Crop Machinery Benchmarks

By Michael R. Langemeier & Gregg Ibendahl

ABSTRACT

This paper examined crop machinery investment and cost benchmarks for a sample of Kansas farms. Crop machinery benchmarks varied widely among the farms. On average, crop machinery investment and cost were $227 and $82, respectively. Crop machinery investment and cost were significantly correlated with the interest and depreciation expense ratios, the asset turnover ratio, percent acres owned, and net machinery purchases. Crop machinery cost was also significantly correlated with crop intensity (harvested acres/crop acres). As with most machinery issues, a balance between controlling crop machinery investment and cost, and timeliness needs to be reached. This paper points out the importance of controlling investment and cost rather than investment and the cost.

Introduction

Most new technology in production agriculture is labor saving and capital intensive. This increases the importance of evaluating the efficiency of asset use. In particular, because they make up a large proportion of assets on most farms, it is important to evaluate land and machinery use (land and machinery made up 46 percent and 20 percent of total assets on Kansas Farm Management Association farms in 2012). Machinery use is the focus of this paper.

The rapid increase in machinery purchases the last several years also increases the importance of evaluating machinery use efficiency. Net machinery purchases for non-irrigated eastern Kansas farms participating in the Kansas Farm Management Association (KFMA) from 2008 to 2012 ranged from $70,398 in 2008 to $96,963 in 2010. In contrast, during the previous five-year period (2003 to 2007), net machinery purchases ranged from $32,647 in 2003 to $44,184 in 2007. Data through June of 2013 from the Association of Equipment Manufacturers indicates that sales so far in 2013 are even higher than the latest five-year average (2008 to 2012).

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Two commonly used machinery benchmarks are crop investment per acre and crop machinery cost per acre (Kay, Edwards, and Duffy, 2008). Using KFMA data for 2008-2012, crop machinery investment and cost per acre were $227 and $82, respectively. This paper examines these two benchmarks in order to determine how they affect a farm's financial performance. Relationships between crop machinery benchmarks, and farm size, financial performance, and other farm characteristics are explored.

Methods

Benchmark definitions used by the Kansas Farm Management Association (KFMA) are used in this paper. Crop machinery investment is equal to the average of the beginning and ending remaining basis values for motor vehicles, listed property, and machinery and equipment used for crop production. KFMA members, along with their economist, determine the percentage of machinery investment allocated to crop and livestock enterprises.

Crop machinery cost is 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. Notice that the crop share of the costs above is used rather than the total cost for each item. Each KFMA farm, along with their economist, computes the portion of each cost that should be allocated between the crop and livestock enterprises.

It is important to note that the basis and depreciation values used in the benchmarks above are generated using economic depreciation rather than tax depreciation. Economic depreciation is typically smaller (larger) in early (later) years of an asset's life than tax depreciation. Given the bonus depreciation and relatively large section 179 deductions allowed in recent years, the difference between economic and tax depreciation is particularly evident. Use of economic depreciation, because it does a better job of mimicking the actual decline in an asset's value, is preferable to the use of tax depreciation in the computation of machinery benchmarks.

The costs included in machinery costs for the KFMA machinery benchmark computations are similar to those discussed by previous authors (e.g., Kay, Edwards, and Duffy, 2008; Edwards, 2009; and Lazarus, 2012). Differences revolve around the exclusion of labor and inclusion of custom work income in the KFMA computations. Separating out the labor pertaining to machinery operations from labor used to market, transport, and store crops and for livestock production would improve the comparability of machinery costs across farms. However, it would be very difficult for the KFMA farms to separate this labor. Thus, labor is not included in the machinery cost benchmarks. Custom work income is subtracted from the costs to reflect the fact that machinery costs are higher due to the custom work enterprise.

Correlation coefficients are used to establish the relationship between crop machinery investment and cost per acre, and operator age, farm size, crop intensity, percent acres owned, financial

performance, and net machinery purchases. Correlation is a statistical measure of how variables move together and is bounded by -1.0 and 1.0. A value of -1.0 indicates two variables move together perfectly, but in opposite directions, while a value of 1.0 indicates two variables move together proportionally. Values close to zero indicate that two variables have little relationship to each other. It is important to note that correlation does not imply causation.

Farm size variables included in the correlation analysis were crop acres, harvested acres, total acres, and value of farm production. Crop intensity was computed by dividing harvested acres by crop acres. A farm that utilizes double-cropping would have a crop intensity index above 1.0. Financial performance variables included operating profit margin ratio, asset turnover ratio, rate of return on assets, interest expense ratio, depreciation expense ratio, operating expense ratio, total expense ratio, adjusted total expense ratio, and economic total expense ratio. All of the financial performance variables except the adjusted total expense ratio and the economic total expense ratio were computed using the Financial Guidelines for Agricultural Producers (Farm Financial Standards Council, 2008). The adjusted total expense ratio and economic total expense ratio included opportunity costs on unpaid family and operator labor, and unpaid family and operator labor and equity capital, respectively, and were computed using information in Langemeier (2013).

Data

Table 1 contains the average and standard deviation of crop machinery investment per acre, crop machinery cost per acre, and the farm characteristics that are related to the two benchmarks in the results below. Only KFMA farms designated as non-irrigated crop farms in eastern Kansas with continuous data from 2008 to 2012 were included in the analysis. A five-year period was used so that the farm characteristics related to financial performance depicted long-term benchmarks and were not as dependent on a single year. Benchmarks are typically useful if compared across similar farms. Thus, non-irrigated farms in eastern Kansas were used to illustrate the benchmarks. It is important to note that crop machinery benchmarks for farms in central and western Kansas would differ from those in eastern Kansas due to different weather patterns and less intense cropping systems used in these regions.

The KFMA program presents the two machinery benchmarks on a per-crop-acre and a per-harvested-acre basis. Where double-cropping is common, which it is for many farms in eastern Kansas, the harvested acre benchmarks would be preferable. Thus, all of the crop machinery benchmarks discussed in this paper were computed using harvested acres as the denominator.

The average crop machinery investment and cost per acre for the 302 farms in the sample were $227 and $82, respectively. Harvested acres averaged approximately 1,600 acres. The average crop intensity index was 1.074. The average value of farm production was approximately $600,000. The average operating profit margin and asset turnover ratios were 0.1613 and 0.3749, respectively. Net machinery purchases were computed by summing up machinery purchases and subtracting machinery

sales. To account for differences in farm size, net machinery purchases were divided by value of farm production. Net average purchases in relation to value of farm production averaged 0.1440.

Analysis of Benchmarks

Figure 1 illustrates the five-year crop machinery investment per acre for each farm in the sample. Crop machinery investment per acre varied widely for the sample of eastern Kansas farms. Thirty-nine of the farms had crop machinery investment that was below the average minus one standard deviation. Crop machinery investment per acre for this group averaged only $83 per acre. Forty-three of the farms had crop machinery investment that was greater than one standard deviation above the average. Crop machinery investment per acre for this group averaged $429. It is important to note that having a really low crop machinery investment per acre does not necessarily lead to high profits. These farms may be using older machinery that is not as efficient and that could prevent the farms from planting and harvesting their crop in a timely manner. Similarly, farms with a relatively high level of machinery investment per acre are not necessarily unprofitable. These farms may focus production on a capital intensive crop and may need more machinery to ensure that the planting and harvesting activities takes place in a timely manner. As with other benchmarks, crop machinery investment needs to be analyzed along with other farm benchmarks to effectively identify and mitigate problems.

As indicated in Figure 2, crop machinery cost per acre also varied widely for the sample of eastern Kansas farms. Crop machinery cost per acre ranged from $17 per acre to $226 per acre. The 39 farms with relatively low crop machinery investment per acre had an average crop machinery cost per acre of $52 while the 43 farms with relatively high crop machinery investment per acre had an average crop machinery cost per acre of $124.

Table 2 presents the correlation of operator age, farm size, crop intensity, percent acres owned, financial performance, and net machinery purchases with crop machinery investment and cost per acre. The significance level of each correlation coefficient is also presented. A significance level below 0.05 indicates that a particular variable is significant at the five percent level. A larger absolute value is indicative of a relatively more significant relationship.

The results in Table 2 indicate that older operators tend to have higher crop machinery investment and cost per acre. Given the strong positive relationship between operator age and percent acres owned, it is not surprising to also find that farms with relatively more acres owned also have higher levels of crop machinery investment and cost per acre. Crop intensity was negatively related to both crop investment and cost per acre, but this relationship was only significant for crop machinery cost per acre. Farms with a higher incidence of double-cropping had a lower crop machinery cost per acre.

The relationship between the two crop machinery benchmarks and the farm size variables was inconsistent and not significant in many instances. The only consistent and significant result for both

benchmarks was the relationship between each benchmark and total acres operated. The negative correlation coefficient on total acres operated suggests that larger farms tended to have lower levels of crop machinery investment and cost per acre.

The operating profit margin and the rate of return on assets represent profitability measures. Neither benchmark was significantly correlated with the two profitability measures. As indicated above, farms with relatively low or relatively high levels of crop machinery investment and cost per acre are not necessarily profitable or unprofitable.

Financial efficiency variables represented in Table 2 include asset turnover ratio, interest expense ratio, depreciation expense ratio, operating expense ratio, total expense ratio, adjusted total expense ratio, and economic total expense ratio. The asset turnover ratio and interest expense ratios were significant and negatively related to both crop machinery benchmarks. A lower asset turnover ratio would suggest that a farm is not using its asset base as efficiently as a farm with a higher asset turnover ratio. Thus, the negative relationship between the two crop machinery benchmarks and the asset turnover ratio suggests that farms with higher levels of crop machinery investment and cost were not using assets as efficiently as farms with lower levels of these two benchmarks. The negative relationship between the two crop machinery benchmarks and the interest expense ratio seems counter-intuitive at first glance. If farms are purchasing machinery with borrowed funds, we would expect there to be a positive relationship between the two crop machinery benchmarks and the interest expense ratio. However, we need to keep in mind that the 2008 to 2012 period was a very profitable period. With this mind, the negative relationship suggests that farms with low levels of debt tended to purchase more machinery than farms with higher levels of debt. Farmers may have used machinery purchases as a way of lowering taxable income. The profitability experienced during the study period created the cash flow that allowed the farms with low levels of debt to purchase assets and not necessarily incur substantial increases in debt.

It is not surprising to find a positive relationship between net machinery purchased and the two crop machinery benchmarks. This variable is included in Table 2 so that the reader notes that aggressively purchasing machinery will lead to relatively higher levels of crop machinery investment and cost. Again, machinery investments do not necessarily lead to lower profit. If machinery purchases lead to increased efficiency, farm expansion, or timeliness; profitability may increase.

Concluding Comments

This paper examined crop machinery benchmarks for a sample of Kansas farms. The average crop machinery investment and cost per acre for 2008-2012 were $227 and $82, respectively. Crop machinery investment and cost were significantly correlated with the interest and depreciation expense ratios, the asset turnover ratio, percent acres owned, and net machinery purchases. Crop machinery cost was also significantly correlated with crop intensity (harvested acres/crop acres).

As farms consolidate and expand, machinery size increases. Also, it is important to note that the above average profitability of crop farms and tax incentives (i.e., bonus depreciation and section 179 deduction) since 2007 have led to increases in machinery purchases. These two factors have increased the importance of monitoring the benchmarks discussed in this paper.

There are several potential strategies that can be used to control crop machinery investment and cost per acre. These strategies include using smaller machinery, increasing annual machine use, holding onto machinery longer before trading, purchasing used machinery, using alternatives to ownership such as custom hire, and farming more intensely (e.g., increasing double-cropping). Of course, many of these factors may decrease timeliness, which could be particularly detrimental during planning and harvesting seasons. Thus, as with most machinery issues a balance between controlling machinery investment and cost, and timeliness needs to be reached. This paper points out the importance of controlling the investment and cost rather than investment and the cost.

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Table 1. Summary Statistics for Sample of Eastern Kansas Farms

Item	Average	Standard Deviation
Crop Machinery Benchmarks		
Crop Machinery Investment per Acre	226.89	107.79
Crop Machinery Cost per Acre	82.26	29.41
Farm Characteristics		
Age of Operator	57.38	10.97
Crop Acres	1,473	1,043
Harvested Acres	1,601	1,176
Total Acres	1,885	1,308
Crop Intensity	1.074	0.124
Percent Acres Owned	0.3678	0.2889
Value of Farm Production	604,276	530,501
Operating Profit Margin Ratio	0.1613	0.1814
Asset Turnover Ratio	0.3749	0.2039
Rate of Return on Assets	0.0652	0.0642
Interest Expense Ratio	0.0379	0.0345
Depreciation Expense Ratio	0.0824	0.0354
Operating Expense Ratio	0.6078	0.1091
Total Expense Ratio	0.7282	0.1264
Adjusted Total Expense Ratio	0.8766	0.1910
Economic Total Expense Ratio	1.0914	0.2980
Net Machinery Purchases / Value of Farm Production	0.1440	0.0750

Source: 2012 Kansas Farm Management Association Databank.

Table 2. Correlation Coefficients Between Crop Machinery Benchmarks and Farm Characteristics

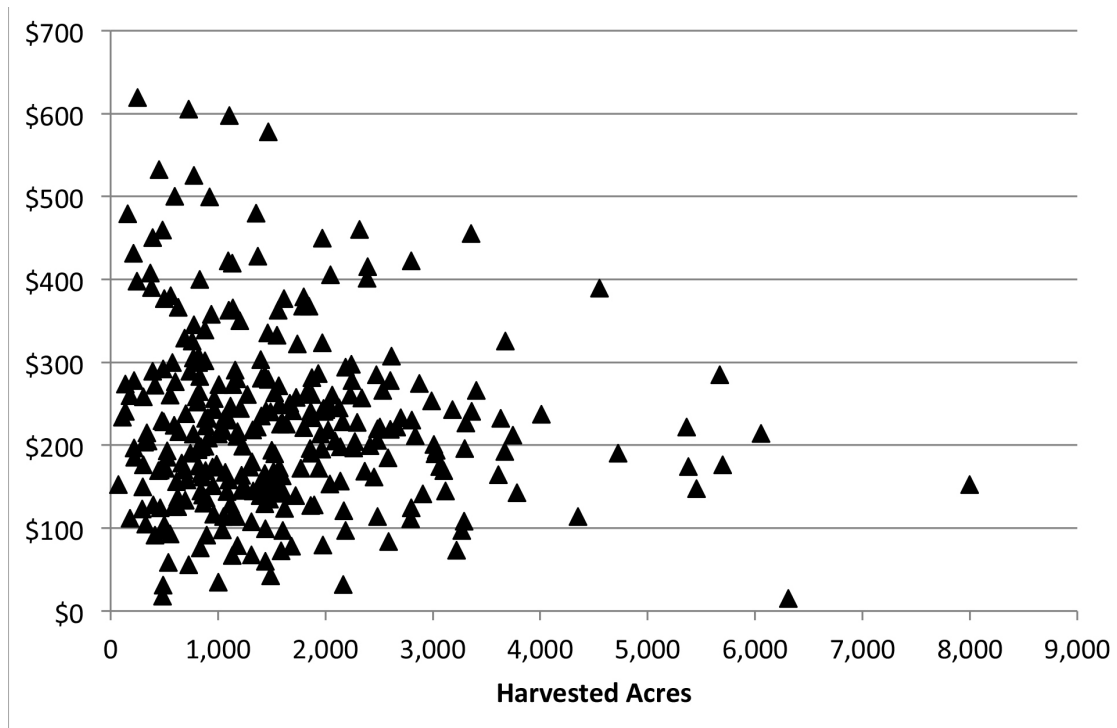| Item	Machinery Investment	Significance (p-value)	Machinery Cost	Significance (p-value)
Operator Age	0.201	0.001	0.170	0.003
Crop Acres	-0.091	0.113	-0.109	0.059
Harvested Acres	-0.103	0.075	-0.125	0.030
Total Acres	-0.137	0.017	-0.150	0.009
Crop Intensity	-0.105	0.068	-0.181	0.002
Percent Acres Owned	0.258	< 0.0001	0.240	< 0.0001
Value of Farm Production	0.110	0.056	0.114	0.048
Operating Profit Margin Ratio	0.096	0.095	-0.027	0.644
Asset Turnover Ratio	-0.236	< 0.0001	-0.149	0.010
Rate of Return on Assets	0.027	0.639	-0.063	0.278
Interest Expense Ratio	-0.248	< 0.0001	-0.173	0.003
Depreciation Expense Ratio	0.618	< 0.0001	0.441	< 0.0001
Operating Expense Ratio	-0.231	< 0.0001	0.075	0.196
Total Expense Ratio	-0.094	0.102	0.141	0.014
Adjusted Total Expense Ratio	-0.136	0.018	-0.006	0.919
Economic Total Expense Ratio	0.094	0.103	0.120	0.038
Net Machinery Purchases / Value of Farm Production	0.373	< 0.0001	0.208	0.000

Figure 1. Crop Machinery Investment per Acre

Figure 2. Crop Machinery Cost per Acre