

# Land Leasing and Debt on Farms: Substitutes or Complements?

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## **Abstract**

### **Land Leasing and Debt on Farms: Substitutes or Complements?**

Theoretically, leasing and debt are thought to be substitutes. This assumes that a lease payment, which is a fixed obligation like a loan, displaces debt and reduces debt capacity, i.e., if firms have optimal debt to equity ratios, then, to the extent that it represents “off-balance sheet” financing, leasing reduces debt capacity. Ang and Peterson—the seminal work in the literature—fit Tobit models with 1976 to 1981 data from 600 firms in which a leasing to book value of equity ratio is the dependent variable and a debt to book value of equity ratio and other variables are the explanatory variables. Contrary to expectations, their model results indicate that leasing and debt are complementary activities. This study follows the Ang and Peterson methodology, but utilizes a set of firms which are distinct from those of earlier studies—non-corporate U.S. commercial farms—to test a land leasing-debt substitution hypothesis. An advantage of the land lease example is that by focusing on a single industry—production agriculture—the problem of potential industry affects is substantially reduced. In a departure from earlier studies, the issue of whether the leasing-debt relation is sensitive to heterogeneous firm characteristics and shifting business conditions is examined.

OLS leasing models corrected for heteroskedasticity are fit with 1977 through 1992 Kansas farm-level data in which a leasing ratio is the dependent variable and a debt ratio and other explanatory variables serve as independent variables. The models account for fixed time and farm type effects. Results strongly indicate that land leasing and debt are substitutes, albeit not dollar for dollar. A coefficient estimate of about -0.43 on the total asset full sample model indicates that on average, leasing decreases by \$0.43 for each dollar of debt incurred. The rate at which farms

substitute leasing for debt is sensitive to heterogenous farm characteristics and shifting farm business conditions. The cross-section sample split results offer some evidence that farms which are thought to be a priori more credit constrained substitute debt for leasing at a higher rate than farms which are thought to be a priori less credit constrained. All of the sample split results however, are consistent, with the notion that in order to push the leasing ratio to higher levels, leasing must substitute for debt at increasingly higher levels.

# **Land Leasing and Debt on Farms: Substitutes or Complements?**

## **Introduction**

Theory indicates that leasing and debt are substitutes (Myers, Dill, Bautista; Ross, Westerfield, and Jaffe). This assumes that a lease payment, which is a fixed obligation like a loan, displaces debt and reduces debt capacity, i.e., if firms have optimal debt to equity ratios, then, to the extent that leasing represents “off-balance sheet” financing, it reduces debt capacity. The leasing-debt substitution hypothesis has been empirically tested in the corporate finance literature with leasing models fitted with firm-level corporate data. Ang and Peterson—the seminal work in the literature—fit tobit models with 1976-81 data from 600 U.S. firms. Contrary to theory, model results indicate that leasing and debt are complementary. Ang and Petersen suggest that inefficient capital markets, and differences in tax brackets and the debt between leasing and nonleasing firms may be responsible for the complementary leasing-debt relation.

Subsequent studies attribute Ang and Petersen’s unexpected results to several shortcomings in the study. Ang and Petersen’s data set contains firms from diverse industries and therefore diverse debt capacity. Critics believe that the addition of the non-debt explanatory variables do not adequately control for diverse debt capacities which may explain the complimentary relation found between debt and leasing. A second criticism of Ang and Peterson is that they fail to include operating leases, focusing exclusively on capital leases. Graham, Lemmon, and Schallheim indicate that this may be a serious omission. Finally, Ang and Peterson use debt and leasing to equity ratios while other studies normalize debt and leasing with total assets. Normalizing by equity and total assets may lead to different results, especially when leasing and debt comprise a substantial portion of total assets.

Several studies seek to remedy the problems associated with Ang and Peterson’s study.

Finucane normalizes leasing and debt with total assets. Adams and Hardwick use a U.K. data set in which they define leasing to include operating and financial leases, and leasing and debt are normalized by total fixed assets. Similarly, Marston and Harris, who examine changes in leasing and debt financing, rather than levels, include both capital and operating assets, and normalize leasing and debt with total assets. Erickson includes capital and operating assets and accounts for differences in debt capacity with industry dummy variables. Like Ang and Peterson, Finucane, and Adams and Hardwick, find leasing and debt to be substitutes, while Marston and Harris, and Erickson conclude that leasing and debt are substitutes.

The current study further examines the leasing puzzle by examining the substitution of agricultural land leasing for debt on non-corporate U.S. commercial farms. Farms are interesting examples because they are representatives of the vast number of small privately-held firms—a group which has been ignored in the literature. In numbers, farms lead all other types of firms and they lease at high levels. In 1997 there were 1.9 million U.S. farms and 43% of agricultural acreage was leased. Sharpe and Nguyen indicate that credit constraints and leasing are positively related. Thus, farms should be prime candidates to lease assets—of which land is the most important—because farms are capital intensive and under pressure to expand due to ever expanding economies of scale, and farms are thought to have limited borrowing capacity and access to equity markets (Bierlen and Featherstone).

The study remedies several of the shortcomings found in Ang and Peterson. By focusing on a single industry—U.S. production agriculture—in a single state, the problem of divergent debt capacities should be greatly reduced. To further account for divergent debt capacity, the model accounts for heterogeneous farm enterprises following Erickson. The study accounts for the bulk of farm leasing activity—land leasing. A second form of leasing—equipment and machinery

capital leases—is relatively unimportant. In a departure from previous studies, following the credit constraint literature, separate leasing models are estimated for sets of farms with differential access to credit (see, e.g., Fazzari, Hubbard, and Petersen; Gilchrist and Himmelberg; and Bierlen and Featherstone. Farms with less access to credit due to greater asymmetry of information and agency problem should substitute leasing for debt at higher rates.

### **Farm Sample**

The data consist of 417 Kansas farms which were continuously enrolled in the Kansas Farm Management Association (KFMA) program from 1973 through 1992.<sup>2</sup> The group of 417 farms is not a random sample of Kansas farms because KFMA farms tend to be larger than non-KFMA farms and participation is voluntary. Because of the relatively large size of KFMA farms, the results of this study are considered to be representative of commercial or full-time operator farms. Eight farms are dropped from the sample because of low equity levels, leaving 409 farms in the sample.<sup>3</sup>

1992 leasing and debt ratio means are presented in Table 1 for the 409 Kansas farms. The ratios are estimated for ‘total assets’ and ‘land assets.’ The denominators in the total asset ratios include all owned and leased assets and debt is total debt. The denominators in the land asset ratios include owned and leased land assets and debt is long-term debt. Unlike Compustat firms, the preponderance of the farms lease. Land is leased in 6044 of 6544 farm-years or, in over 92.3% of farm-years. Leased land is an important component of the typical asset portfolio, comprising 39.3% of total assets and 53.1% of land assets.<sup>4</sup> As expected, the leasing to total

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<sup>2</sup>See Langemeier for a description of the raw KFMA farm variables.

<sup>3</sup>Since several variables are normalized by assets, the inclusion of these farms creates problems associated with outliers.

<sup>4</sup>Total assets refers to owned assets plus leased land.

asset ratio is the highest for crop farms at 0.439. Dairy farms have the lowest leasing to total asset ratio at 0.277. Mean debt levels are moderate. The mean debt to owned asset ratio is 0.291 and the mean debt to total asset ratio is 0.166.

The means of the leasing and debt to total asset ratios and the means of the leasing and debt to land asset ratios by leasing quartiles indicate that leasing and debt are substitutes.<sup>5</sup> While the mean leasing to total asset ratio increases monotonically from 0.111 in the first quartile to 0.815 in the fourth quartile, the mean debt to total asset ratio monotonically falls from 0.201 in the first quartile to 0.089 in the fourth quartile. However, the mean debt to owned asset ratio monotonically increases in moving from the first to fourth quartiles. The relationships are similar for the land asset ratios found in the bottom half of the table.

### **Leasing Model**

Following the literature, the relation between the leasing and debt ratios is defined as:

$$DR_o = DR_l + \alpha LR_l \quad (1)$$

where,  $DR_o$  is the debt to total asset ratio of a farm which owns all of its land,  $DR_l$  is the debt to total asset ratio and  $LR_l$  is the value of leased land to total asset ratio of a similar farm which leases some or all of its land, and  $\alpha$  is the extent to which leasing substitutes for (or complements) debt or the debt to lease displacement ratio. If leasing substitutes for debt dollar for dollar, the testable hypothesis is that the debt to lease displacement ratio is equal to one. If leasing and debt are substitutes, but not on a dollar for dollar basis, then the debt to lease displacement ratio should be strictly positive, but less than one. Klein, Crawford, and Alchian indicate that leased assets are riskier than owned assets—increasing bankruptcy and liquidity costs—thus pushing the

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<sup>5</sup>The quartiles in the total assets section are based on the leasing to total asset ratio and in the land assets section on the leasing to land assets ratio.

displacement ratio beyond one. A negative debt to lease displacement ratio, of course, indicates that leasing and debt are complementary.

Equation (1) can be rewritten as:

$$DR_0 = DR_1 + \alpha LR_1 = f(x_1, x_2, \dots, x_k), \quad (2)$$

where  $f(\cdot)$  is a function of lessee explanatory variables which control for debt capacity. Ignoring the  $DR_0$  term which is unknown, subtracting  $DR_1$  from both sides and dividing through by  $\alpha$  results in the general form of the estimable model of interest:

$$LR_1 = -(1/\alpha)DR_1 + (1/\alpha)f(x_1, x_2, \dots, x_k) \quad (3)$$

Equation (3) is a non-structural model developed by Ang and Peterson with use by subsequent leasing-debt substitution studies. Relying on past studies with appropriate changes to agriculture and following equation (3), the actual econometric model to be estimated for farm  $i$  at time  $t$  is:

$$LR_{it} = \gamma_1 DR_{it} + \gamma_2 SIZE_{it} + \gamma_3 AGE_{it} + \gamma_4 LIVESTOCK_{it} + \gamma_5 PROFIT_{it} + \gamma_6 LIQUIDITY_{it} + \delta_i + \mu_t + \epsilon_{it} \quad (4)$$

where,

LR	= beginning period leasing to asset ratio;
DR	= beginning period debt to asset ratio;
SIZE	= beginning period market value of total assets;
AGE	= beginning period age of the principal operator;
LIVESTOCK	= beginning period market value of feeder livestock to total inventories;
PROFIT	= return on capital assets in the previous year;
LIQUIDITY	= beginning period current ratio;
$\delta$	= is a vector of dummy variables to capture fixed farm type effects; and
$\mu$	= is a vector of dummy variables to capture fixed time effects. <sup>6</sup>

SIZE, AGE, LIVESTOCK, PROFIT, and LIQUIDITY are added to the model to control

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<sup>6</sup>There are 13 farm types. These include dryland cash crop, irrigated cash crop, cow-sheep herd, dairy, cattle backgrounding, cattle feeding, cashcrop/cattle backgrounding, hog production, cash crop/cows-sheep, general farm, cash crop/hog production, cash crop/cattle finishing, and cattle finishing/hog production. In specialty farms at least 70% of labor is utilized in that specialty area. In crop/livestock farms at least 35% of labor is used in livestock production and 35% in crop production. General farms do not fit either of these two criteria.

for debt capacity. The expected sign on the SIZE coefficient estimate is indeterminate. The credit constraint literature indicates that larger firms have lower asymmetry of information problems and thus are able to borrow at higher levels. This indicates that the lease ratio is inversely related to size. However, USDA (1992) statistics indicate that there is a positive relation between total assets and leasing. The expected sign on AGE is negative because it is thought that over a farmer's life cycle the land portfolio is made up of ever increasing percentages of owned land while the percentage of leased land decreases. A priori we are uncertain about the sign on the LIVESTOCK coefficient estimate. The LIVESTOCK coefficient may be negative because livestock farms by their nature are less land intensive than crop farms, thus leased land should be a smaller portion of their total asset portfolio than crop farms. However, because livestock production typically needs high levels of short-term borrowing, livestock farms may need to lease more land relative to crop farms in order to stay within their borrowing limits. The expected signs of the PROFIT and LIQUIDITY signs are indeterminate. If leasing produces higher cash flows than owning land, PROFIT and LIQUIDITY should increase with leasing levels. However, farms with higher cash flows, and thus more internal funds, should be better able to purchase land.

### **Full Sample Model Results**

Full-sample OLS leasing model coefficient estimates are reported for in table 2.<sup>7</sup> Two-sided coefficient p-values are reported in parenthesis. To correct for potential heteroskedasticity, common in panel data, the multiplicative heteroskedasticity approach of Harvey (1976) is followed. All models are estimated with time and farm type dummy variables whose coefficient

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<sup>7</sup>Due to the low number of farms which do not lease (7.6%), the differences in estimate values from Tobit are likely negligible. Moreover, attempts to use Tobit with a correction for heteroskedasticity were unsuccessful because of convergence difficulties.

estimates are not reported due to space considerations.

The DR coefficient estimate is negative and highly significant. This supports the hypothesis that leasing and debt are substitutes. The DR coefficient estimates of -0.43 indicates that for each dollar increase in debt there is a \$0.43 decrease in the value of leased land. That the DR coefficient estimate is less than 1 in absolute value is consistent with the notion leasing does not have to be reduced dollar for dollar with debt because leasing cash flows better than owning, the cost of leasing is responsive to market conditions, and unprofitable land leases can be dropped.

The signs of the non-DR coefficient estimates are as expected. The coefficient estimate on AGE is negative and significant which supports the life cycle theory that farmers replace leased land with owned land as they age. The SIZE coefficient estimate is positive and highly significant which indicates that dependence on leasing increases with total assets. This is contrary to Branson and Erickson who find support for the credit constraint hypothesis. The signs on firm size (total assets) in Ang and Peterson's models are not consistent. However, in their study, the signs on firm size are negative in all instances in which the coefficient estimates are statistically significant. Here, the negative signs on SIZE support the notion that leasing plays a key role in increasing the size of productive assets. The LIVESTOCK coefficient estimates are positive and statistically significant. This supports the hypothesis that livestock farms are more reliant on leasing than crop farms because of the heavy investment in and borrowing needs of livestock. The PROFIT and LIQUIDITY estimates are positive and statistically significant. The positive coefficient estimates are consistent with the hypothesis that operators choose to lease because it increases cash flow levels. The positive coefficients estimates on PROFIT are inconsistent with Ang and Peterson, and Branson, who find higher levels of leasing to be associated with lower

profitability levels. The positive coefficient estimates on LIQUIDITY are consistent with the findings of Ang and Peterson, but contrary to Branson.

### **Model Results by Farm Characteristics**

In order to determine the robustness of the basic results, models are estimated for cross-sectional subsets of the Kansas farm panel data set following the recent credit constraint literature. The data are split into cross-sectional groupings based on credit constraints. Credit constraints are typically attributed to asymmetry of information between borrowers and lenders, and financial hierarchies in which internal funds are preferred to either outside debt or equity. Farms are thought to be especially susceptible to credit constraints because: 1) they are capital intensive relative to their sales and cash flow levels, 2) farm assets are undiversified and inflexible—held almost exclusively in farm-specific capital, especially agricultural land, 3) debt is important as a source of investment funds due to a lack of well-developed equity markets, and 4) the U.S. farm economy is known to suffer from period bouts of debt deflation.

Farms are split into more and less credit constrained groups according to owned equity, total operating assets, the importance of livestock, and the age of the principal farm operator. Farms are first ordered by their pre-sample 1976 levels of the four cross-sectional criteria. In order to increase the diversity between the two groupings, following Bierlen et al., the middle one-third of the farms are deleted and separate models for the upper and lower one-third of the farms using 1977-92 data are estimated.

Model coefficient estimates are reported in table 2 by cross-sectional sample. Comments will focus on the DR coefficient estimates. The non-DR coefficient estimates are similar to the full sample models. Consistent with the full sample results, all DR coefficient estimates are negative and highly statistically significant. This indicates that the leasing-debt substitution

relationship holds across farms with heterogeneous characteristics.

A priori we hypothesize that the absolute value of the DR coefficient estimate will be larger (in absolute value) for farms with more severe credit constraint problems, i.e., more credit constrained farms would have to reduce their land leasing obligations at a higher rate than less severely credit constrained farms in order to take on additional debt. Thus, it is expected that low equity and small farms will be more credit constrained than high equity and large farms because they have lower collateral and cash flow levels to back up their borrowing. Because livestock farms frequently purchase feeder livestock, feed, and other livestock supplies, they are more dependent on short-term borrowing and hold a higher percentage of their loan portfolio in short-term notes than crop farms. The risk of bankruptcy is higher in the livestock than the crop sector because livestock prices are cyclical with debt depreciation more frequent in the livestock than the crop sector. Thus, livestock farms should be relatively more credit constrained than crop farms. Finally, older operators should be less credit constrained than young operators because they have longer standing relations with their lenders, greater equity accumulations, and generally better financial variables. However, young operators are better educated and may be more adept at demonstrating credit worthiness to lenders.

Estimated DR coefficients for low and high equity farms, and young and old operators are consistent with expectations. The DR coefficients for the small and large, and the crop and livestock farms are contrary to expectations. Thus, support for the notion that credit constraints determine the rate of substitution between leasing and debt is weak. All of the sample split results however, are consistent, with the notion that in order to push the leasing ratio to higher levels, leasing must substitute for debt at increasingly higher levels.

## **Concluding Remarks**

Theoretically, leasing and debt are thought to be substitutes. This assumes that a lease payment, which is a fixed obligation like a loan, displaces debt and reduces debt capacity, i.e., if firms have optimal debt to equity ratios, then, to the extent that it represents “off-balance sheet” financing, leasing reduces debt capacity. This study follows the Ang and Peterson methodology, but utilizes a set of firms which are distinct from those of earlier studies—non-corporate U.S. commercial farms—to test a land leasing-debt substitution hypothesis.

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**Table 1. 1992 Lease and Debt Ratio Means**

	All Farms	Non-Leasing Farms	Leasing Farms	1st Leasing Quartile	2nd Leasing Quartile	3rd Leasing Quartile	4th Leasing Quartile	Crop Farms	Dairy Farms	Livestock Farms	Mixed Farms
<b>1992 Means for Total Assets</b>											
L/A	0.870	0	1.000	0.055	0.337	1.747	2.327	1.078	0.596	0.487	0.578
D/A	0.267	0.154	0.284	0.158	0.276	0.263	0.369	0.265	0.324	0.251	0.264
L/(A+L)	0.347	0	0.399	0.049	0.248	0.428	0.660	0.386	0.279	0.258	0.299
D/(A+L)	0.156	0.154	0.157	0.150	0.202	0.155	0.119	0.141	0.202	0.198	0.172
N	409	53	356	102	102	102	103	242	21	21	125
<b>1992 Means for Land Assets</b>											
L/A	2.141	0	2.459	0.108	0.744	1.905	5.769	2.195	4.621	1.861	1.665
D/A	0.252	0.147	0.268	0.149	0.232	0.275	0.351	0.258	0.184	0.167	0.267
L/(A+L)	0.493	0	0.567	0.084	0.404	0.626	0.856	0.515	0.556	0.471	0.444
D/(A+L)	0.110	0.147	0.104	0.136	0.138	0.108	0.057	0.098	0.123	0.118	0.128
N	409	53	356	102	102	202	103	242	21	21	125

*Notes:* L is the market value of leased land. D is total debt in the 'total assets' section and long-term debt in the 'land assets' section. "A" is the market value of total owned assets in the 'total assets' section and the market value of owned land in the 'land assets' section. In the 'total assets' section the quartiles refer to the leasing to total assets ratio and in the 'land assets' section the leasing to total land assets ratio.

Table 2. 1975-92 OLS Coefficient Estimates of Total Asset Leasing Model for the Full Sample and by Sample Splits

	Full Sample	Low Equity	High Equity	Small Farms	Large Farms	Crop Farms	Livestock Farms	Young Operators	Old Operators
DR	-0.4321 (0.0001)	-0.4901 (0.0001)	-0.2785 (0.0001)	-0.4005 (0.0001)	-0.5354 (0.0001)	-0.5063 (0.0001)	-0.3564 (0.0001)	-0.6828 (0.0001)	-0.3303 (0.0001)
AGE	-0.0058 (0.0001)	-0.0024 (0.0001)	-0.0044 (0.0001)	-0.0063 (0.0001)	-0.0043 (0.0001)	-0.0058 (0.0001)	-0.0050 (0.0001)	-0.0058 (0.0001)	-0.0054 (0.0001)
SIZE	0.0104 (0.0001)	0.0450 (0.0001)	0.0173 (0.0001)	0.0345 (0.0001)	0.0043 (0.0002)	0.0132 (0.0001)	0.0101 (0.0001)	0.0052 (0.0001)	0.0174 (0.0001)
LIVESTOCK	0.0439 (0.0001)	-0.0407 (0.0066)	0.0262 (0.0822)	0.0744 (0.0001)	0.0571 (0.0013)	0.0332 (0.2080)	0.0188 (0.3129)	0.0942 (0.0001)	0.0779 (0.0001)
PROFIT	0.2540 (0.0001)	0.1885 (0.0001)	0.6339 (0.0001)	0.5236 (0.0001)	0.3509 (0.0001)	0.4915 (0.0001)	0.0850 (0.0001)	0.1189 (0.0001)	0.3376 (0.0001)
LIQUIDITY	0.0228 (0.0001)	0.0107 (0.0003)	0.0179 (0.0001)	0.0190 (0.0001)	0.0272 (0.4780)	0.0239 (0.0001)	0.0256 (0.0001)	0.0269 (0.0001)	0.0206 (0.0001)
Log Likelihood	1318.00	659.44	916.15	791.53	509.89	446.82	605.13	707.59	436.51
N	6544	2176	2176	2176	2176	2176	2176	2160	2224
Non-leasing farm-years	500	95	233	261	107	184	159	65	319

*Notes:* The dependent variable is the ratio of the market value of leased land to the market value of land assets. DR is the ratio of long-term debt to the market value of land assets. All models are estimated with farm type and time dummy variables. Two-sided p-values are in parentheses. Models are corrected for heteroskedasticity following the multiplicative heteroskedasticity method of Harvey (1976). See the Appendix for a definition of the other explanatory variables and the sample split criteria.

### **Appendix: Variable Definitions and Sample Splits**

**Leasing ratio**-The ratio of the market value of leased land to the market value of total operating assets.

**Total operating assets**-The market value of owned assets plus the market value of leased land.

**Owned Assets**-The sum of the market value of end of year inventories, owned land, stock of motor vehicles and machinery, breeding livestock, non-residential buildings, and cash on hand. The depreciable capital stock of equipment and machinery is built up using the perpetual inventory method (see Bierlen and Featherstone).

**Value of owned and leased land**-Each farm reports the number of owned and leased acres of irrigated crop land, non-irrigated crop land, and pasture. The Kansas Board of Agriculture (Schlender) reports annual per acre land values for irrigated crop land, non-irrigated crop land, and pasture land for nine statistical districts. Land values are estimated by multiplying reported acreage by the district price and summing across land types.

**Total debt ratio**-Total debt to owned assets.

**Long-term debt ratio**-The ratio of long-term debt to the market value of owned land and

buildings. Long-term debts are those loans with a maturity over seven years (Langemeier).

**Current ratio**-The ratio of the market value of ending year current assets to current loans.

Current assets include inventories of crops, feeding livestock, animal feed, livestock and crop supplies, and fuel and oil, and cash on hand.

**Age**- The age of the principal farm operator in years.

**Profit**-The ratio of cash flow to the market value of owned capital assets. Cash flow is net income (not including interest and taxes as expenses). Owned capital assets include real estate, breeding livestock, and machinery and equipment.

**Sample Splits**- Low equity farms are the lower one-third of 409 Kansas farms in which 1976 equity is  $< \$145,000$ . High equity farms are the upper one-third of 409 Kansas farms in which 1976 equity is  $> \$274,750$ . Small asset farms are the lower one-third of 409 Kansas farms in which 1976 owned assets are  $< \$309,000$ . Large asset farms are the upper one-third of 409 Kansas farms in which 1976 owned assets are  $> \$495,700$ . Crop farms are the lower one-third of 409 Kansas farms in which 1976 feeder livestock to total inventory ratios are  $< 0.145$ . Livestock farms are the upper one-third of 409 Kansas farms in which 1976 feeder livestock to total inventory ratios are  $> 0.461$ . Young operator farms are the lower one-third of 409 Kansas farms in which 1976 operator ages are  $< 42$ . Old operator farms are the upper one-third of 409 Kansas farms in which 1976 operator ages are  $> 50.5$ .

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