Impact of Government Payments, Depreciation and Inflation on Investment Behavior in American Agriculture Sector Using Sample of Kansas Farms

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Abstract

A farm's physical investment is affected by its fundamental q and by its financial situation, with the later comprising both the firm's liquidity and its possibility of facing capital market imperfections. This study determines the effects of government payments, depreciation, and inflation on crop farm machinery and equipment investment behavior employing the Nonlinear Generalized Method of Moment (GMM) estimator to estimate the investment system. The magnitude of the lagged cash flows such as government payments, cash crop income, and grain income were largely responsible for determining farm investment behavior in the Kansas agriculture sector. An increase in lagged machinery and equipment depreciation and lagged farm motor vehicle and listed property depreciation increases total crop farm investment substantially for an average farm. Statistically, there is no evidence of inflation affects on crop farm machinery investment behavior.

Introduction

Key and Roberts (2006) use a Cox proportional hazards model to estimate the effect of government payments on the instantaneous probability of farm business failure controlling for farm and operator characteristics. They found that an increase in government payments has a small but statistically significant negative effect on the rate of business failure, and the magnitude of this effect increases with farm size. They argue that government payments allow liquidity constrained farms to achieve a more efficient scale and remain in business longer. It is worthwhile to examine whether only government payments and/or other cash flows results in a liquidity constrained farm to achieve a more efficient scale and remain in the business. To achieve a more efficient scale, farm firms must expand their operations through making sound investment decisions. In this study, the goal is to understand a farm firm's investment decisions through financial variables such as cash inflows, outflows, and cash stocks.

Financial variables such as cash inflow, outflow, and cash holdings are important explanatory variables for investment at the firm level. A large body of recent empirical work attempts to quantify the determinants of investment. In the case of investment, neoclassical theory denies any role for current output and only relative factor prices should drive investment. However, liquidity constraints have been offered as one possible explanation of short-run fluctuations of Gross Domestic Product (GDP). Liquidity has a larger effect on cash flow, a cheaper source of finance than external funds. Fazzari, Hubbard and Petersen (1988) show theoretically and empirically the potential effects of cash flow on investment for the U.S. corporate sector. Bierlen and Featherstone (1998) using 1976-1992 panel data test whether farm machinery investors face internal or external financing constraints. They found that debt was the strongest determinant of credit constraints whereas asset size and operator age were less important. Hart and Lence (2004) used a Bayesian approach to evaluate the impact of internal financial variables using a q-based investment model for the agriculture sector and found that a farm's liquidity situation significantly affects its investment.

Melichar (1979) pointed out that policy actions taken to accelerate the growth in current returns to assets will increase wealth, but cause a higher portion of the real return to occur as capital gain relative to current income. Further, he argues that established farmers thrive on that growth and eventually high rates of return on the funds invested in earlier years. New and young entrants to the agriculture industry find it difficult to undertake investments with a low initial current income return or may find themselves in financial difficulty shortly after doing so. To address this phenomenon in the agriculture sector, this study separates farms into size and experience categories according to the value of the total farm assets and age of the farm operator. The major assumption behind this type of categorization is that the smallest farms or young farm operators may have a more difficult time in access in credit relative to the largest farms or highly experienced older farm operators.

Hall and Jorgenson (1967) investigated the effects of changes in tax policy on investment behavior for three major tax revisions in the post war period: the adoption of accelerated methods for calculating depreciation in the Internal Revenue Code of 1954; the reduction of lifetimes used for calculating depreciation on equipment and machinery in 1962 and the investment tax credit for equipment and machinery in the revenue Act of 1962. They concluded that the effects of accelerated depreciation were substantial for investment in manufacturing equipment and structures. Further, to investigate industry's investment behavior under renewed liberalization of depreciation policy from first-year write off of investment in 1954, they showed that the adoption of first year write off for investment expenditures in 1954 resulted in a sharp rise in desired capital for all the industries they analyzed. Goolsbee (1998) investigated how the investment tax credit affects capital goods prices. He concluded that the investment tax credit has essentially no effect on firm's incentive to invest.

In this analysis not only we do examine investment behavior in the agriculture sector using q based investment models, we evaluate an impact of different depreciation regimes on investment behavior of farm firms as well as how inflation influences on firm farm's investment decision.

Conceptual Framework

This study uses the q-theory approach to construct an approximation of the discounted expected stream of marginal profits from an extra unit of machinery investment if capital markets are perfect. While this model is an approximation of the dynamic theory of the firm under uncertainty, the results are generally robust and easily interpreted. In this model, the proxy of a firm's investment opportunities is constructed using a set of vector autoregressive equations (VAR) to determine a value for the expected discounted stream of marginal profits to investment (Bierlen and Featherstone 1998). Under full information and quadratic adjustment costs, the investment equation is

$$(\mathrm{I}_{\mathrm{i,t}} / \mathrm{K}_{\mathrm{i,t-1}}) = \alpha_0 + \alpha_1 Q_{i,t} + \eta_i + \theta_{\mathrm{t}} + u_{i,t} \qquad (1)$$

where I is investment, K is the capital stock, Q is a tax-adjusted Tobin's q for firm i and time t, η_i are individual firm-specific effects, θ_t is time effect and u is the error term. Under asymmetric information, the availability of internal financing will also influence the investment spending of some firms. The more general form of the investment equation is,

$$(\mathrm{I}_{\mathrm{i,t}} / \mathrm{K}_{\mathrm{i,t-1}})_{\mathrm{j}} = \alpha_0 + \alpha_1 Q_{i,t,j} + \alpha_2 C_{i,t,j} + \eta_i + \lambda_j + \theta_{\mathrm{t}} + u_{i,t,j} \qquad (2)$$

where $C_{i,t,j}$ is the liquidity condition for firm i, time t belonging to financial market imperfection group j (j = 1, 2, 3 and 4) and λ are the group-specific effects.

Empirical model

The reduced form fundamental q-model is represented by equations (3), (4), and (5). Hence, the following econometric investment system for farm i, group j, and time t is estimated;

$$(\mathrm{I}_{\mathrm{i,t}} / \mathrm{K}_{\mathrm{i,t-1}})_{\mathrm{j}} = \alpha_0 + \alpha_1 Q_{i,t,j} + \alpha_2 C_{i,t,j} + \eta_i + \lambda_j + \theta_{\mathrm{t}} + u_{i,t,j} \qquad (3)$$

$$\mathrm{X}_{\mathrm{i,t,j}} = \mathrm{A}\,\mathrm{X}_{\mathrm{i,t-1,j}} + f_i + d_j + \mathrm{g}_{\mathrm{t}} + e_{i,t,j} \qquad (4)$$

$$\mathrm{Q}_{\mathrm{i,t,j}} = [\mathrm{c}' \quad (\mathrm{I} - \gamma \mathrm{A})^{-1} \gamma \mathrm{A}]\, X_{i,t,j} \qquad (5)$$

where equations (3) and (4) are estimated and equation (5) is a mathematical identity. Equation (3) is the investment equation, where $I_{i,t}$ is the stock of crop farm machinery and equipment, $K_{i,t-1}$ is the lagged value of the total capital managed, $Q_{i,t,j}$ is fundamental q, $C_{i,t,j}$ is the disaggregated cash inflows and outflows including lagged income from beef cattle ($BeefI_{i,t-1}$), lagged income from grain[1] ($GrnI_{i,t-1}$), lagged income from cash crops[2] ($CashcpI_{i,t-1}$), lagged non-farm income ($NONFI_{i,t-1}$), lagged government payments ($GPY_{i,t-1}$), operator's age ($AGE_{i,t-1}$), lagged total interest expenses ($Interest_{i,t,j}$), group dummy ($D_{i,t,j}$), and lagged chain type personal consumption expenditures price index ($PCEPI_{t-1}$). Lagged machinery and equipment depreciation ($DEPm_{i,t-1}$),

[1]Grain included barley, corn, grain sorghum, oats, rye, and wheat.
[2] Cash crop included soybeans, pinto/dry beans, sugar beets, legume and grass seed, cotton, popcorn, and sunflowers.

lagged motor vehicle and listed property depreciation ($DEPv_{i,t-1}$), and lagged building and farm structures depreciation ($DEPb_{i,t-1}$) were also included in the regression.

The rationale behind the inclusion of incomes derived from beef cattle, grain, and cash crops, and non-farm income, and government payments is for including the components of farm's aggregate cash flow variable as one needs to aggregate the above mentioned individual variables. We consider interest expenses as a cash outflow for a farm. Operator's age ($AGE_{i,t-1}$) was used in the regression to capture the life cycle of the firm. Mature or experienced farm firms are less likely to face as many informational problems, because lenders will tend to know more about farm firms that have been in business for an extended period of time and because mature firms can credibly enter into repeated relationships with lenders, and such repeated relationships reduce informational asymmetries.

The variable η_i is firm-specific effects and λ is group-specific effects. θ_t is time effect and u is the error term. $C_{i,t,j}$ represents the sensitivity of investment to fluctuations in internal finance after investment opportunities are controlled for through the variables in the estimation of fundamental $Q_{i,t,j}$. Equation (4) is a system of VAR equations used to forecast the matrix of coefficients or companion matrix A, that contains lagged fundamentals including the marginal value product of machinery (mvpm) as the k^{th} element. The variable f_i is a vector of fixed farm effects, d_j is a vector of fixed effects, g_t is a vector of fixed time effects and e_{itj} is a vector of errors in forecasting $X_{i,t,j}$. $X_{i,t,j}$ represents a vector of variables that represent the liquidity condition of the farm firm including average net worth ($ANW_{i,t,j}$), marginal value product of machinery ($MVPM_{i,t,j}$), debt to assets ratio ($DA_{i,t,j}$), and the total number of acres used in the crop production ($Acre_{i,t,j}$). Equation (5) is an identity used to estimate fundamental q where A is the companion matrix from the VAR equations, c' is a vector with the k^{th} element equal to 1 and the non-k^{th} elements equal to 0. The variable γ is the discount rate or depreciation rate.

Data

The data used in this study were from the Kansas Farm Management Association farms that had annual farm financial records from 1998 through 2007. Those farms that did not have data for all 10 years were excluded from the sample. In addition, those farms that did not have data on total capital managed and total crop machinery investment for the entire study period were also deleted.

The data consisted of information on 811 farms. The variables used in this analysis were year, total capital managed, total crop machinery investment, machinery and equipment depreciation, motor vehicle and listed property depreciation, building depreciation, total interest expenses, beef cattle income, grain income, cash crop income, non-farm income, government payments, marginal value product of machinery, debt to assets ratio, average net worth, operator's age, and total crop production acres.

Total capital managed is the total farm assets plus the value of rented land. Total crop machinery investment is equal to the average of the beginning and ending values for motor vehicles, listed property, and machinery and equipment used for crop production. Machinery and equipment depreciation, motor vehicle and listed property depreciation, and building depreciation were management depreciation (Langemeier 2003). Total interest expenses were calculated on an accrual basis and included cash expenses, change in accounts payable inventory, and change in expense inventory (Langemeier 2003). Beef cattle income was accrual beef cattle income. Grain and cash crop incomes were calculated on accrual basis. Grain included barley, corn, grain sorghum, oats, rye, and wheat. Cash crop included soybeans, pinto/dry beans, sugar beets, legume and grass seed, cotton, popcorn, and sunflowers. Non-farm income was total non-farm taxable income. Government payments were cash government payments.

Total crop production acres included both total owned and rented crop acres. The debt to asset ratio was calculated by adding short-term loans, intermediate-term loans, and long-term loans divided by total short-term assets, intermediate-term assets, and long-term assets. The marginal value product of machinery is equal to net accrual revenue less labor cost less cost associated with the total number of acres owned and rented divided by total capital managed by the farm less variable costs (Bierlen and Featherstone 1998). Net accrual revenue is the sum of livestock and crop accrual income, government payments, crop insurance proceeds, custom feeding revenue, and patronage refunds. The cost of rented and owned crop acres is total owned and rented crop acres times average annual cash rent per acre for the state of Kansas. Labor cost (operator, family, and hired labor) is estimated by the number of workers time average hourly earnings of production workers multiplied by 10 working hours per day, 5 working days per week and 52 working weeks per year. Variable costs are feed, seed, fertilizer and lime, vet medicine and drugs, gasoline fuel and oil, and herbicide and insecticide costs. A chain type Personal Consumption Expenditure (PCE) price index from U.S. Department of Commerce, Bureau of Economic Analysis was used to convert all the nominal values into real dollar values with 1998 used as the base year. Summary statistics of all real variables are in Table 1.

Average real total crop machinery investment during 1998 to 2007 was $166, 888 with a median of $128, 141 and a standard deviation of $151,714 standard deviation (Table 1). Machinery investment ranged from maximum of $2,070,711 to minimum of $0. Real total capital managed averaged $1,801,932 with a median of $1,452,945 and standard deviation of $1,396,816. Capital managed ranged from $17,807,622 to $37,006. Real machinery and equipment depreciation averaged $9,980 with a median and a standard deviation of $7,157 and $10,244, respectively, ranging from $0 to $130,865. During the study period, an average farm's debt to assets ratio was 0.312. During 1998 to 2007, real non-farm income and government payment were $12,367 and $34,551, respectively. Beef cattle income; grain income; and cash crop income were $60,607; $109,664; and $43,708 respectively. The average operator's age during the study period was 54.7 years. On average 1,173 of own and rented crop acres where operated. The marginal value product of machinery averaged 0.108 with a median of 0.091, ranging from -0.1135 to 4.248.

The stationarity of the variables used to estimate fundamental Q, were tested using the Dickey and Fuller unit root test. The Dickey and Fuller unit root test suggested that the variables used to estimate fundamental Q were not cointegated at degree 1 (I(1)). Granger (1986) supported the conclusion of less aggregated variables such as primary production and sales of U.S. durables were less likely to be cointegrated. The nonlinear Generalized Method of Moment (GMM) estimator (SAS 9.1.3) was used to estimate the investment equation system (equations 3-5). The GMM estimates moment conditions that can be used in a straight forward way to estimate the model parameters without making strong assumptions regarding the stochastic properties of variables (Hansen 1982).

Results and Discussions

In this section, we discuss results for the whole sample as well as the results for the each individual farm assets quartiles. All the cash flow variables and variables that used to construct fundamental q were normalized using lagged total capital managed in order to eliminate possible heteroskedastic errors. Explanatory variables representing cash inflows and outflows include lagged income from beef cattle ($BeefI_{i,t-1}$), lagged income from grain ($GrnI_{i,t-1}$), lagged income from cash crops ($CashcpI_{i,t-1}$), lagged non-farm income ($NONFI_{i,t-1}$), lagged government payments ($GPY_{i,t-1}$), operator's age ($AGE_{i,t-1}$), lagged total interest expenses ($Interest_{i,t,j}$), group dummy ($D_{i,t,j}$), lagged personal consumption expenditures price index ($PCEPI_{t-1}$), lagged machinery and equipment depreciation ($DEPm_{i,t-1}$), lagged motor vehicle depreciation ($DEPv_{i,t-1}$), lagged building and farm structures depreciation ($DEPb_{i,t-1}$), and fundamental $Q_{i,t,j}$ were regressed on the total crop machinery investment.

Parameter estimates are reported in the Table 2. Variables such as lagged grain income, lagged cash crop income, lagged government payments, lagged machinery and equipment depreciation, lagged motor vehicle and listed property depreciation, and farm assets quartile 3 and 4 were positively related to total crop machinery investment and lagged interest payments were negatively related to total crop machinery investment. We expected that lagged beef income, operator's age, and lagged building depreciation were positively related to total crop machinery investment for the period of 1998 to 2007 for the sample of Kansas farms. It turned out to be lagged beef income and lagged building depreciation were negatively related to total crop machinery investment. A parameter estimate of 0.4934 for the lagged government payment was statistically significant at an α level of 0.005. A parameter estimate of -0.1888 for lagged beef cattle income was also statistically significant at an α level of 0.005. Since parameter estimate for lagged beef cattle income was statistically different from zero, it is necessary to explain why it was negatively related to the total crop machinery investment. In this analysis, we used as our dependent variable total crop machinery investment rather than total farm investment. Thus the dependent variable may not reflect true relationship between lagged beef cattle income and total crop machinery investment for the sample of Kansas farms from 1998 to 2007. More likely many beef operations may purchase a larger proportion of feed, so that crop machinery may be not needed as much. Another possible alternative explanation for the negative relation between lagged beef cattle income and total crop machinery investment would be the hypothesis of a competitive relationship between beef cow-calf and crop enterprises. Bobst and Davis (1987) provided evidence that cattle numbers fluctuate in an inverse relationship to changes in the number of harvested crop acres. Their finding was consistent with Rucker, Burt, and LaFrance (1984).

Parameter estimates of 0.1778 and 0.4381 for lagged grain income and lagged cash crop income were statistically significance at α levels of 0.05 and 0.005 respectively. Lagged cash inflows such as government payments, and income from grain crops and cash crops were very important in terms of infusing vital new investment for the Kansas farms. New investment in the farming sector heavily depends on the magnitude of the lagged cash flows such as government payments, cash crop income, and grain income. Roberts and Key (2008) examined whether payments from federal farm programs contributed to increased concentration of crop land and farm land using zip code-level data. Their findings indicated that government payments are strongly associated with subsequent concentration growth. Our study provides evidence that in addition to Roberts and Key (2008) conclusion of government payments being associated with farmland, it is also associated with machinery investment.

Total farm assets quartiles were examined. In this analysis farms with assets worth of less than or equal to US $545,835 were in Quartile 1; farms with assets worth between US $545,836 and US $859,917 were in Quartile 2; farms with assets worth between US $859,918 and US $1,402,511 were in Quartile 3; and farms with assets greater than or equal to US $1,402,512 were in Quartile 4. Table 3 presents the parameter estimates for the farm assets quartiles. Farm assets quartiles 1 and 2 had parameter estimates on government payments of 0.7649 and 0.4494 that were statistically significant at α level of 0.005. Farm assets quartiles 3 and 4 had parameter estimates on government payments of 0.0672 and 0.006 that were statistically not different from zero. Larger farm's investment decisions did not depend on internal cash flows such as government payments as those farms with smaller assets bases. Smaller farm's investment decisions depended more on internal cash flows such as government payments than larger farms.

In the full sample, a parameter estimate on the operator's age was positively related to the total crop machinery investment but it was statistically not different from zero. So that investment decisions do not depend on the age of the farm operator. Parameter estimate on operator age of farms with the smallest and the largest assets bases (quartiles 1, 3 and 4) were statistically not different from zero (table 3). Parameter estimates for operator's age of farms with medium-sized assets bases (quartile 2) are positively related to the total crop machinery investment and statistically significant. To examine investment behavior among operator age quartiles, four different regressions were performed for each age quartile. All the regression results for age quartiles are reported in Table 4. Farm operators whose age below 47.8 years were young farmers. We treated age between 47.9 years and 62.9 years as middle-aged farm operators (age quartile between 47.9 and 54.8 years and age quartile between 54.9 and 62.9 years). We categorized farmers with age over 63.0 years as older farm operators. Young operators (quartile 1) total crop farm machinery investment decisions depended on lagged cash crop income (parameter estimate of 0.3395 was statistically significant at α level of 0.005) and grain income (parameter estimate of 0.2610 was statistically significant at α level of 0.005). A parameter estimate of 0.1132 on lagged government payments was not statistically different from zero. Middle-aged farm operators (age quartile 2 and 3) crop farm investment decisions mainly depended on lagged government payments (for age quartiles 2 and 3 parameter estimates of 0.5661 and 0.476 were statistically significant at α level of 0.005); lagged grain income (for age quartile 2 and 3 parameter estimates of 0.3502 and 0.1355 were statistically significant at α level of 0.005); and lagged cash crop income (for age quartile 2 and 3 parameter estimates of 0.4955 and 0.2078 were statistically significant at α levels of 0.005 and 0.05).

For young farmers (age quartile 1), parameter estimates of 0.2610 on lagged grain income and 0.3395 on lagged cash crop income were positively related to total crop farm machinery investment and statistically significant at α level of 0.005 but parameter estimate on lagged government payments was not different from zero. For the older farm operators parameter estimates of 0.4569 on lagged grain income and 0.3444 on lagged cash crop income were statistically significant at α level of 0.005 while parameter estimate on lagged government payment was not different from zero. Parameter estimates on lagged government payments for middle aged farm operators (age quartile 2 and 3) were statistically significant at α level of 0.005.

If we look at magnitudes and statistical significance of parameter estimates for the four age regressions, it provides an interesting story about evolution of the Kansas farm sector. Young farmers have less equity to expand their assets base but they may not be face with labor shortages including own labor and family labor. In order to build their equity base, they might be largely involved in profitable cash crop enterprises through easily accessible land tenure arrangements and they may not be benefited by the government payment schemes. Over time or as they move into middle age they might be achieving efficiency through operating at a more optimal scale (getting bigger). May be older farmers are land owners relative to young farmers.

Effects of inflation and method of depreciation on farm investment behavior

The effect of inflation on the incentive to invest depends on balancing the change in the cost of funds including equity as well as debt against the change in the maximum potential return that farms can afford to pay. Brenner and Venezia (1983) studied the effect of inflation on the investment. Their main conclusion is that inflation does not always increase the duration of investment and hence, it does not reduce the average investment per period. The other important way in which inflation affects the behavior of investment is through the value of depreciation that is allowed in calculating taxable income. Since depreciation allowances are fixed in nominal terms, the real percent value of the depreciation allowances is reduced when the rate of inflation rises.

In this study we used the chain type PCE price index as a proxy for economy wide inflation to explain farm firm's investment behavior. In the full sample, parameter estimate on the lagged price index was statistically not different from zero (Table 2). A neutral effect of inflation on the behavior of crop farm machinery investment may be because of better anchoring of inflation and long-run expectations. If inflation and expectations become better anchored, investors may be less sensitive to news on the state of the economy, probably because the public expects to Federal Reserve to act to keep inflation stable.

The parameter estimates on lagged personal consumption expenditure price index for farm assets quartiles and age quartiles varied significantly by magnitude and statistical significance (Table 3). The parameter estimates on lagged price index of -28,885 and -48,294 for the total farm assets quartiles 2 and 4 were statistically significant at α=0.005 level while parameter estimates on lagged price index for the total farm assets quartiles 1 and 3 were not statistically different from zero. The parameter estimate of -27,662 on lagged personal consumption expenditure price index for young farm operators (age quartile 1) was statistically significant at α=0.005 level (Table 4). The parameter estimates of 78,387 on lagged price index for age quartile 3 statistically significant at α=0.005 level.

The parameter estimates on lagged machinery and equipment depreciation and motor vehicles and listed property depreciation were positively related to total crop farm machinery investment and statistically significant in the full sample regression as well as all the other regressions (total assets quartile regressions and operator age quartile regressions). The parameter estimates on lagged agricultural building and structures depreciation were negatively related to the total crop farm machinery investment and statistically significant in the full sample regression as well as all the other regressions.

In order to mimic effects of depreciation rate and length of the depreciation schedule on farm investment behavior, we simulated percentage increases of lagged machinery and equipment depreciation and lagged farm motor vehicle and listed property depreciation to determine magnitude of change in total crop farm machinery investment in an average Kansas farm (Figure 1). We simulated a 0 to 10 percentage increase of lagged machinery and equipment depreciation and farm motor vehicle and listed property depreciation separately as well as together for an average farm. Figure 1 shows that an increase of lagged crop machinery and equipment depreciation and lagged farm motor vehicle and listed property depreciation together increase total crop farm investment substantially. From these findings we can deduce that increasing the depreciation rate and/or decrease length of the depreciable property's life encourages farm investment behavior towards increased on crop farm machinery investments.

Summary and Conclusions

In this study we used sample of Kansas farms from 1998 to 2007 to determine effects of government payments and depreciation on crop farm machinery and equipment investment behavior. The sample contained 811 farm businesses. Nonlinear Generalized Method of Moments was used to estimate the investment equation system. Explanatory variables representing cash inflows and outflows included lagged income from beef cattle, lagged income from grain, lagged income from cash crops, lagged non-farm income, lagged government payments, operator's age, lagged total interest expenses, group dummy, lagged personal consumption expenditure price index, lagged machinery and equipment depreciation, lagged motor vehicle and listed property depreciation, lagged building and farm structures depreciation, fundamental q were regressed on the total crop machinery investment.

The parameter estimate on lagged government payments was statistically significance and positively related to the total crop farm investments in the full sample as well as in the farm total assets quartiles 1 and 2 and the age quartiles 2 and 3. The parameter estimates on lagged cash crop income and lagged grain income were statistically significance and positively related to the total crop farm machinery investment in the full sample as well as in all farm assets quartiles. The magnitude of the lagged cash flows such as government payments, cash crop income, and grain income were largely responsible for determining farm investment behavior in the Kansas agriculture sector. A combine increase of lagged machinery and equipment depreciation and lagged farm motor vehicle and listed property depreciation in an average farm increases total crop farm investment substantially.

Since this study did not use any random sampling procedure, generalization of the results is limited. Farms in the study may possess some special financial characteristics which nonparticipating farms do not possess. Participating farms may be financially well managed, technologically progressive, or the opposite.

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Table 1: Summary Statistics of Financial Variables for Kansas Farms, 1998-2007.

	Average	Median	Std. Deviation	Maximum	Minimum
Total Crop Machinery Investment (US $)	166,888	128,141.41	151,714	2,070,711	0
Total Capital Managed (US $)	1,801,932	1,452,945	1,396,816	17,807,622	37,006
Motor Vehicle and Listed Property Depreciation (US $)	12,922	9,004.86	13,381	132,290	0
Machinery and Equipment Depreciation (US $)	9,980	7,156.85	10,244	130,865	0
Building Depreciation (US $)	2,925	961.52	6,796	170,966	0
Total Government Payments (US $)	34,551	25,236.73	33,594	493,278	0
Non-farm income (US $)	12,367	1,156.2	19,604	178,496	-51,384
Beef Cattle Income (US $)	60,607	21,750.47	123,491	2,339,637	-136,260
Grain Income (US $)	109,664	65,516.3	150,969	2,292,499	-149,969
Cash Crop Income (US $)	43,708	16,485.13	75,870	1,128,208	-69,050
Interest Payments (US $)	17,440	10,135.59	22,216	298,488	-35,871
Operator Age	54.7	54.0	11.4	98.0	20.0
Total Crop Acres	1,173	999.0	887	9,472	0
Average Net Worth (US $)	835,176	550,800.1	950,025	16,320,071	0
Debt/Assets ratio	0.312	0.245	0.304	6.111	0.005
Marginal value product of machinery	0.1077	0.0906	0.09112	4.2479	-0.1135

All the dollar values are in 1998 constant real dollar terms. Personal consumption expenditure price index was used to account inflation.

Table 2: GMM Parameter Estimates of Investment Equations for the Full Sample, 1998-2007

Parameter	Estimate	Std Err	t -Value
Intercept	0.019809**	0.00832	2.38
Fundamental Q	1.977844**	0.5753	3.44
Beef income	-0.18877**	0.0316	-5.97
Grain income	0.177801*	0.0913	1.95
Cash crop income	0.438149**	0.1469	2.98
Non-farm income	-0.08516	0.1133	-0.75
Government payments	0.493448**	0.1525	3.24
Operator age	95.53921	154.4	0.62
Personal Consumption Expenditure price index	11248.48	17028.4	0.66
Machinery & Equipment Depreciation	4.305593**	0.5472	7.87
Motor Vehicle and Listed Property Depreciation	4.022315**	0.3715	10.83
Building Depreciation	-2.83083**	0.39	-7.26
Interest payments	-0.55531**	0.1521	-3.65
Assets Quartile1	-0.01106	0.00693	-1.59
Assets Quartile3	0.008785**	0.00353	2.49
Assets Quartile4	0.007772	0.00612	1.27

** Statistically significant at α=0.005 and * statistically significant at α=0.05 level.

Table 3: GMM Parameter Estimates of Investment Equations for Assets Quartiles, 1998-2007

	Parameter	Estimate	Std Err	t -Value
Quartile 1	Intercept	0.0091	0.0146	0.62
	Fundamental Q	4.2461**	1.1696	3.63
	Beef income	-0.3169**	0.0754	-4.2
	Grain income	0.0342	0.0618	0.55
	Cash crop income	0.3402	0.2232	1.52
	Non-farm income	-0.1675	0.1113	-1.5
	Government payments	0.7650**	0.374	2.05
	Operator age	48.1048	162	0.3
	Personal Consumption Expenditure Price Index	20,378.2	15816.1	1.29
	Machinery & Equipment Depreciation	3.6059**	0.8765	4.11
	Motor Vehicle and Listed Property Depreciation	3.6595**	0.662	5.53
	Building Depreciation	-4.7969**	0.7618	-6.3
	Interest payments	-0.6654**	0.256	-2.6
Quartile 2	Intercept	0.0240**	0.00617	3.88
	Fundamental Q	3.0685**	0.7498	4.09
	Beef income	-0.1585**	0.0442	-3.58
	Grain income	0.4811**	0.0519	9.28
	Cash crop income	0.6050**	0.0797	7.59
	Non-farm income	0.2231**	0.0779	2.86
	Government payments	0.4494**	0.0991	4.53
	Operator age	384.1**	149.7	2.57
	Personal Consumption Expenditure Price Index	-28,884.7**	11040.2	-2.62
	Machinery & Equipment Depreciation	3.3338**	0.7419	4.49
	Motor Vehicle and Listed Property Depreciation	3.5603**	0.6062	5.87
	Building Depreciation	-1.5636**	0.5457	-2.87
	Interest payments	-0.5487**	0.2205	-2.49
Quartile 3	Intercept	0.0178**	0.00434	4.09
	Fundamental Q	3.4785**	0.6821	5.1
	Beef income	-0.1843**	0.0358	-5.15
	Grain income	0.3391**	0.043	7.89
	Cash crop income	0.2895**	0.0666	4.35
	Non-farm income	0.0526	0.0745	0.71
	Government payments	0.0672	0.0839	0.8
	Operator age	173.3	182	0.95
	Personal Consumption Expenditure Price Index	-10,539.0	13301	-0.79
	Machinery & Equipment Depreciation	5.3453**	0.461	11.6
	Motor Vehicle and Listed Property Depreciation	4.3644**	0.3083	14.16
	Building Depreciation	-1.4863**	0.3684	-4.03
	Interest payments	0.0163	0.1554	0.11
Quartile 4	Intercept	0.0207**	0.00458	4.53
	Fundamental Q	2.9460**	0.4642	6.35
	Beef income	-0.1308**	0.0227	-5.76
	Grain income	0.2449**	0.0362	6.76
	Cash crop income	0.2295**	0.0505	4.55
	Non-farm income	0.3264*	0.1745	1.87
	Government payments	0.0060	0.0787	0.08
	Operator age	394.1	248.9	1.58
	Personal Consumption Expenditure Price Index	-48,294.4**	14136.7	-3.42
	Machinery & Equipment Depreciation	6.6405**	0.5575	11.91
	Motor Vehicle and Listed Property Depreciation	4.7326**	0.3179	14.89
	Building Depreciation	-1.6859**	0.4343	-3.88
	Interest payments	0.1340	0.1448	0.93

** Statistically significant at α=0.005 and * statistically significant at α=0.05 level.

Table 4: GMM Parameter Estimates of Investment Equations for Age Quartiles,1998-2007

	Parameter	Estimate	Std Err	t- Value
Quartile 1	Intercept	0.0203**	0.005	4.07
	Fundamental Q	2.9600**	0.7909	3.74
	Beef income	-0.0955**	0.0426	-2.24
	Grain income	0.2610**	0.0384	6.79
	Cash crop income	0.3395**	0.0723	4.7
	Non-farm income	0.0069	0.0642	0.11
	Government payments	0.1132	0.1149	0.99
	Operator age	745.8**	295.5	2.52
	Personal Consumption Expenditure Price Index	-27,661.5**	10180.5	-2.72
	Machinery & Equipment Depreciation	4.8953**	0.5496	8.91
	Motor Vehicle and Listed Property Depreciation	4.5835**	0.3867	11.85
	Building Depreciation	-3.1010**	0.7462	-4.16
	Interest payments	-0.3731*	0.2108	-1.77
Quartile 2	Intercept	-0.0033	0.0117	-0.28
	Fundamental Q	5.1167**	0.7993	6.4
	Beef income	-0.1726**	0.0483	-3.57
	Grain income	0.3502**	0.0559	6.27
	Cash crop income	0.4955**	0.1061	4.67
	Non-farm income	-0.3400*	0.1699	-2
	Government payments	0.5661**	0.1533	3.69
	Operator age	-324.6	1188.8	-0.27
	Personal Consumption Expenditure Price Index	50,021.6	62276.3	0.8
	Machinery & Equipment Depreciation	2.5957**	0.8132	3.19
	Motor Vehicle and Listed Property Depreciation	3.2421**	0.5668	5.72
	Building Depreciation	-3.8545**	0.6887	-5.6
	Interest payments	-0.6889**	0.2101	-3.28
Quartile 3	Intercept	0.0407**	0.00653	6.22
	Fundamental Q	1.8502**	0.4972	3.72
	Beef income	-0.1973**	0.0354	-5.58
	Grain income	0.1355**	0.0472	2.87
	Cash crop income	0.2078*	0.1271	1.63
	Non-farm income	0.0625	0.0541	1.16
	Government payments	0.4760**	0.1386	3.43
	Operator age	-1513.4**	458.3	-3.3
	Personal Consumption Expenditure Price Index	78,387.2**	24704.6	3.17
	Machinery & Equipment Depreciation	3.9391**	1.0452	3.77
	Motor Vehicle and Listed Property Depreciation	5.0996**	0.4554	11.2
	Building Depreciation	-1.3445*	0.6542	-2.06
	Interest payments	-0.5866**	0.2231	-2.63
Quartile 4	Intercept	0.0072	0.00606	1.19
	Fundamental Q	2.9483**	0.5999	4.91
	Beef income	-0.2562**	0.0423	-6.05
	Grain income	0.4569**	0.0454	10.06
	Cash crop income	0.3444**	0.0712	4.84
	Non-farm income	-0.0745	0.0991	-0.75
	Government payments	0.0248	0.1072	0.23
	Operator age	-321.7	285.7	-1.13
	Personal Consumption Expenditure Price Index	29,204.8	18911.2	1.54
	Machinery & Equipment Depreciation	6.7294**	0.8091	8.32
	Motor Vehicle and Listed Property Depreciation	3.5682**	0.495	7.21
	Building Depreciation	-2.0914**	0.7985	-2.62
	Interest payments	0.5537**	0.212	2.61

** Statistically significant at α=0.005 and * statistically significant at α=0.05 level.

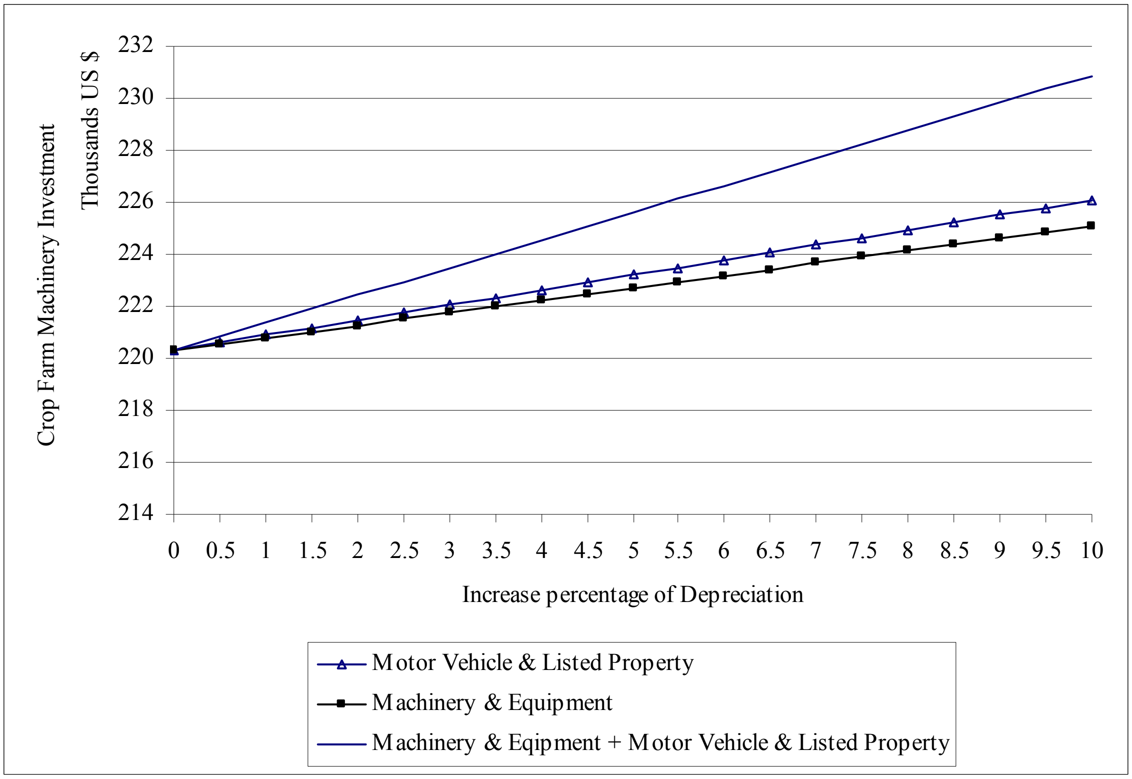

Figure 1: Effects of Increase Percentage Depreciation on Crop Farm Machinery Investment on an Average Farm