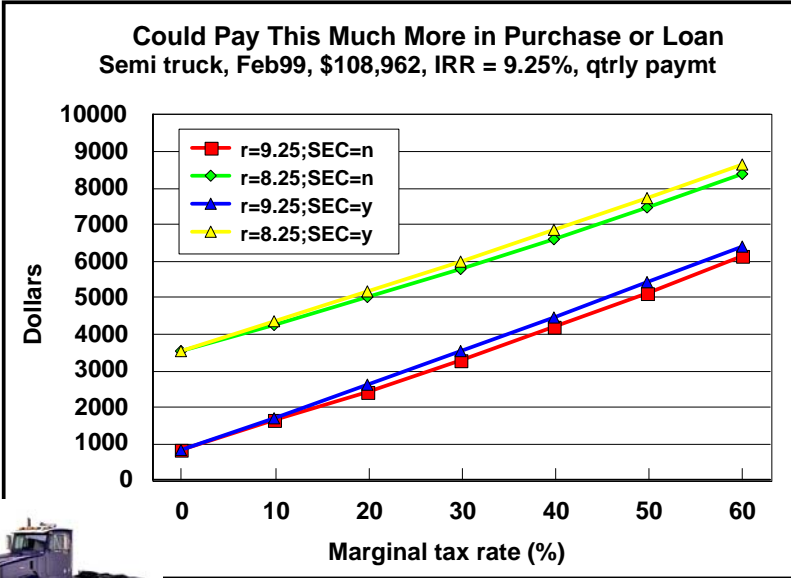
Paying more implies a disadvantage to leasing



Leasing is always at a disadvantage



Leasing is at an advantage in most cases

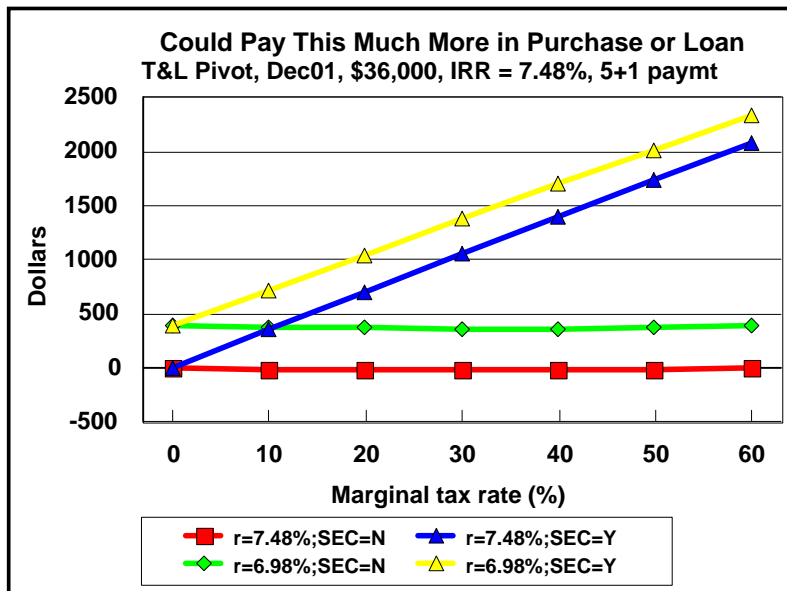


Leasing is always at a disadvantage

## T&L Pivot, etc.

- Dan's Irrigation, Iuka, KS
- Dan Manwarren
- \$36,000 – Dec. 2001
- 5-year + 1 lease
- 5 payments ( $\frac{2}{3} \times 0.197126 + \frac{1}{3} \times 0.20$ )
- Buyout (year 6) same as payment
- T&L 5-year loan = 6.98%

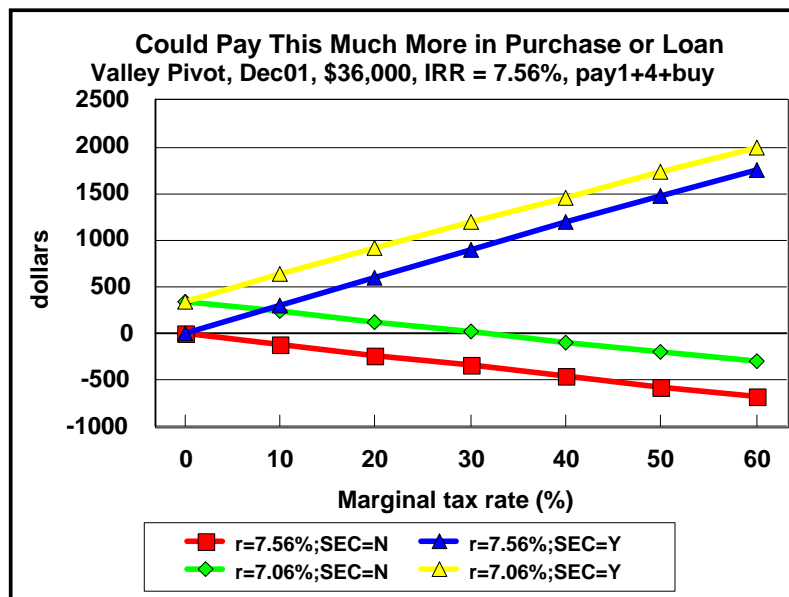
Maximum Sec. 179 was \$24,000 in 2001



Leasing is always at a disadvantage

## Valley Pivot, etc.

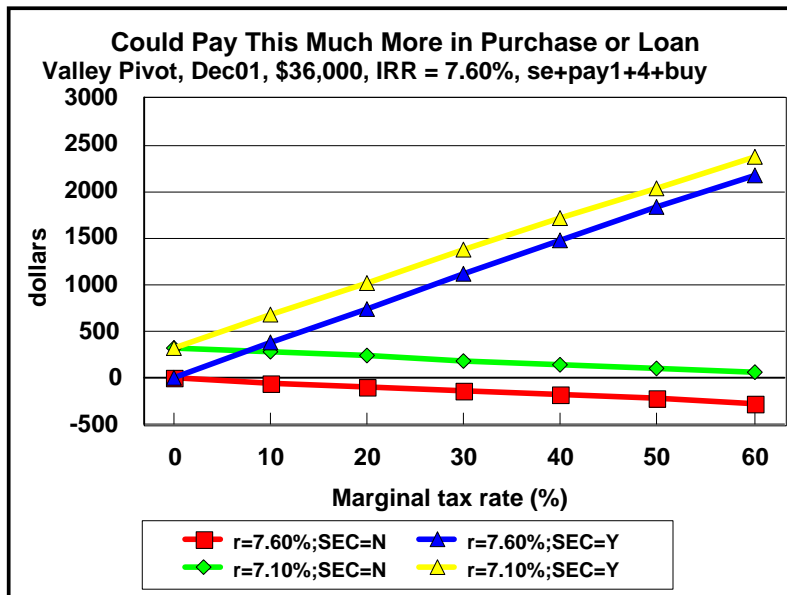
- Ag Systems, Inc., Larned, KS
- Don Schoonover
- \$36,000 – Dec. 2001
- 5-year Standard (Plan 1) lease
- 0% security deposit
- 21.419% advance payment
- 4 annual payments of 21.419%
- 10% buyout
- Valley 5-year loan = 7.32%



Leasing is sometimes an advantage

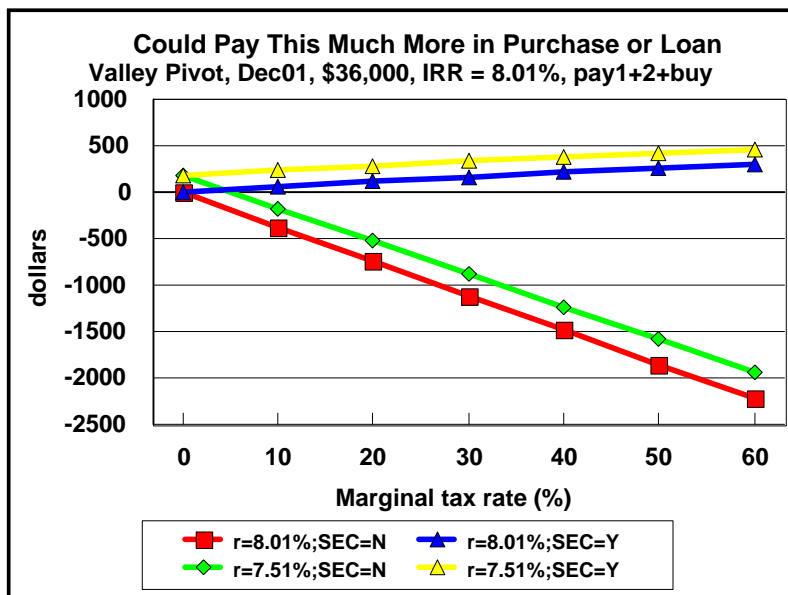
## Valley Pivot, etc.

- Ag Systems, Inc., Larned, KS
- Don Schoonover
- \$36,000 – Dec. 2001
- 5-year 10/10 (Plan 1) lease
- 10% security deposit
- 10% advance payment
- 4 annual payments of 23.941%
- 10% buyout and get back security deposit
- Valley 5-year loan = 7.32%



## Valley Pivot, etc.

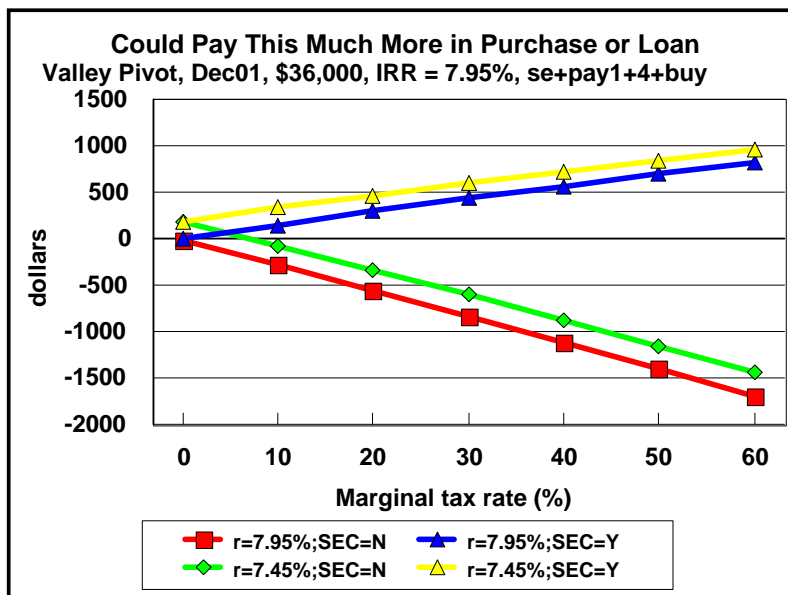
- Ag Systems, Inc., Larned, KS
- Don Schoonover
- \$36,000 – Dec. 2001
- 3-year Standard (Plan 1) lease
- 0% security deposit
- 33.079% advance payment
- 2 annual payments of 33.079%
- 10% buyout
- Valley 3-year loan = 7.49%



Leasing in a 3-year lease was often an advantage

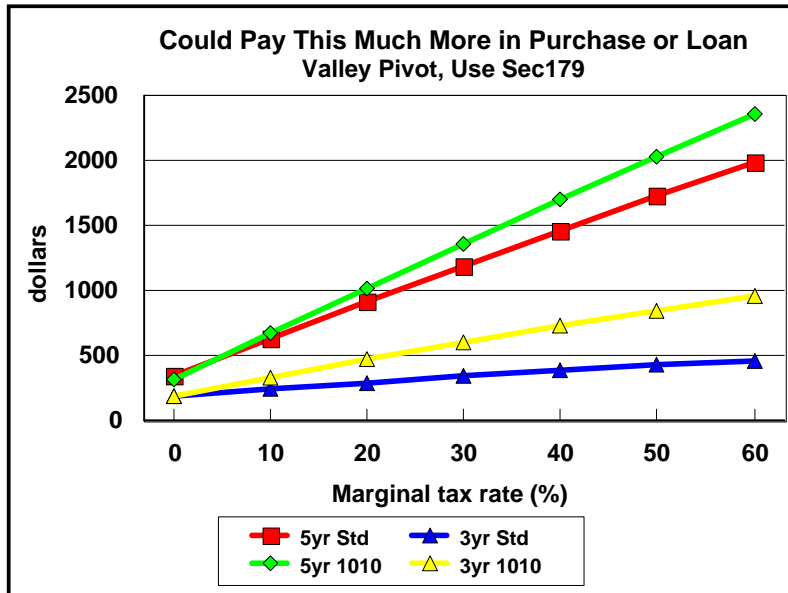
## Valley Pivot, etc.

- Ag Systems, Inc., Larned, KS
- Don Schoonover
- \$36,000 – Dec. 2001
- 3-year 10/10 (Plan 1) lease
- 10% security deposit
- 10% advance payment
- 2 annual payments of 44.829%
- 10% buyout and get back security deposit
- Valley 3-year loan = 7.49%



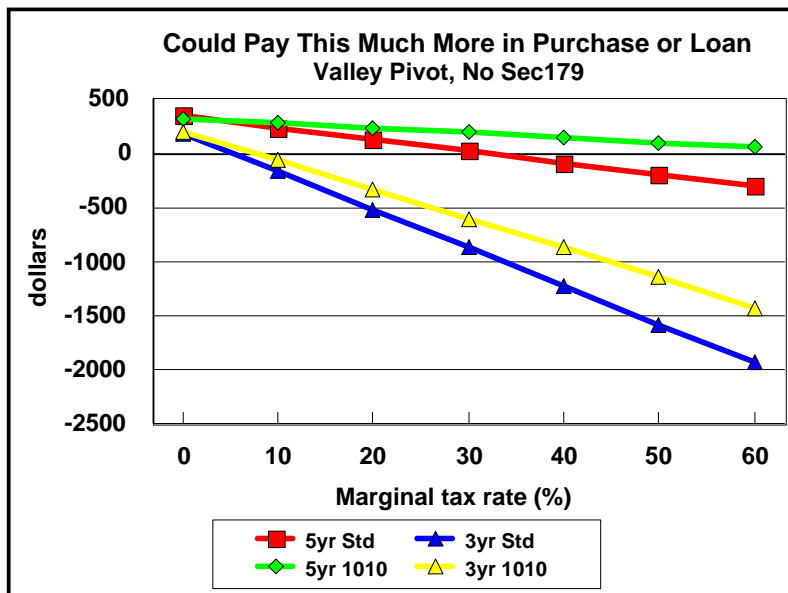
Leasing in a 3-year lease was often an advantage

## Summary of Valley Pivot, etc.



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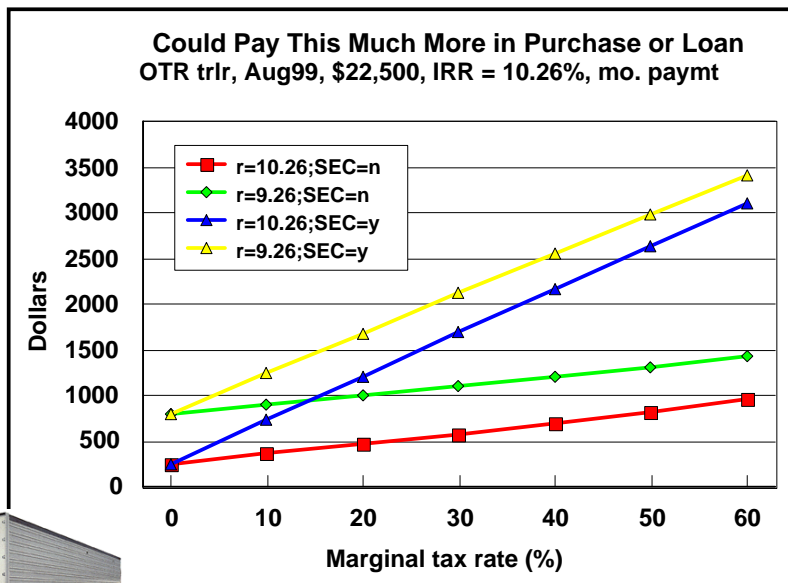
## Summary of Valley Pivot, etc.



96

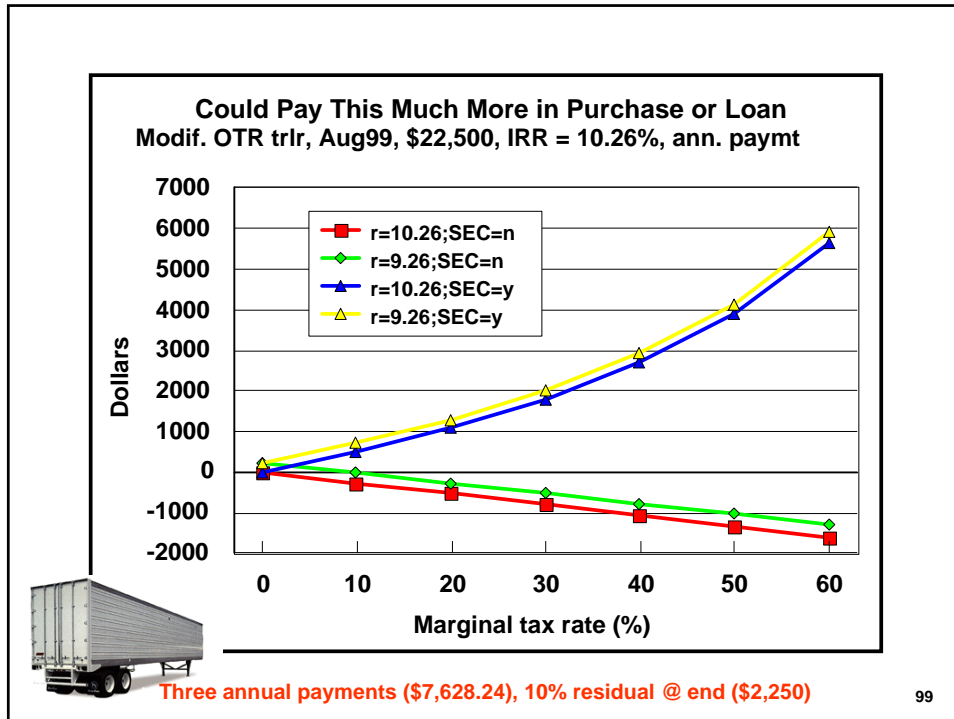
## Might a lease be modified to fit our needs?

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Monthly payments (\$419.63), 20% residual @ end (\$4,500)

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- What will large Sec. 179 and first-year bonus depreciation do to leasing companies?**
- Folks with high taxable income will be less inclined to lease
    - Before, a second purchase may have benefited from a lease (Sec. 179 was “used up”)
    - Implies a DECREASE in demand for leases
  
  - Folks with low taxable income will likely be more inclined to lease
    - Assuming leasing company passes on benefits of first-year bonus depreciation (low-income producer would not benefit from bonus depreciation directly)
    - Implies an INCREASE in demand of leases
- 100

## Lease vs. Purchase ...

*To lease or not to lease will depend on ...*

- Credit availability
- Terms of lease vs. credit terms
- Cash-flow situation
- **TAX SITUATION**
- Other ??? – asset type
  
- Your own unique situation – difference between lease and purchase will likely be small, NPV analysis will allow you to “capture” that benefit.

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## Machinery Decision Tools at [www.agmanager.info](http://www.agmanager.info)



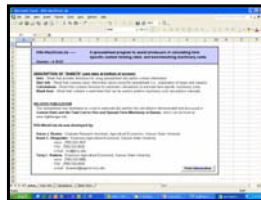
*OwnCombine.xls*



*OwnBaler.xls*



*OwnSpray.xls*



*KSU-MachCost.xls*



*OwnTractor.xls*



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## **Sprayers, tractors, combines, and balers...**

- Excel spreadsheets to help producers calculate the cost of owning and operating machinery
- **Sprayer & Combine**
  - costs per year, per hour, and per acre
- **Tractor**
  - costs per year and per hour
- **Baler**
  - costs per year, bale, ton, hour, acre
- Analysis is based on after-tax net present value of costs but summary costs are converted back to pre-tax for rent/hire comparison purposes.

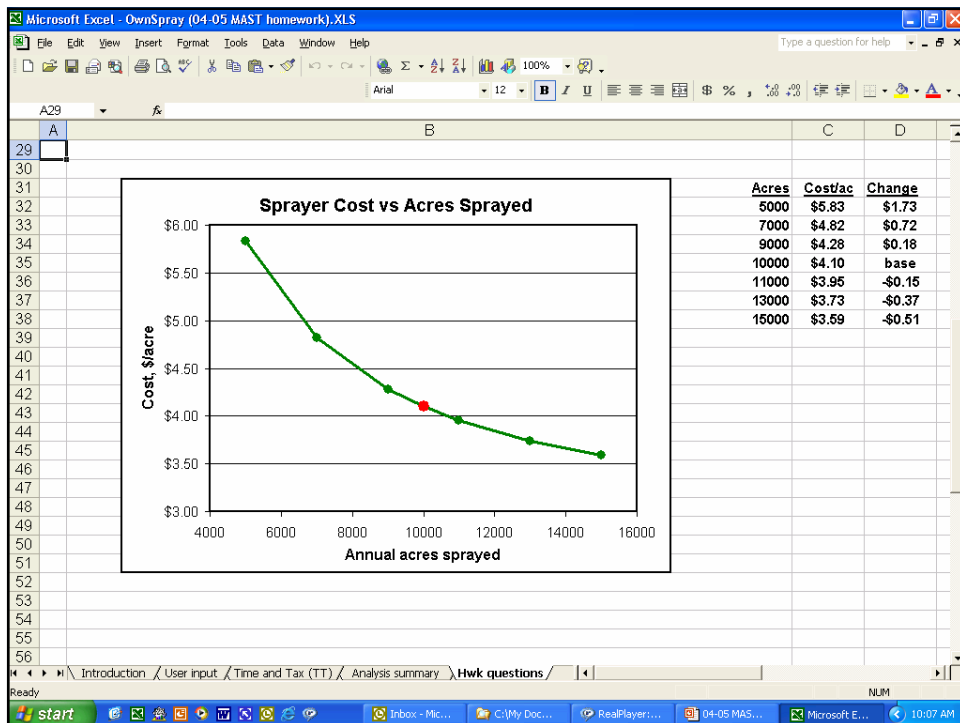
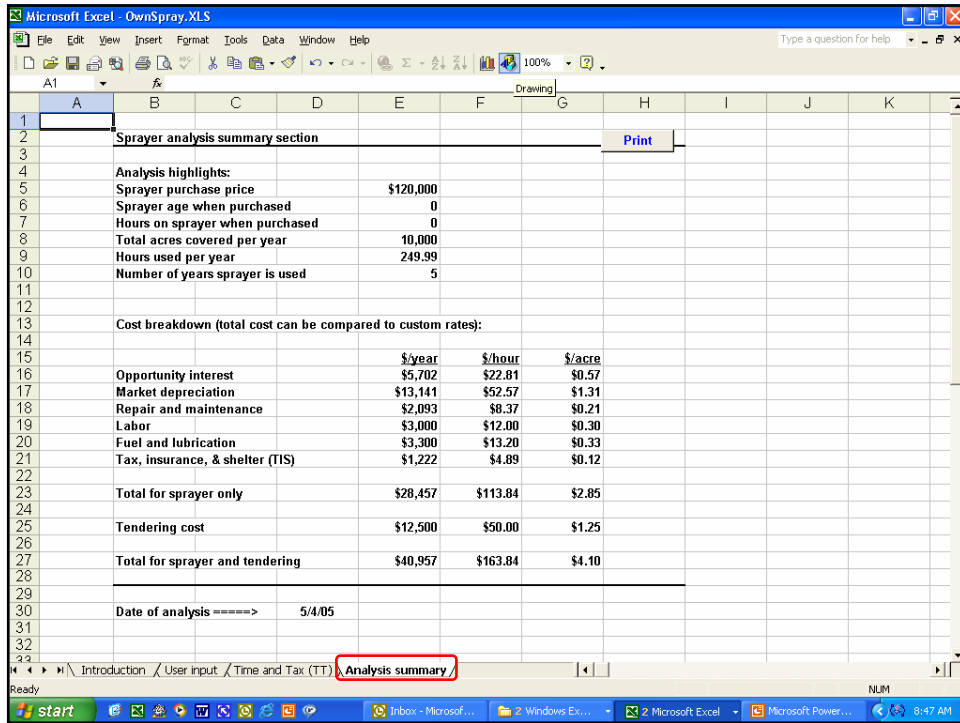
103

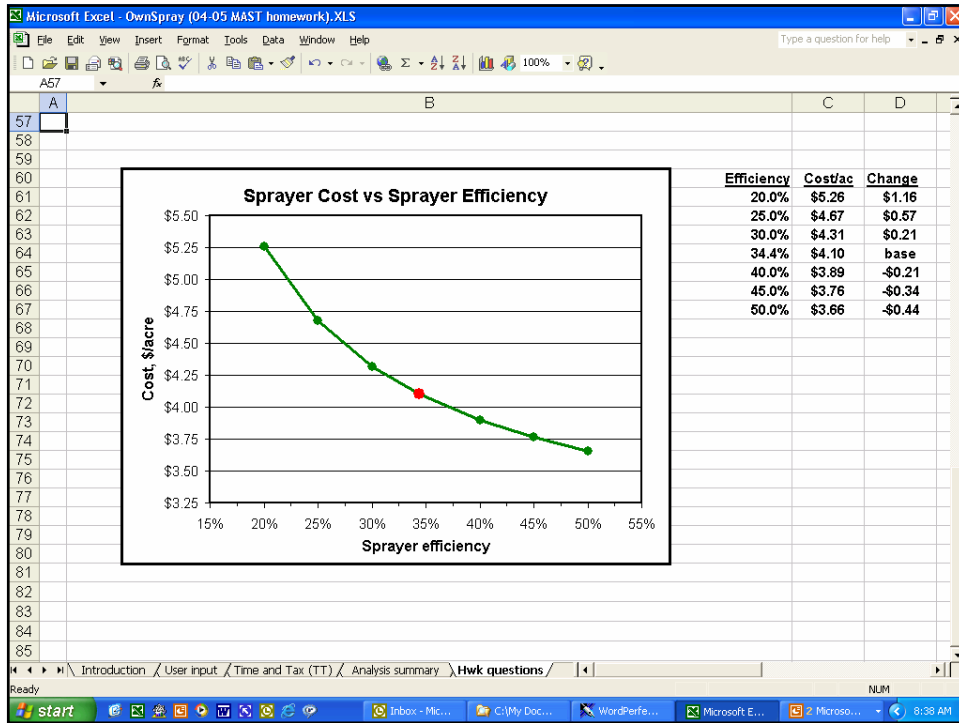
## **Using *OwnSpray.xls* -- base scenario:**

- New “medium class” sprayer cost is \$120,000
- Down payment of \$50,000 and finance rest at 7%
- Expect to use sprayer on 10000 acres/year for 5 years
- Boom width of 80 ft, travel speed of 12 mph, 250 hrs/year
- Fuel consumption of 10 gph @ \$1.20/gal (+10% for lube)
- Repairs will accumulate according to ASAE formula
- Taxes, insurance, and shelter (TIS) of 1.5% of value
- Labor cost of \$12/hr for sprayer op, \$10 for tendering
- Tendering cost of \$1/acre (plus labor)
- Income tax rate of 19% (15% fed + 4% state), SE = 15.3%
- Expect to use Sec 179 of \$50,000
- Depreciation rates are MACRS for 7-yr life asset

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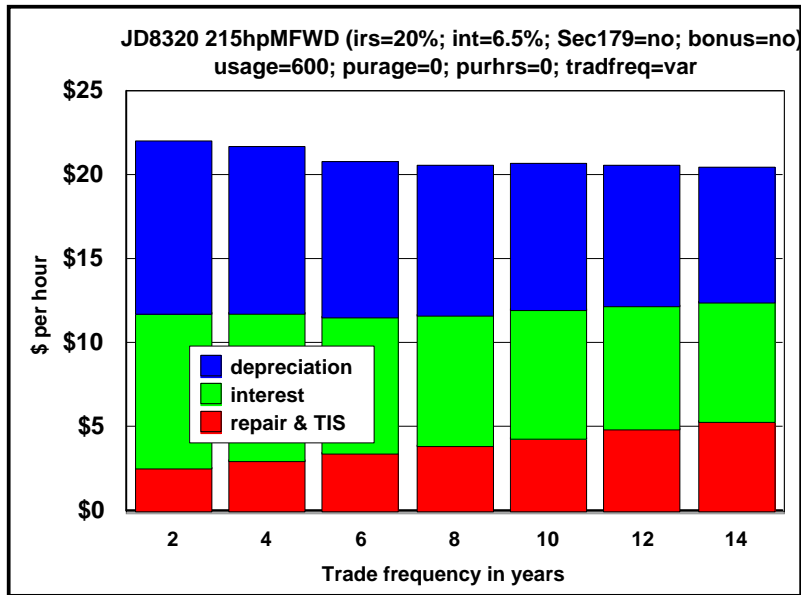




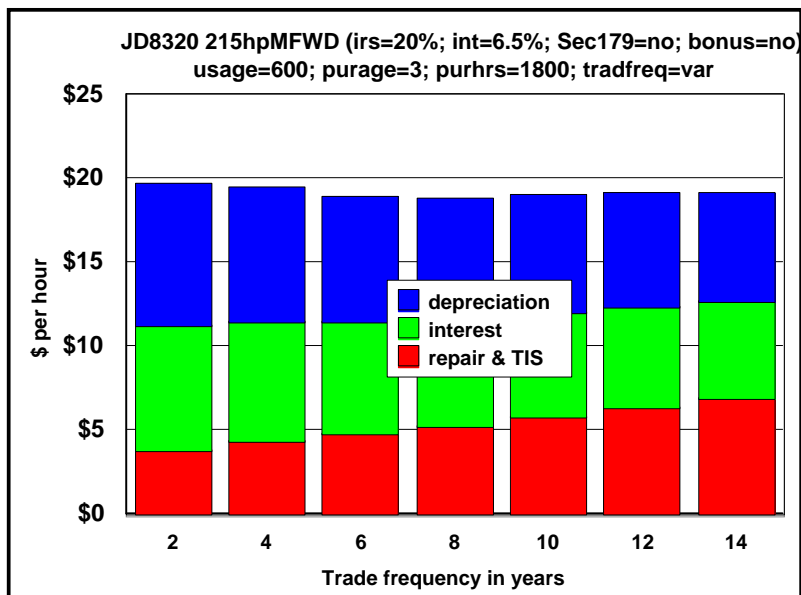
## Tractor simulation assumptions

- Built valuation models from Blue Book data
- All based on Resale Cash Price (not trade premium)
  - Since repair formulas assume tractors are “kept up”
  - Buy and sell at this market price
  - Assume old tractor is sold and new is purchased outright
- 15.3% SE tax is on top of the stated IRS/state rate
- Report cost as \$/hour to compare with rental rates
- 6.5% interest, 7-year MACRS
- Considering a tractor “like” a JD 8320 MFWD 215hp
  - The model predicts the new tractor to cost \$109,917
  - Has pto and 3 pt hitch and power shift 16/4
- No consideration of timeliness

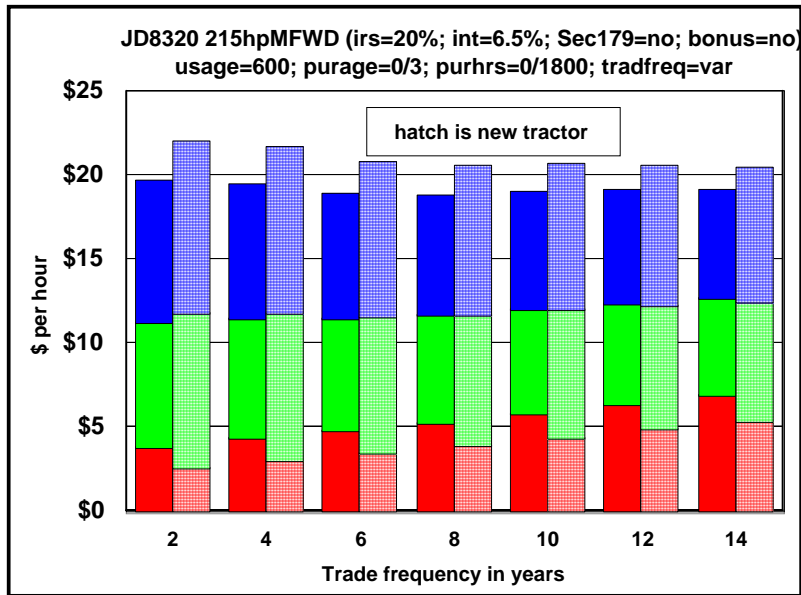




The market is fairly efficient when buy NEW and with a variable holding period

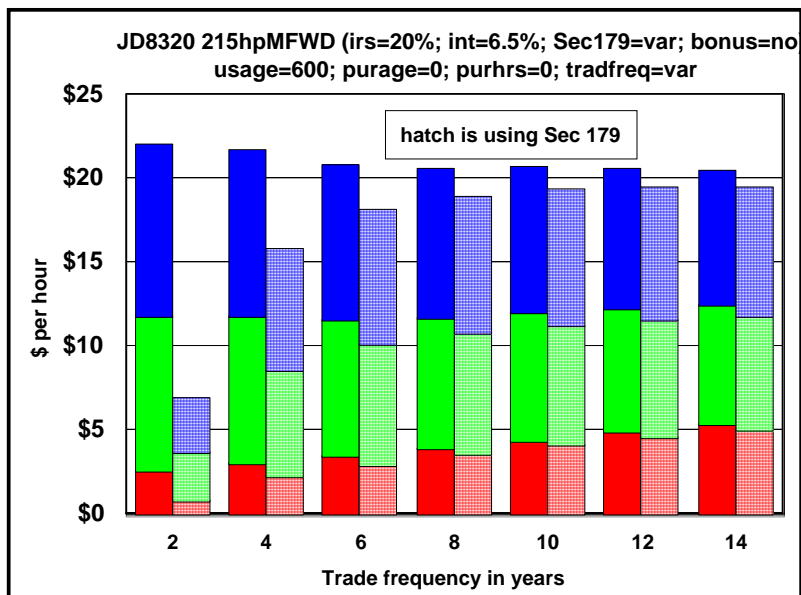


The market is fairly efficient when buy OLD and with a variable holding period



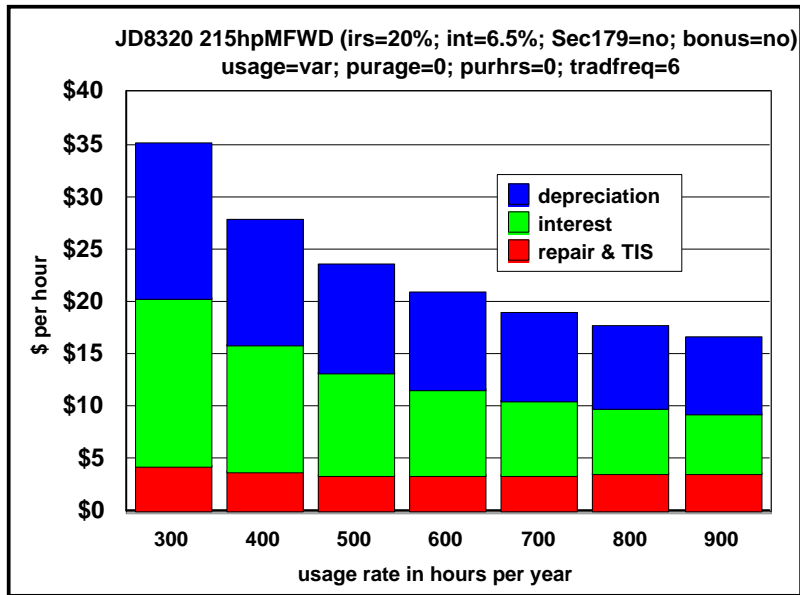
Showing new vs. used strategies

113



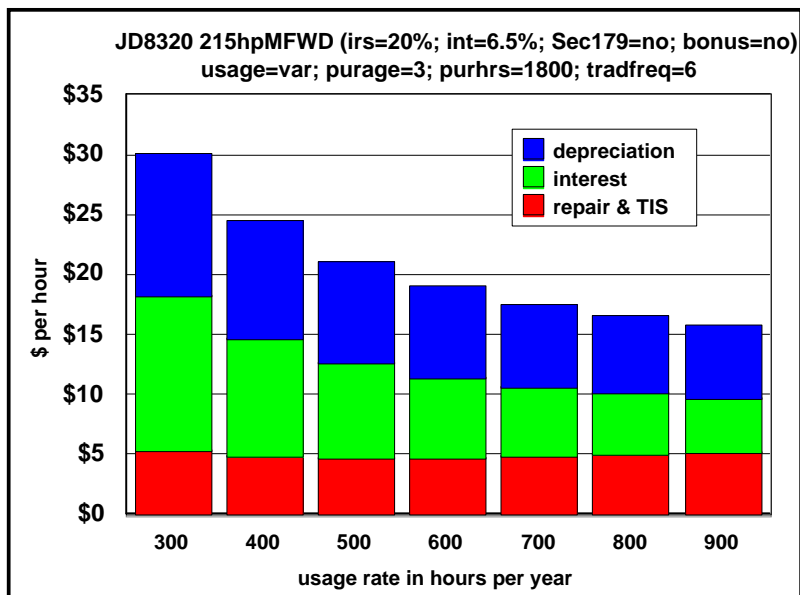
With and w/o Sec 179 on buying a new tractor – difference driven by time held.  
Do you have sufficient taxable income?

114



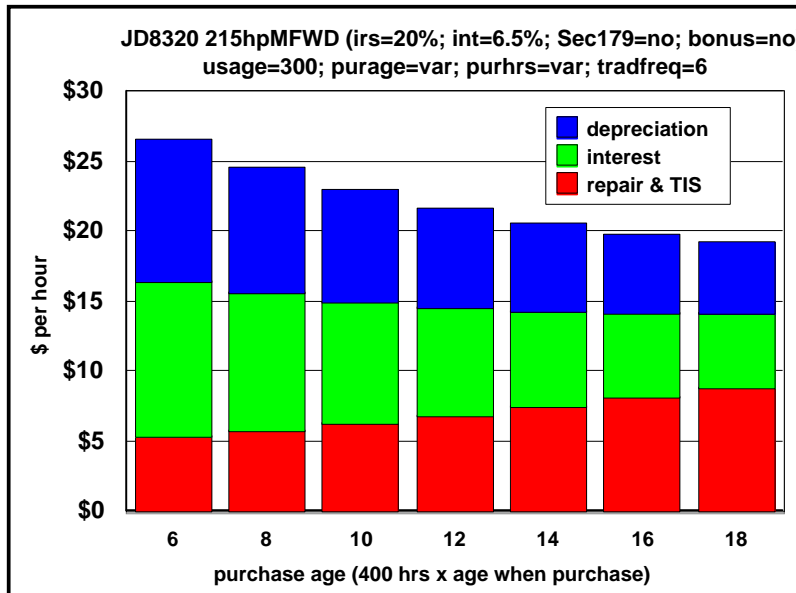
Not a trading strategy, but putting more hours on per year really pays off

115



Buying slightly used won't compensate for not putting on enough hours

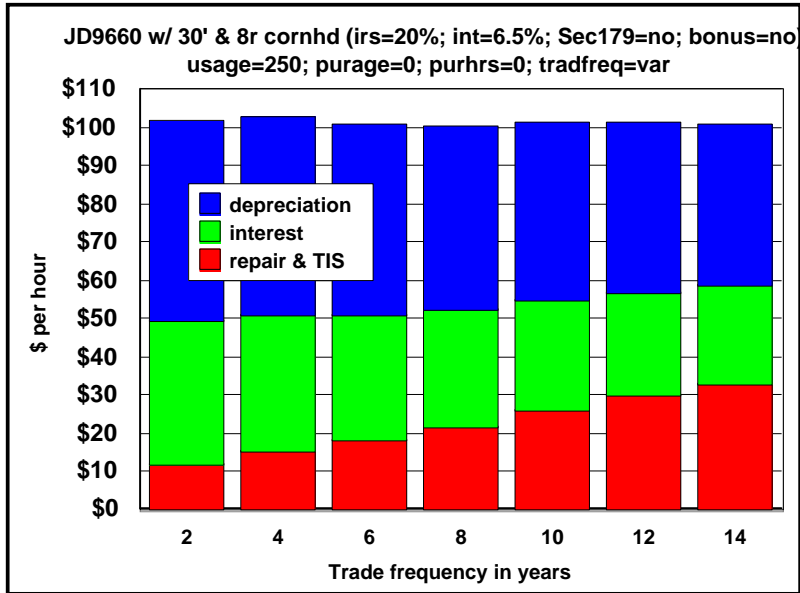
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Less intensive users can hold down costs by buying older tractors, but must be able to handle high repairs and do without newer technologies

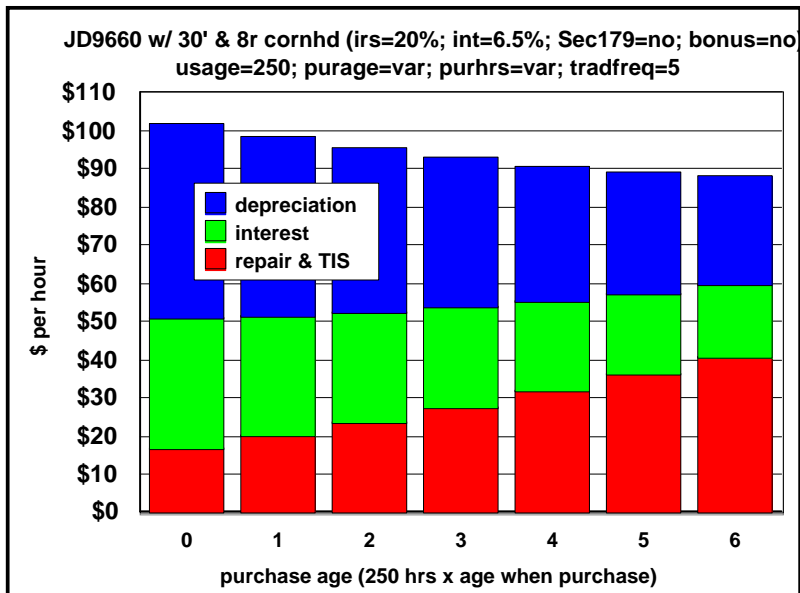
## Combine simulation assumptions

- **Combine is a JD 9660 conventional with a 30' rigid grain platform and an 8-row cornhead**
  - Based on separator hours, not engine hours
  - Separator hours are about 70% of engine hours
  - The model predicts the new combine to cost \$180,765
    - Not too far from what custom cutters would be paying
  - Has chopper, chaff spreader, and large engine



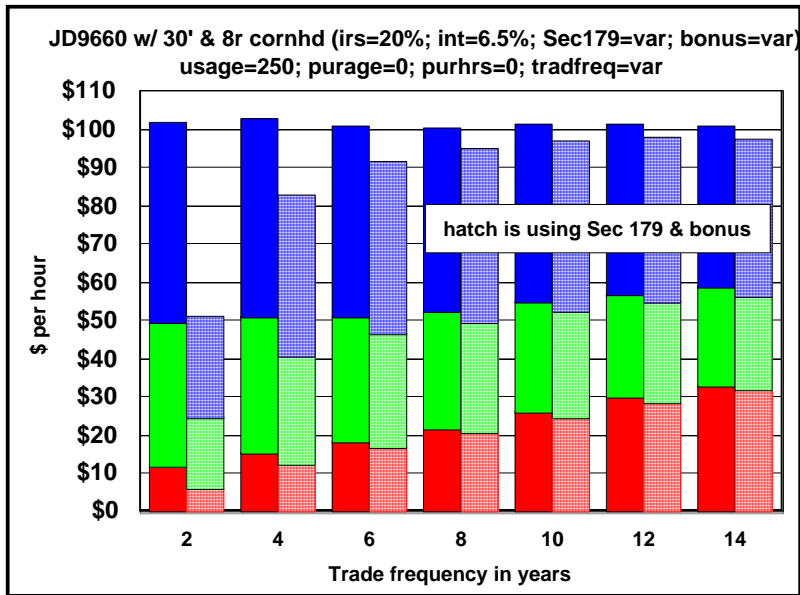
The market appears fairly efficient for holding period (repairs mount)

119

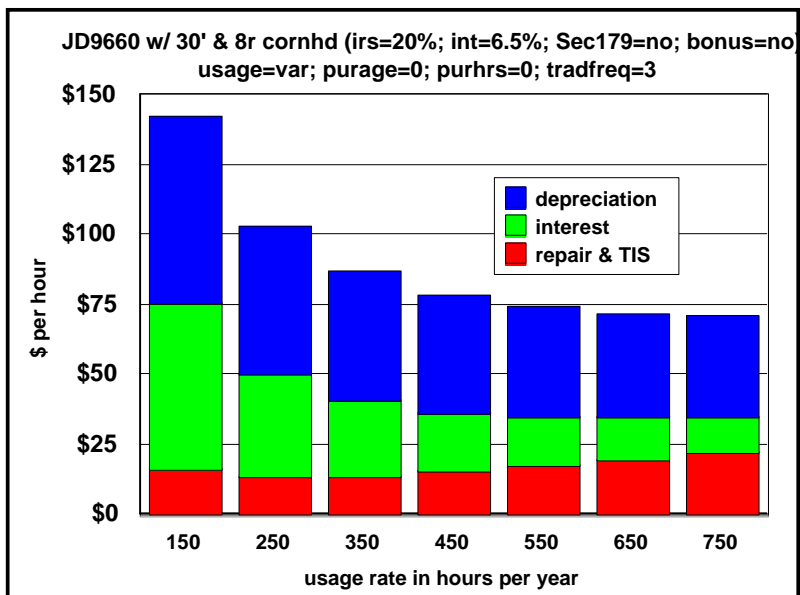


The market appears fairly efficient for purchase age (repairs mount)

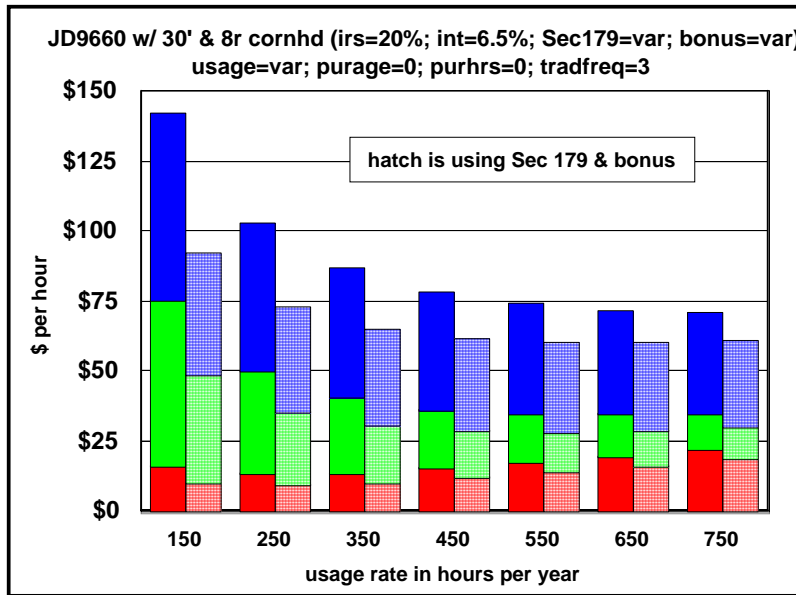
120



With and w/o Sec 179 on buying a new combine – difference driven by time held. Do you have sufficient taxable income?



Not a trading strategy, but putting on more hours per year really pays off. Should the more intensive user trade more often than 3 years? Probably.



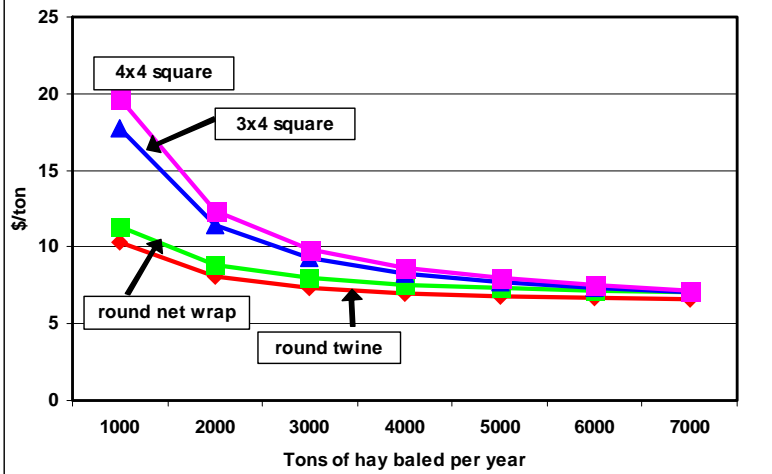
Tax advantages make the 250 hour guy similar to 600 hr guy w/o advantages

OwnBaler.xls

Cost for whole baling operation, various balers

baler = var; wrap = var; purage = 0; purbales = 0; tradfreq = 1; T/year = var; mph = 6.50

swath = 29.0; T/acre/cut = 1.20; tractor:baler hrs ratio = 1.75; labor:tractor hrs ratio = 2.00



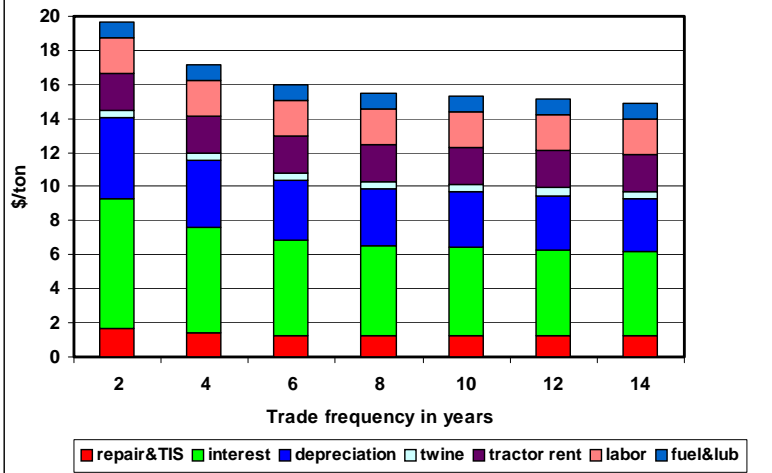
Matches approximately with custom rates in the 1500-2000 T/year range.

### OwnBaler.xls

#### Cost for whole round baling operation (twine)

5x6 round; wrap = 0%; purage = 0; purbales = 0; tradfreq = var; T/year = 240; mph = 6.50

swath = 29.0; T/acre/cut = 1.20; tractor:baler hrs ratio = 1.75; labor:tractor hrs ratio = 2.00



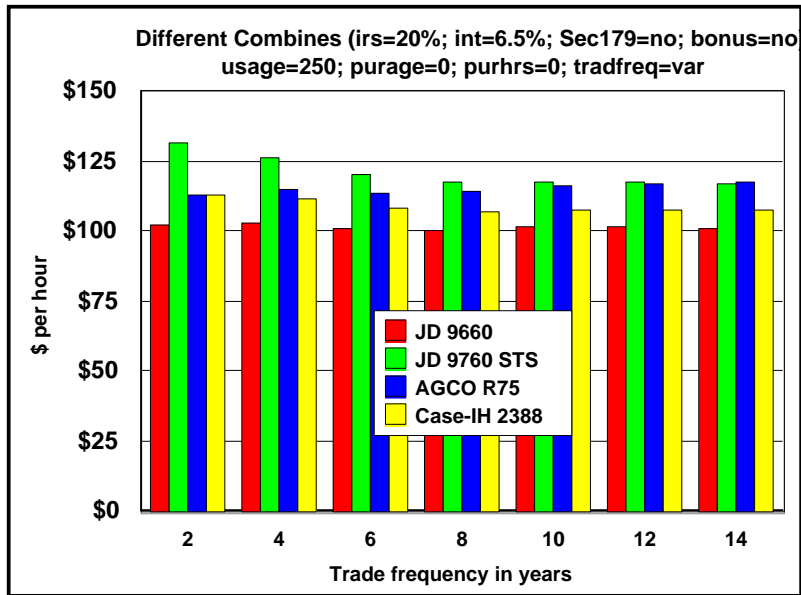
Costs seem high for this small (typical) hay operation starting with a new baler, but, really, sort of like Beaton's research showed.

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## Thinking about Sec 179 & Bonus

- **\$100,000 Section 179; 50% first-yr bonus on new**
  - Take section 179 first, then bonus, then regular depreciation
- **Do you have sufficient taxable income?**
- **Biggest gains come with short holding periods**
- **Don't buy everything in one year**
  - Section 179 goes away \$1 for \$1 after \$400,000 purchases
- **Section 179 is planned to drop to \$25,000 after 2005**
- **Bonus depreciation sunsets at the end of 2004**

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OwnCombine compares combines – but think about capacity and other features

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## Questions ???

Kevin C. Dhuyvetter  
785-532-3527  
kcd@ksu.edu

Terry L. Kastens  
785-532-5866  
tkastens@ksu.edu



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