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Do Government Payments Influence Farm Size and Survival?

Nigel D. Key and Michael J. Roberts

Using farm-level data from the 1987, 1992, and 1997 *Census of Agriculture*, this study estimates what effect agricultural payments have had on the likelihood of farm business survival and on farm size. The unique panel data set permits conditioning current farm size on past farm size, which removes much of the individual heterogeneity of farms that could be spuriously correlated with payment levels. Results indicate that between consecutive censuses, past per acre payments have a significant positive effect on farm business survival and a small yet significant influence on the size of continuing farms.

Key words: agricultural payments, exit rate, farm size, growth, payment limits, survival

Introduction

Although the influence of government payments on agricultural structure has long been of interest to policy makers and economists, recent increases in payments to farmers have heightened concern that farm payments are hastening the concentration of agricultural production to the detriment of small farms. In 2000, the Environmental Working Group argued that government payments have allowed large farms to "increase their competitive advantage over smaller producers, making it that much more difficult for small and medium sized farmers to make a profit from their farming operations" (Williams-Derry and Cook, 2000, p. 6). During the most recent farm bill debate, Senator Hagel expressed his view that agricultural payments "only widen the disparity gaps between large and small farmers" (Egan, 2004). Concern about the distribution of farm payments spurred congressional efforts to tighten payment caps on large-scale producers (e.g., Nelson, 2002). Though these efforts failed, the 2002 Farm Act created a Commission on the Application of Payment Limitations for Agriculture to study the effects of limitations on the receipt of direct payments, countercyclical payments, loan deficiency payments, and marketing loan gains by producers.

In this study we test whether government payments influence the likelihood of farm survival and subsequent farm size using a unique, limited-access, farm-level panel data set derived from the 1987, 1992, and 1997 *Census of Agriculture*. A major challenge to estimating the effect of government payments on farm structure is identifying an exogenous source of variation in government payments. Government payments are determined largely by farm size and crop mix, and crop mix is an important determinant of

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farm size. For example, due to the design of farm programs, grain farms receive far more government payments than vegetable and fruit farms. Grain farms also tend to be larger than vegetable and fruit farms, creating a positive relationship between payments and farm size that is not causal.

This study attempts to isolate an exogenous source of variation in government payments—differences in payments that result from differences in "base acreage" in otherwise similar farms. Farmers who operate the same amount of land, located in the same county, and producing the same crop received different levels of government payments if they had different amounts of land enrolled as "base acres"—i.e., land enrolled in a particular commodity program based on past plantings. Prior to 1996, acreage reduction provisions and restrictions on what could be planted on base acreage discouraged some farmers from fully participating in government programs; between 15% and 40% of eligible cropland was not enrolled in a federal program [U.S. Department of Agriculture/ Economic Research Service (USDA/ERS), various years]. Due to historical variation in enrollment, similar farms had different base acres and received different amounts of government payments.

Our approach is to estimate a reduced-form relationship between government payments per acre of farmland and the likelihood of survival and subsequent farm size, controlling for farm heterogeneity using fixed effects associated with the county where the farm is located, the primary crop produced by the farm [determined by its six-digit Standard Industrial Classification (SIC) code], and other operator and operation characteristics. By limiting the variation in government payments per acre to within-county, within-crop variation, we purge the variability associated with those features of the farm which may be spuriously correlated with farm size and exit rates. The remaining variation in payments per acre should stem from within-county differences in the "base acreage." Furthermore, the panel data set allows us to condition current farm size on past farm size, thereby removing much of the individual heterogeneity of farms which may be spuriously correlated with payment levels.

Literature

There is a large theoretical and empirical literature relating to firm size and firm survival. Jovanovic (1982), Ericson and Pakes (1992), and Pakes and Ericson (1998) present models in which firms (or entrepreneurs) are uncertain about their own efficiencies at startup. In these models, entrepreneurs gradually learn about their firm's abilities over time. The longer an entrepreneur operates in the market, the more information he or she gathers. Those entrepreneurs who revise their perceptions of their ability upward tend to expand, while those revising downward tend to contract or exit. Consequently, the longer a firm has existed, the bigger it will become and the less likely it will be to fail. Empirical studies generally confirm these theoretical predictions (Dunne, Roberts, and Samuelson, 1988; Baldwin and Gorecki, 1991; Audretsch, 1991; Audretsch and Mahmood, 1995).

For small businesses, the personal characteristics of the owner, such as educational attainment, can be important for business survival (Bates, 1990; Taylor, 1999). In agriculture, the farm operator's age may be an important determinant of farm size and business survival. Age may be correlated to knowledge about the firm's competitive abilities—with older owners able to acquire more information than their younger counterparts (Jovanovic, 1982). Alternatively, the operator's age may be related to financial liquidity. In the presence of liquidity constraints, it may take many years for business owners to accumulate sufficient net worth to attain a certain scale of production (Evans and Jovanovic, 1989; Holtz-Eakin, Joulfaian, and Rosen, 1994).

Although a limited number of econometric studies have attempted to explain changes in the size and survival of farms based on characteristics of the farm operator or farm (Sumner and Leiby, 1987; Hallam, 1993; Zepeda, 1995; Weiss, 1999; Kimhi and Bollman, 1999), none have considered the role of government payments. In general, the relationship between government payments and farm size and survival is ambiguous. In fact, in the absence of transaction costs or market imperfections, there would seem to be no theoretical link. This point is illustrated by the neoclassical model of structural change developed by Kislev and Peterson (1983) in which the quantity of agricultural land is fixed, and labor and capital are mobile between agricultural and nonagricultural sectors. In their model, an increase in government payments increases returns to farming but additional profits are capitalized into the price of land. Because a change in government payments has no effect on the relative returns to labor or capital or on the capital-land ratio, a change in payments does not affect the optimal farm size.

Kislev and Peterson (1983) modeled the behavior of one representative farm with perfect markets. In reality, transaction costs and market imperfections create a range of farm sizes, and a variety of mechanisms through which payments can affect farm structure. If payments *per acre* are unequally distributed across farms of different sizes, then an increase in payments could influence farm structure. Higher payments per acre for a particular farm size group would allow this group to expand and bid up the prices of fixed resources—especially land—which can cause other size farms to shrink or exit.

The unequal distribution of *total* payments could also influence farm size and exits through capital or labor market mechanisms. Liquidity constraints may cause a farm's cost of capital to depend on its net worth: farms with greater net worth face lower borrowing costs because they have more resources with which to secure a loan (e.g., Hubbard, 1998). If this is the case, an increase in income from government payments raises the net worth of a farm, which makes it less costly for the farm to obtain financing to increase farm size. If large farms are liquidity constrained and small farms are not, then an increase in payments causes large farms to expand and increase in number, which bids up land prices and causes small farms to shrink and decline in number (Key and Roberts, 2005). Likewise, if both large and small farms are liquidity constrained, then the effect of an increase in government payments on farm size and numbers is ambiguous.

Total payments could also influence farm size and survival by altering farm operator labor-leisure decisions through a wealth effect. Higher payments increase farm income, which, if leisure is a normal good, induces farmers to substitute leisure for labor. With perfect markets this substitution would not affect on-farm labor levels or farm size—i.e., hired labor would provide a perfect substitute for own labor. However, with imperfect markets, farm household consumption and production decisions are nonseparable and the optimal allocation of labor may differ from that of a profit-maximizing firm (Lopez, 1984; Strauss, 1986). Hence, with imperfect labor markets, higher government payments could reduce on-farm labor, production, and farm size. In general equilibrium, however, the effect of payments on farm size is ambiguous. For example, an increase in payments could cause large farms to reduce on-farm labor and consequently reduce their demand for land, resulting in lower land prices. Lower land prices could induce small farms to expand, despite a wealth effect from the government payments.

Given the theoretical ambiguity of the effect of payments on structure, we address the empirical question as to whether the level of farm payments has had any effect on the size or survival of individual farms. A few studies have examined the relationship over time between government payments and *aggregate* measures of farm structure, including the national agricultural bankruptcy rate (Shepard and Collins, 1982), the total number of farms (Tweeten, 1993), and average farm size (Huffman and Evenson, 2001). To our knowledge, this is the first study to examine the effect of government payments on the size and survival of individual farms.

Data

The data used in this study are from the *Census of Agriculture* longitudinal file maintained by the USDA's National Agricultural Statistics Service.[1] The longitudinal file includes a subset of responses from the agricultural censuses conducted in 1978, 1982, 1987, 1992, and 1997. The farm operation-level file allows researchers to track changes in particular operations at four- or five-year intervals. There are approximately 4.5 million records in the longitudinal file—approximately one million observations per census.

Table 1 reports summary statistics on the size and number of farms for each census year between 1978 and 1997. The table illustrates the increasing concentration among large farms in the production of the major field crops.[2] The number of farms with more than 800 acres increased between 1978 and 1997, with their collective share of total farmland rising from 47.4% to 62.1%. In contrast, smaller farms declined in number and farmland share.

For this analysis we use only data from the census years in which information about government payments received by the farm household are available: 1987, 1992, and 1997. We pool two two-period panels (1987–1992 and 1992–1997), permitting us to examine how government payments in the first period (1987 or 1992) influenced growth and survival between consecutive periods. Each two-period panel consists of farms that either "survived" or exited between the consecutive five-year periods between censuses (1987 and 1992, or 1992 and 1997). The sample does not include farms that entered production between the five-year periods. Farms are defined as "surviving" if they report operating at least 10 acres of land in consecutive censuses. To eliminate differences which may occur due to a change in the farm operator, we keep only those surviving farms for which the age of the operator differs by five years—i.e., the length of time between consecutive censuses.[3]

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[1] More information about the *Census of Agriculture* can be found online at http://www.nass.usda.gov/census/. To protect the confidentiality of respondents, access to the micro files is limited and analysis must be performed on-site at the U.S. Department of Agriculture.

[2] The data used to construct the table are limited to farms in the 765 counties where land in barley, corn (grain), cotton, hay, oats, rice, sorghum (grain), soybeans, and wheat represented at least 90% of the total land harvested.

[3] The *Census of Agriculture* longitudinal file tracks census file numbers (CFNs) that are associated with the farm business rather than the farm operator. A farm is defined as out of business if there is no response to the census questionnaire or if the questionnaire is returned stating the farm is no longer operating. If a farm changes operators through a business transaction or inheritance, the CFN may not change.

Table 1. Farm Structure for Agricultural Census Years 1978–1997 in Major Commodity-Producing Counties

Description	Census Year				
	1978	1982	1987	1992	1997
Total Number of Farms	660,392	627,230	562,014	507,885	497,363
Mean (acres)	344.50	362.31	390.85	428.66	431.53
Farmland (acres): Number of Farms					
Farmland < 10	35,415	39,365	38,599	33,093	28,700
10 ≥ Farmland < 100	199,922	193,500	168,641	153,319	164,723
100 ≥ Farmland < 200	142,182	125,148	109,299	94,897	92,459
200 ≥ Farmland < 400	144,063	128,370	108,169	93,061	84,521
400 ≥ Farmland < 800	89,714	87,764	80,456	72,962	65,347
Farmland ≥ 800	49,096	53,083	56,850	60,553	61,613
Farmland (acres): Percent of Farms					
Farmland < 10	5.36	6.28	6.87	6.52	5.77
10 ≥ Farmland < 100	30.27	30.85	30.01	30.19	33.12
100 ≥ Farmland < 200	21.53	19.95	19.45	18.68	18.59
200 ≥ Farmland < 400	21.81	20.47	19.25	18.32	16.99
400 ≥ Farmland < 800	13.58	13.99	14.32	14.37	13.14
Farmland ≥ 800	7.43	8.46	10.12	11.92	12.39
Farmland (acres): Percent of Farmland					
Farmland < 10	0.05	0.06	0.06	0.06	0.06
10 ≥ Farmland < 100	4.46	4.17	3.76	3.40	3.67
100 ≥ Farmland < 200	9.00	7.91	7.14	6.23	6.13
200 ≥ Farmland < 400	17.75	15.89	13.84	12.02	11.03
400 ≥ Farmland < 800	21.35	21.06	20.23	18.61	16.97
Farmland ≥ 800	47.38	50.90	54.96	59.67	62.13

Source: *U.S. Census of Agriculture*, 1978, 1982, 1987, 1992, and 1997.

Note: Sample includes all farms in the 765 counties where total land harvested in the nine major field commodities [barley, corn (grain), cotton, hay, oats, rice, sorghum (grain), soybeans, and wheat] represented at least 90% of the total land harvested in the county as measured by the census in 1987, 1992, and 1997.

To reduce sample heterogeneity, we limit the sample to farms with SIC codes identifying the primary commodity produced as wheat, corn, soybeans, or cash grains in the lagged period (either 1987 or 1992). These four SIC commodity classes receive the largest shares of government farm payments. Because we perform separate analyses for each SIC type, we ensure enough within-county variation for identification by limiting the sample to farms in counties with at least 30 farms with the same SIC code. In addition, to minimize the effect of outliers, we limit the sample to farms having fewer than 10,000 acres in the lagged period.

Table 2 defines and reports summary statistics for all the variables used in this study except for the age and county indicators. Lagged government payments (1987 and 1992), which ranged from $18.69 to $30.67 per acre, represent a sizeable share of expected net returns—which have been estimated to range between $50 and $200 per acre (USDA/ERS, 2004). The survival rate for the five-year periods between censuses varied from 50.6% for soybean farms to 62.0% for "cash grain" farms. These survival rates are somewhat lower than have been reported for farms elsewhere because the surviving farms

Table 2. Variable Definitions and Summary Statistics for Continuing and Exit Samples

Variable Name	Definition	Wheat Mean/(SD)	Corn Mean/(SD)	Soybeans Mean/(SD)	Cash Grains Mean/(SD)
Land	Land in farm (acres owned plus rented in minus rented out)	1,398.78 (1,538.34)	530.54 (609.40)	377.82 (485.00)	684.01 (797.48)
L_*Land*	Lagged land in farm (acres)	1,188.85 (1,368.30)	425.18 (513.26)	306.66 (417.80)	610.99 (706.93)
L_*Land*1	10 ≤ lagged land in farm (acres) < 200	0.195 (0.396)	0.425 (0.494)	0.561 (0.496)	0.271 (0.445)
L_*Land*2	200 ≤ lagged land in farm (acres) < 400	0.142 (0.349)	0.210 (0.408)	0.199 (0.400)	0.226 (0.418)
L_*Land*3	400 ≤ lagged land in farm (acres) < 600	0.193 (0.394)	0.212 (0.409)	0.154 (0.361)	0.260 (0.439)
L_*Land*4	600 ≤ lagged land in farm (acres) < 1,600	0.219 (0.413)	0.121 (0.326)	0.068 (0.251)	0.171 (0.377)
L_*Land*5	1,600 ≤ lagged land in farm (acres) < 10,000	0.252 (0.434)	0.032 (0.177)	0.018 (0.133)	0.071 (0.258)
Sales	Value of sales ($)	92,276 (142,773)	138,073 (200,393)	81,254 (127,876)	140,444 (193,953)
L_*Sales*	Lagged value of sales ($)	71,034 (94,937)	96,334 (139,866)	57,130 (92,293)	114,977 (149,314)
L_*Sales*1	0 ≤ lagged sales ($) < 15,000	0.288 (0.453)	0.264 (0.441)	0.378 (0.485)	0.152 (0.359)
L_*Sales*2	15,000 ≤ lagged sales ($) < 50,000	0.294 (0.456)	0.254 (0.435)	0.305 (0.460)	0.273 (0.445)
L_*Sales*3	50,000 ≤ lagged sales ($) < 100,000	0.186 (0.389)	0.170 (0.376)	0.148 (0.356)	0.202 (0.402)
L_*Sales*4	100,000 ≤ lagged sales ($) < 250,000	0.183 (0.387)	0.213 (0.410)	0.130 (0.336)	0.255 (0.436)
L_*Sales*5	250,000 ≤ lagged sales ($)	0.049 (0.217)	0.099 (0.298)	0.038 (0.192)	0.118 (0.323)
L_*GovPay*	Lagged government payments (1997 $)	20,409 (28,571)	14,210 (30,870)	7,232 (15,123)	14,623 (23,736)
L_*GovPay/Acre*	Lagged government payments per acre (1997 $/acre)	18.75 (18.90)	30.67 (39.93)	18.69 (27.99)	23.32 (28.59)
*Year*1992	Current year is 1992 (not 1997)	0.523 (0.499)	0.464 (0.499)	0.649 (0.477)	0.522 (0.500)
L_*Occup–Nonfarm*	Lagged principal occupation of operator not farming	0.261 (0.439)	0.330 (0.470)	0.417 (0.493)	0.213 (0.409)
L_*Tenure–Owner*	All land in farm owned	0.334 (0.472)	0.409 (0.492)	0.458 (0.498)	0.306 (0.461)
L_*Tenure–Tenant*	All land in farm rented in	0.469 (0.499)	0.399 (0.490)	0.358 (0.479)	0.521 (0.500)
L_*Tenure–Mixed*	Land in farm owned and rented in	0.197 (0.398)	0.192 (0.394)	0.183 (0.387)	0.172 (0.378)
L_*Org–Family*	Lagged organization type = family or individual	0.825 (0.380)	0.854 (0.353)	0.875 (0.331)	0.853 (0.354)
L_*Org–Partner*	Lagged organization type = partnership	0.101 (0.301)	0.100 (0.300)	0.095 (0.294)	0.106 (0.307)

(continued . . .)

Table 2. Continued

Variable Name	Definition	Wheat Mean/(SD)	Corn Mean/(SD)	Soybeans Mean/(SD)	Cash Grains Mean/(SD)
L_*Org–Incorp*	Lagged organization type = incorporated under state law	0.065 (0.246)	0.038 (0.192)	0.023 (0.150)	0.036 (0.187)
L_*Org–Other*	Lagged organization type = other (estate, trust, etc.)	0.009 (0.096)	0.008 (0.088)	0.006 (0.080)	0.005 (0.069)
Survive	Farm operation in business in current period	0.533 (0.499)	0.531 (0.499)	0.506 (0.500)	0.620 (0.485)
No. of Observations		52,578	158,434	117,571	139,815

Source: *U.S. Census of Agriculture*, 1987, 1992, and 1997.

in this sample are restricted to those where the age of the operator in consecutive censuses differs by five years (plus or minus one year). In addition, because some census questionnaire nonresponses are classified as exits even if the farm is still operating (see footnote 3), the census underestimates the actual survival rate to some degree. Despite these qualifications, the five-year survival rates—equivalent to annual exit rates between 8% and 13%—are not out of line with survival rates for small nonfarm businesses (e.g., Audretsch, 1991; Disney, Haskel, and Heden, 2003).

Empirical Approach

We are interested in how a change in government payments affects farm size and the likelihood of surviving. The expected size of all farms in the next period, including the ones that fail, depends on the probability of survival (P) and the expected farm size conditional on survival:

$$E(S \mid \mathbf{X}, G) = P(\mathbf{X}, G)E(S \mid Survive, \mathbf{X}, G),$$

where S is a measure of farm size, $\mathbf{X}$ denotes farm and farm operator characteristics, and G is government payments. The expected marginal effect of a change in government payments on farm size is therefore:

$$\text{(1)} \quad \mathrm{d}E(S \mid \mathbf{X}, G)/\mathrm{d}G = (\mathrm{d}P(\mathbf{X}, G)/\mathrm{d}G)E(S \mid Survive, \mathbf{X}, G) + P(\mathbf{X}, G)\mathrm{d}E(S \mid Survive, \mathbf{X}, G)/\mathrm{d}G.$$

As (1) indicates, payments influence expected farm size by affecting both the probability of surviving in farming and the scale of those who survive. There are two possible measures of the effect of payments on scale. The conditional marginal effect $\mathrm{d}E(S \mid Survive, \mathbf{X}, G)/\mathrm{d}G$ indicates how government payments influence the size of surviving farms. The unconditional marginal effect $\mathrm{d}E(S \mid \mathbf{X}, G)/\mathrm{d}G$ indicates how payments affect all farmers, not just those farmers who survive to the next period. An alternative approach would have been to consider the effect of payments on growth rates rather than size (Dunne, Roberts, and Samuelson, 1989). Explaining firm growth rates requires distinguishing between a *realized* growth rate which includes operations that exited and a growth rate for survivors only—a distinction which is analogous to that made here between the conditional and unconditional expected farm size.

A probit regression can be used to obtain unbiased estimates of the effect of a change in payments on the probability of surviving $dP(\mathbf{X}, G)/dG$. However, an OLS regression to estimate the effect of government payments on farm size $dE(S \mid Survive, \mathbf{X}, G)/dG$ using the sample of surviving farms may be biased due to sample attrition if unobservable factors are correlated with the likelihood of survival and farm growth. For example, suppose government payments and an unobservable factor such as "farming ability" are both positively correlated with the probability of survival and the rate of farm growth. If this were the case, then farmers with high ability will be over-represented among the sample of survivors. Selection bias arises because within the sample of survivors, ability is negatively correlated with government payments: farmers must have high levels of ability to overcome low government payments, and farmers with low ability need high payments to survive. Estimates of the effect of payment on farm size would therefore be biased toward zero. To address potential sample selection bias, we employ a maximum-likelihood approach.

Results

The estimated maximum-likelihood coefficients associated with the sample selection model are presented in table 3. Farm size is defined as the amount of land in the operation according to the census: the land owned by the operator plus land rented in minus land rented out. Section A of table 3 reports the coefficients associated with variables explaining the probability of survival between census periods, while section B presents coefficients associated with variables explaining farm size. We estimate separate regressions corresponding to the four lagged SIC commodity codes to allow for the estimation of different parameters across the commodity types, and to reduce the heterogeneity within each sample. The likelihood of surviving and farm size in the current period are hypothesized to depend on the age of the operator, farm size in the previous period, lagged government payments per acre, and indicators for operator occupation, land tenure, and organizational structure. We also control for fixed effects associated with the county of the operation and the year of the survey. A farm size categorical variable is interacted with the government payments per acre to allow the effect of payments on farm size to vary with scale.

To make interpretation of the estimated coefficients more intuitive, coefficients corresponding to the likelihood of farm survival in section A of table 3 are presented as the average estimated marginal effects for the sample.[4] The parameter estimates and significance tests for the survival equation display several consistent results across the regressions. Compared to the missing age category (<35 years), operations with middle-aged operators (35–60 years) are more likely to survive, while those with older operators (≥60 years) are less likely to survive. Age is positively correlated with survival for operators until age 55 (the coefficients for each consecutive age category increase over this range). The fact that age is positively correlated with business survival is consistent with the studies of firm growth and survival mentioned above.[5] The natural logarithm

[4] The estimated marginal effect of the independent variables on the probability of surviving is $dP/d\mathbf{Z} = f(\mathbf{BZ})\mathbf{B}$, where f is the normal density function, $\mathbf{Z}$ is the matrix of independent variables ($\mathbf{X}$ and G), and $\mathbf{B}$ is the vector of estimated parameters.

[5] For this study, a farm business "survives" only if it has the same operator (identified by age, as discussed in the text). Hence, the fact that the survival rate begins declining with operator age after 55 years is not surprising because we expect the rate at which operators retire to increase after this age.

Table 3. Sample Selection Model Coefficients: Land in Farm

	Wheat		Corn		Soybeans		Cash Grains	
Variable	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error
A. Dependent Variable: *Probability of Survival*								
35 ≤ L_*Age* < 40	0.0601*	0.0246	0.0737*	0.0133	0.0700*	0.0162	0.1044*	0.0142
40 ≤ L_*Age* < 45	0.0942*	0.0247	0.0644*	0.0132	0.0502*	0.0159	0.1018*	0.0143
45 ≤ L_*Age* < 50	0.0979*	0.0250	0.0991*	0.0135	0.0837*	0.0158	0.1469*	0.0147
50 ≤ L_*Age* < 55	0.1326*	0.0248	0.0898*	0.0133	0.1087*	0.0156	0.1531*	0.0145
55 ≤ L_*Age* < 60	0.1032*	0.0243	0.0147	0.0131	0.0266	0.0153	0.0670*	0.0141
60 ≤ L_*Age* < 65	-0.1258*	0.0234	-0.3245*	0.0131	-0.2482*	0.0153	-0.2441*	0.0139
65 ≤ L_*Age* < 70	-0.0687*	0.0243	-0.2156*	0.0143	-0.1926*	0.0165	-0.1479*	0.0155
L_*Age* ≥ 70	-0.3319*	0.0225	-0.4459*	0.0141	-0.4179*	0.0159	-0.4206*	0.0151
log(L_*Land in Farm*)	0.1644*	0.0150	0.1748*	0.0069	0.1856*	0.0072	0.1569*	0.0102
L_*Land*1 (10–200)	0.1293	0.0574	0.0812	0.0362	0.1938*	0.0480	0.2884*	0.0391
L_*Land*2 (200–400)	0.0828	0.0452	0.0462	0.0322	0.1308*	0.0449	0.2408*	0.0315
L_*Land*3 (400–800)	0.1194*	0.0368	0.0178	0.0305	0.1060	0.0443	0.1955*	0.0276
L_*Land*4 (800–1,600)	0.0647	0.0304	-0.0066	0.0318	0.0989	0.0461	0.0745*	0.0253
(L_*GovPay/Acre*) ∗ L_*Land*1	0.0025*	0.0005	0.0008*	0.0001	0.0008*	0.0002	0.0004	0.0002
(L_*GovPay/Acre*) ∗ L_*Land*2	0.0046*	0.0008	0.0010*	0.0002	0.0017*	0.0003	0.0007*	0.0003
(L_*GovPay/Acre*) ∗ L_*Land*3	0.0029*	0.0007	0.0019*	0.0002	0.0027*	0.0004	0.0015*	0.0003
(L_*GovPay/Acre*) ∗ L_*Land*4	0.0047*	0.0007	0.0022*	0.0004	0.0036*	0.0006	0.0034*	0.0004
(L_*GovPay/Acre*) ∗ L_*Land*5	0.0065*	0.0009	0.0016	0.0007	0.0032	0.0015	0.0041*	0.0008
*Year*1992	0.1549*	0.0122	0.1254*	0.0078	0.0786*	0.0084	0.0602*	0.0081
L_*Occup–Nonfarm*	-0.0301	0.0149	0.0101	0.0083	0.0325*	0.0093	-0.0453*	0.0100
L_*Tenure–Tenant*	0.3325*	0.0145	0.3230*	0.0087	0.3070*	0.0098	0.3038*	0.0094
L_*Tenure–Mixed*	0.0969*	0.0170	0.1196*	0.0100	0.0732*	0.0114	0.0912*	0.0116
L_*Org–Partner*	-0.4319*	0.0194	-0.4770*	0.0112	-0.4248*	0.0132	-0.5115*	0.0116
L_*Org–Incorp*	-0.2021*	0.0241	-0.2579*	0.0172	-0.3450*	0.0256	-0.2192*	0.0191
L_*Org–Other*	-0.4249*	0.0597	-0.5128*	0.0385	-0.4970*	0.0492	-0.4665*	0.0504
Intercept	-1.3174*	0.1236	-1.1846*	0.0967	-1.3890*	0.0823	-0.8928*	0.2476
County Fixed Effects	yes		yes		yes		yes	
B. Dependent Variable: *Log of Land* (farm size)								
35 ≤ L_*Age* < 40	-0.0766*	0.0118	-0.0735*	0.0060	-0.0824*	0.0077	-0.0753*	0.0056
40 ≤ L_*Age* < 45	-0.1198*	0.0114	-0.1334*	0.0057	-0.1409*	0.0074	-0.1337*	0.0055
45 ≤ L_*Age* < 50	-0.1383*	0.0112	-0.1623*	0.0057	-0.1558*	0.0071	-0.1574*	0.0054
50 ≤ L_*Age* < 55	-0.1518*	0.0108	-0.1920*	0.0055	-0.1884*	0.0070	-0.1817*	0.0053
55 ≤ L_*Age* < 60	-0.2055*	0.0107	-0.2443*	0.0055	-0.2391*	0.0069	-0.2404*	0.0053
60 ≤ L_*Age* < 65	-0.2926*	0.0112	-0.3586*	0.0062	-0.3426*	0.0076	-0.3650*	0.0061
65 ≤ L_*Age* < 70	-0.3155*	0.0116	-0.3336*	0.0068	-0.3298*	0.0081	-0.3474*	0.0064
L_*Age* ≥ 70	-0.3275*	0.0113	-0.3464*	0.0071	-0.3334*	0.0083	-0.3515*	0.0069
log(L_*Land*)	0.9482*	0.0072	0.9417*	0.0035	0.9308*	0.0037	0.9399*	0.0047
L_*Land*1 (10–200)	-0.0091	0.0271	-0.0300	0.0136	-0.0319	0.0199	-0.0379	0.0165
L_*Land*2 (200–400)	-0.0250	0.0215	-0.0402*	0.0109	-0.0278	0.0179	-0.0531*	0.0127
L_*Land*3 (400–800)	-0.0121	0.0165	-0.0350*	0.0093	-0.0034	0.0171	-0.0354*	0.0109
L_*Land*4 (800–1,600)	-0.0182	0.0125	-0.0119	0.0087	0.0304	0.0171	-0.0169	0.0087

(continued . . .)

Table 3. Continued

Variable	Wheat Coeff.	Wheat Std. Error	Corn Coeff.	Corn Std. Error	Soybeans Coeff.	Soybeans Std. Error	Cash Grains Coeff.	Cash Grains Std. Error
B. Dependent Variable: *Log of Land* (cont'd.)								
(L_*GovPay/Acre*) * L_*Land*1	0.0013*	0.0003	0.0007*	0.0001	0.0012*	0.0001	0.0007*	0.0001
(L_*GovPay/Acre*) * L_*Land*2	0.0016*	0.0004	0.0004*	0.0001	0.0008*	0.0001	0.0007*	0.0001
(L_*GovPay/Acre*) * L_*Land*3	0.0013*	0.0003	0.0005*	0.0001	0.0007*	0.0001	0.0005*	0.0002
(L_*GovPay/Acre*) * L_*Land*4	0.0016*	0.0003	0.0004*	0.0001	0.0005*	0.0002	0.0006*	0.0001
(L_*GovPay/Acre*) * L_*Land*5	0.0010*	0.0003	0.0003*	0.0001	0.0024*	0.0005	0.0007*	0.0002
*Year*1992	0.0227*	0.0054	0.0263*	0.0034	0.0075	0.0038	0.0192*	0.0034
L_*Occup–Nonfarm*	-0.0398*	0.0074	-0.0658*	0.0040	-0.0516*	0.0045	-0.0615*	0.0044
L_*Tenure–Tenant*	-0.0541*	0.0067	-0.0219*	0.0040	-0.0350*	0.0045	-0.0398*	0.0039
L_*Tenure–Mixed*	-0.0132	0.0086	0.0198*	0.0049	0.0226*	0.0058	-0.0058	0.0050
L_*Org–Partner*	0.0091	0.0099	-0.0007	0.0058	-0.0170	0.0071	0.0064	0.0052
L_*Org–Incorp*	0.0058	0.0093	0.0501*	0.0068	0.0617*	0.0104	0.0504*	0.0066
L_*Org–Other*	0.0189	0.0306	-0.0359	0.0188	-0.0371	0.0278	-0.0020	0.0220
Intercept	0.5825*	0.0595	0.4662*	0.0534	0.5283*	0.0432	0.5414*	0.0935
County Fixed Effects	yes		yes		yes		yes	
ρ	0.0258*	0.0078	0.0659*	0.0054	0.0883*	0.0086	0.0321*	0.0048
σ	0.4059*	0.0025	0.3972*	0.0014	0.4056*	0.0017	0.3870*	0.0014
Wald Test of Indep. Eqns. (ρ = 0): χ^2 / (*p*-Value)	10.98 (0.0009)		148.77 (0.0000)		103.96 (0.0000)		43.97 (0.0000)	
Log Likelihood	-48,584		-143,337		-106,703		-127,939	
Wald χ^2 / (*p*-Value)	210,737 (0.0000)		652,276 (0.0000)		445,054 (0.0000)		559,735 (0.0000)	
No. of Censored Observations	24,541		74,289		58,110		53,170	
No. of Uncensored Observations	28,036		84,145		59,461		86,645	
Total Observations	52,577		158,434		117,571		139,815	

Note: An asterisk (*) denotes coefficient is significant at the 1% confidence level.

of farm size in the previous period is positively correlated with the probability of survival. This finding is also consistent with the empirical studies of nonagricultural firms discussed above. The lagged farm size categorical variables are included in the regressions because they are required to isolate the effect of lagged government payments on farms of different sizes.[6] The tenure status of the farm is significant—having all farmland rented by the operator or renting some farmland is associated with an increased likelihood of survival compared to owning all farmland. Compared to being organized as a family farm, being organized as a partnership, corporation, or some other way is associated with a decreased likelihood of survival.[7]

[6] The categorical variables also make the parametric relationship between lagged farm size and current farm size more flexible, as they permit a fixed effect for each farm size category. These categorical variables are not highly significant because the explanatory variables include the natural logarithm of farm size (log(L_*Land*)). If log(L_*Land*) was not included as a regressor, the farm size categorical variables would be highly significant.

[7] Differences in observed survival rates between partnerships or corporations and family farms depend on how likely a manager/operator is to respond to the survey and how often these organizations change managers/operators. It is possible that differences in survival rates reflect these reporting issues rather than "true" differences in survival.

Of particular interest, an increase in government farm payments per acre is positively associated with the likelihood of surviving over the subsequent five years. This effect was statistically significant at the 1% level for all farm sizes, except for farms larger than 1,600 acres producing corn or soybeans, and cash grain farms with fewer than 200 acres. The magnitude of the association generally increases across farm size categories. For example, for wheat farms with less than 200 acres, an extra $10 per acre in payments is associated with a 2.5 percentage point increase in the likelihood of surviving (from an average five-year survival rate of 38.2%). For wheat farms with more than 1,600 acres, the extra payments increase the likelihood of surviving by about 6.5 percentage points (from an average five-year survival rate of 62.7%).

Estimates of the coefficients corresponding to the farm size equation in section B of table 3 also display several consistent patterns. The natural logarithm of lagged farm size is very significant and explains most of the variation in the natural logarithm of current farm size.[8] Age is also strongly correlated with farm size growth. Controlling for past farm size, farms with operators older than 35 years of age grow less than farms with younger operators. Hence, while farms with younger operators (less than 35 years) are less likely to survive than those with older operators (35–60 years), if they do survive, farms with younger operators grow more than farms with older operators. Farms with operators not having farming as a primary occupation grew less than farms with operators having farming as their primary occupation. Tenure was also associated with farm size change: farmers who owned all their land expanded their operations more than farmers who did not own all their land. The organizational structure of the farm business is also a significant factor associated with farm size change: farms that are incorporated under state law grow 5–6 percentage points more on average than operations organized as family/individual farms.

The correlation between the errors (ρ) is estimated to be small and positive. We can reject the null hypothesis that the correlation between the errors of the two equations is zero at the 0.001% confidence level for every commodity. This result implies that not controlling for farm survival would bias coefficients in the farm size equation, and therefore bias the estimated effect of government payments on farm size.

Lagged government payments are positively associated with farm size change over the five-year periods between censuses. The lagged payments per acre coefficients are statistically significant at the 1% confidence level for all of the commodity-size categories. Table 4 presents these coefficients for each crop and farm size category in a way that facilitates interpretation. Columns [1] and [2] show the estimated effect of lagged payments on expected farm size conditional on the farm surviving. Column [1] expresses the marginal effect on farmland acres of an increase in payments per acre and column [2] expresses the effect as an elasticity. The effect of payments conditional on survival is small: most elasticity estimates range between 0.01 and 0.02, implying a 10% increase in payments per acre is associated with only a 0.1%–0.2% increase in farm size. For mid-sized continuing farms with between 400 and 800 acres, a $10 per acre increase in government payments is associated with an increase in farm size of 2.7–7.3 acres over five years, depending on the main crop produced by the farm.

[8] Inclusion of lagged farm size as an explanatory variable may introduce serial correlation in the error. Because there are only two or three observations for each farm, this introduces a mild degree of dependence (most of the variation in the error is cross-sectional). We did estimate a model with first-order autocorrelation which failed to reject the hypothesis that the autocorrelation parameter equaled zero; the coefficient estimates and standard errors were nearly identical to those we report in table 3.

Table 4. Effect of Government Payments on Expected Farm Size

Commodity	Lagged Farm Size Category (acres)	Conditional on Survival [1] Marginal Effect [a]	Conditional on Survival [2] Elasticity	Not Conditional on Survival [3] Marginal Effect [a]	Not Conditional on Survival [4] Elasticity	Decomposition of Effect [5] Survival	Decomposition of Effect [6] Farm Size
Wheat	10–200	0.136	0.022	0.313	0.097	0.261	0.052
	200–400	0.475	0.032	1.589	0.195	1.367	0.223
	400–800	0.735	0.026	2.035	0.119	1.639	0.396
	800–1,600	1.758	0.033	6.214	0.175	5.164	1.051
	1,600–10,000	2.656	0.017	18.932	0.163	17.267	1.665
Corn	10–200	0.057	0.017	0.090	0.043	0.065	0.025
	200–400	0.111	0.014	0.336	0.069	0.277	0.060
	400–800	0.273	0.019	1.210	0.119	1.039	0.171
	800–1,600	0.418	0.014	2.581	0.119	2.301	0.280
	1,600–10,000	0.639	0.008	3.838	0.066	3.408	0.430
Soybeans	10–200	0.091	0.016	0.100	0.028	0.060	0.040
	200–400	0.213	0.019	0.570	0.082	0.454	0.116
	400–800	0.368	0.020	1.647	0.126	1.418	0.229
	800–1,600	0.506	0.013	3.981	0.140	3.643	0.338
	1,600–10,000	4.934	0.046	9.633	0.132	6.578	3.055
Cash Grains	10–200	0.072	0.012	0.078	0.016	0.041	0.037
	200–400	0.194	0.017	0.312	0.040	0.194	0.118
	400–800	0.272	0.014	1.001	0.067	0.816	0.184
	800–1,600	0.630	0.016	4.003	0.133	3.571	0.432
	1,600–10,000	1.576	0.014	10.279	0.125	9.232	1.047

Notes: The following equations define the terms in columns [1]–[6], respectively, where the arguments $\mathbf{X}$ and G in the functions $P(\mathbf{X}, G)$ and $E(S \mid Survive, \mathbf{X}, G)$ have been dropped for clarity: [1] $dE(S \mid Survive)/dG$; [2] $[dE(S \mid Survive)/dG] * G / E(S \mid Survive)$; [3] $dE(S)/dG$; [4] $[dE(S)/dG] * G / E(S)$; [5] $(dP/dG) * E(S \mid Survive)$; and [6] $P * dE(S \mid Survive)/dG$.

[a] The marginal effect is the expected change in farm size (acres) attributable to a $1 per acre increase in payments.

Table 4 also presents a decomposition of the effect of lagged payments on farm size not conditional on survival. Column [3] presents the unconditional marginal effect and column [4] expresses this effect as an elasticity. The unconditional effect of payments is much larger than the conditional effect—most of the elasticity estimates are between 0.1 and 0.2, implying a 10% increase in payments per acre is associated with a 1% to 2% increase in expected farm size. For farms with between 400 and 800 acres, a $10 per acre increase in government payments would be associated with an increase in expected farm size of 10.0–20.3 acres over five years.

The unconditional effect of payments is larger than the conditional effect because payments have a relatively large effect on the survival rate. This can be illustrated by decomposing the unconditional effect into two parts [the two summands in equation (1)]. Column [5] shows the effect of payments on expected farm size via its effect on survival, while column [6] shows the effect on expected farm size via its effect on the expected conditional farm size. The effect of payments via survival is about 2 to 10 times larger than the effect via the conditional farm size, depending on the crop and initial farm size. Hence, if we only consider surviving farms, the effect of payments on farm size is small. However, if we account for the fact that payments are associated with higher survival rates (and since farms grow over time, on average), the net effect of government payments on farm size is substantially larger.

To test the robustness of the results to the definition of farm size, we repeat the four commodity regressions using value of sales instead of land to define farm size (table 5). While these regressions provide some insight into the robustness of the result, we consider value of sales inferior to the quantity of farmland as a measure of farm size for this study because sales depend on prices and yields, both of which could be correlated with government payments.[9] Nevertheless, the results presented in table 5 are largely consistent with the results reported in table 3: an increase in government farm payments per acre is significantly associated with an increase in the likelihood of farm survival and in farm size over the subsequent five years. The magnitude of the effect of payments on the likelihood of survival is similar for both definitions of farm size.

Next, we examine the robustness of the results presented in table 3 to alternative model specifications. Table 6 presents the coefficients corresponding to the interaction of lagged government payments per acre and the farm size indicator variables. The first three columns correspond to models with an increasing number of covariates. Column [3] is the full model with all the explanatory variables reported in table 3; column [2] removes county fixed effects; and column [1] further removes the occupation, land tenure, and organization fixed effects. The coefficient estimates are very consistent across model specifications.

Finally, we test the hypothesis that the effect of government payment varies depending on how much the operator works off-farm (serving as a proxy for off-farm income, which is not reported). Column [4] of table 6 presents the results of the full model for the subsample of farm operators who worked fewer than 50 days off-farm.[10]

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[9] If this were the case, then even though past payments are exogenous to current sales, past payments would not be exogenous to past sales, and this could cause a spurious correlation between past payments and the *change* in sales.

[10] The census classifies off-farm work into the following categories: no off-farm work, 1–49 days, 50–99 days, 100–149 days, 150–199 days, or more than 199 days off-farm. The sample that worked fewer than 50 days consisted of 31,054, 84,198, 54,926, and 88,514 observations for wheat, corn, soybeans, and cash grains, respectively.

Table 5. Sample Selection Model Coefficients: Value of Sales

Variable	Wheat Coeff.	Wheat Std. Error	Corn Coeff.	Corn Std. Error	Soybeans Coeff.	Soybeans Std. Error	Cash Grains Coeff.	Cash Grains Std. Error
A. Dependent Variable: *Probability of Survival*								
35 ≤ L_Age < 40	0.0671*	0.0247	0.0798*	0.0133	0.0761*	0.0162	0.1077*	0.0143
40 ≤ L_Age < 45	0.1073*	0.0248	0.0743*	0.0132	0.0609*	0.0159	0.1071*	0.0143
45 ≤ L_Age < 50	0.1170*	0.0250	0.1120*	0.0135	0.0988*	0.0158	0.1552*	0.0147
50 ≤ L_Age < 55	0.1479*	0.0248	0.1075*	0.0133	0.1249*	0.0156	0.1641*	0.0145
55 ≤ L_Age < 60	0.1161*	0.0243	0.0277	0.0131	0.0411*	0.0153	0.0775*	0.0142
60 ≤ L_Age < 65	-0.1228*	0.0235	-0.3157*	0.0131	-0.2366*	0.0154	-0.2354*	0.0140
65 ≤ L_Age < 70	-0.0718*	0.0245	-0.2001*	0.0144	-0.1770*	0.0166	-0.1341*	0.0156
L_Age ≥ 70	-0.3402*	0.0228	-0.4337*	0.0142	-0.4029*	0.0161	-0.4051*	0.0153
log(L_Sales)	0.1371*	0.0119	0.1213*	0.0070	0.1411*	0.0074	0.1317*	0.0090
L_Sales1 (0–15)	-0.0431	0.0655	-0.0650	0.0346	0.0024	0.0437	0.1289*	0.0421
L_Sales2 (15–50)	0.0196	0.0530	-0.1001*	0.0256	-0.0017	0.0368	0.1391*	0.0311
L_Sales3 (50–100)	-0.0093	0.0492	-0.0818*	0.0225	-0.0074	0.0351	0.0759*	0.0265
L_Sales4 (100–250)	-0.0560	0.0466	-0.0533*	0.0199	-0.0288	0.0343	-0.0118	0.0231
(L_GovPay/Acre) * L_Sales1	0.0032*	0.0006	0.0001	0.0002	0.0003	0.0002	0.0001	0.0004
(L_GovPay/Acre) * L_Sales2	0.0024*	0.0006	0.0012*	0.0002	0.0008*	0.0003	0.0002	0.0002
(L_GovPay/Acre) * L_Sales3	0.0014	0.0008	0.0008*	0.0002	0.0009*	0.0004	0.0002	0.0003
(L_GovPay/Acre) * L_Sales4	0.0034*	0.0008	0.0015*	0.0002	0.0030*	0.0004	0.0019*	0.0003
(L_GovPay/Acre) * L_Sales5	0.0006	0.0015	0.0010*	0.0003	0.0029*	0.0008	0.0014*	0.0005
Year1992	0.1256*	0.0123	0.0855*	0.0078	0.0644*	0.0085	0.0330*	0.0081
L_Occup–Nonfarm	-0.0408*	0.0151	0.0139	0.0084	0.0382*	0.0094	-0.0336*	0.0101
L_Tenure–Tenant	0.3558*	0.0145	0.3219*	0.0088	0.3102*	0.0098	0.3013*	0.0094
L_Tenure–Mixed	0.1051*	0.0172	0.1094*	0.0101	0.0598*	0.0115	0.0836*	0.0117
L_Org–Partner	-0.4171*	0.0196	-0.4780*	0.0113	-0.4333*	0.0133	-0.5204*	0.0116
L_Org–Incorp	-0.1905*	0.0243	-0.2691*	0.0173	-0.3666*	0.0258	-0.2422*	0.0193
L_Org–Other	-0.4198*	0.0606	-0.5281*	0.0389	-0.4945*	0.0495	-0.4715*	0.0508
Intercept	-1.5438*	0.1587	-1.3031*	0.1183	-1.6686*	0.1085	-1.3765*	0.2667
County Fixed Effects	yes		yes		yes		yes	
B. Dependent Variable: *Log of Sales*								
35 ≤ L_Age < 40	-0.1159*	0.0209	-0.1032*	0.0097	-0.1405*	0.0127	-0.1136*	0.0088
40 ≤ L_Age < 45	-0.2032*	0.0206	-0.1784*	0.0096	-0.1809*	0.0124	-0.1813*	0.0089
45 ≤ L_Age < 50	-0.2191*	0.0210	-0.2133*	0.0097	-0.2126*	0.0121	-0.2184*	0.0090
50 ≤ L_Age < 55	-0.2395*	0.0202	-0.2428*	0.0096	-0.2634*	0.0119	-0.2432*	0.0088
55 ≤ L_Age < 60	-0.3333*	0.0204	-0.3233*	0.0095	-0.3112*	0.0117	-0.3142*	0.0088
60 ≤ L_Age < 65	-0.4564*	0.0210	-0.4616*	0.0109	-0.4461*	0.0130	-0.5074*	0.0101
65 ≤ L_Age < 70	-0.5040*	0.0220	-0.4645*	0.0122	-0.4560*	0.0141	-0.5142*	0.0116
L_Age ≥ 70	-0.5330*	0.0222	-0.5040*	0.0135	-0.4490*	0.0153	-0.5190*	0.0126
log(L_Sales)	0.6703*	0.0159	0.7287*	0.0106	0.7403*	0.0111	0.7858*	0.0099
L_Sales1 (0–15)	-0.3810*	0.0677	-0.5982*	0.0443	-0.6434*	0.0467	-0.3420*	0.0380
L_Sales2 (15–50)	-0.3380*	0.0481	-0.3822*	0.0286	-0.4853*	0.0327	-0.2939*	0.0279
L_Sales3 (50–100)	-0.2030*	0.0385	-0.2484*	0.0203	-0.3043*	0.0251	-0.2116*	0.0190
L_Sales4 (100–250)	-0.0784*	0.0309	-0.1478*	0.0130	-0.1566*	0.0195	-0.1230*	0.0126

(continued . . .)

Table 5. Continued

	Wheat		Corn		Soybeans		Cash Grains	
Variable	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error
B. Dependent Variable: *Log of Sales* (cont'd.)								
(L_*GovPay/Acre*) * L_*Sales*1	0.0012	0.0007	0.0018*	0.0002	0.0030*	0.0004	0.0012*	0.0004
(L_*GovPay/Acre*) * L_*Sales*2	0.0026*	0.0006	0.0008*	0.0001	0.0022*	0.0002	0.0008	0.0005
(L_*GovPay/Acre*) * L_*Sales*3	0.0020*	0.0006	0.0007*	0.0001	0.0013*	0.0002	0.0012*	0.0002
(L_*GovPay/Acre*) * L_*Sales*4	0.0023*	0.0005	0.0006*	0.0001	0.0010*	0.0002	0.0012*	0.0002
(L_*GovPay/Acre*) * L_*Sales*5	0.0034*	0.0009	-0.0001	0.0002	0.0010*	0.0003	0.0003	0.0002
*Year*1992	0.2173*	0.0109	0.0909*	0.0065	0.1436*	0.0070	0.0991*	0.0061
L_*Occup–Nonfarm*	-0.2007*	0.0149	-0.1897*	0.0077	-0.1555*	0.0081	-0.1588*	0.0080
L_*Tenure–Tenant*	0.1166*	0.0141	0.0894*	0.0077	0.0862*	0.0085	0.0766*	0.0072
L_*Tenure–Mixed*	0.0694*	0.0167	0.1011*	0.0086	0.1334*	0.0100	0.0973*	0.0087
L_*Org–Partner*	0.1167*	0.0186	0.0443*	0.0095	0.0230	0.0115	0.0487*	0.0087
L_*Org–Incorp*	0.1218*	0.0194	0.1418*	0.0114	0.1694*	0.0179	0.1319*	0.0116
L_*Org–Other*	0.0724	0.0601	-0.0220	0.0390	0.0085	0.0441	0.0464	0.0491
Intercept	3.8124*	0.2030	3.1730*	0.1610	3.2612*	0.1501	2.8915*	0.2031
County Fixed Effects	yes		yes		yes		yes	
ρ	0.0197*	0.0047	0.0202*	0.0019	0.0263*	0.0027	0.0162*	0.0023
σ	-0.2282*	0.0074	-0.3435*	0.0048	-0.3306*	0.0059	-0.4076*	0.0049
Wald Test of Indep. Eqns. ($\rho = 0$): χ^2 / (p-Value)	17.41 (0.0000)		107.85 (0.0000)		96.38 (0.0000)		50.62 (0.0000)	
Log Likelihood	-65,868		-189,181		-138,576		-173,526	
Wald χ^2 / (p-Value)	53,108 (0.0000)		279,700 (0.0000)		216,896 (0.0000)		244,365 (0.0000)	
No. of Censored Observations	24,531		74,018		58,037		53,136	
No. of Uncensored Observations	17,239		82,661		58,364		85,902	
Total Observations	51,770		156,679		116,401		139,038	

Note: An asterisk (*) denotes coefficient is significant at the 1% confidence level.

The results indicate that the effect of payments on farm size and survival does not appear to differ systematically between farms with operators who do not work off-farm compared to the full sample. Farmers who work more off-farm may be able to better cope with risk (their off-farm income is less risky than farm income) so they are less vulnerable to farm income shocks. However, farmers who work off-farm may do so because they are financially vulnerable—i.e., they have fewer savings or their farm profits are smaller. Hence, government payments appear to be important for the survival and growth of both groups of farms.

Conclusion

This study used farm-level panel data from the 1987, 1992, and 1997 *Census of Agriculture* to examine how the level of agricultural payments affects the likelihood that a farm business survives between consecutive censuses and subsequent farm size. We exploited an exogenous source of variation in payments—differences in "base acreage" in otherwise

Table 6. Effect of Government Payments on Farm Survival and Size Under Various Model Specifications

Crop-Farmland Category / Acres		[1] Coeff.	[1] Std. Error	[2] Coeff.	[2] Std. Error	[3] Coeff.	[3] Std. Error	[4] Coeff.	[4] Std. Error
Wheat:									
Survival	10–200	0.0026*	0.0005	0.0025*	0.0005	0.0025*	0.0005	0.0022*	0.0009
	200–400	0.0043*	0.0008	0.0040*	0.0008	0.0046*	0.0008	0.0054*	0.0012
	400–800	0.0023*	0.0007	0.0021*	0.0007	0.0029*	0.0007	0.0020	0.0009
	800–1,600	0.0033*	0.0007	0.0035*	0.0007	0.0047*	0.0007	0.0046*	0.0009
	1,600–10,000	0.0043*	0.0009	0.0056*	0.0009	0.0065*	0.0009	0.0055*	0.0011
Scale	10–200	0.0013*	0.0003	0.0012*	0.0003	0.0013*	0.0003	0.0013	0.0006
	200–400	0.0015*	0.0004	0.0014*	0.0004	0.0016*	0.0004	0.0013	0.0006
	400–800	0.0010*	0.0003	0.0010*	0.0003	0.0013*	0.0003	0.0010	0.0004
	800–1,600	0.0013*	0.0003	0.0012*	0.0003	0.0016*	0.0003	0.0010*	0.0003
	1,600–10,000	0.0006	0.0003	0.0006	0.0003	0.0010*	0.0003	0.0003	0.0004
Corn:									
Survival	10–200	0.0008*	0.0001	0.0008*	0.0001	0.0008*	0.0001	0.0008*	0.0002
	200–400	0.0012*	0.0002	0.0010*	0.0002	0.0010*	0.0002	0.0008*	0.0003
	400–800	0.0019*	0.0002	0.0018*	0.0002	0.0019*	0.0002	0.0015*	0.0002
	800–1,600	0.0020*	0.0004	0.0021*	0.0004	0.0022*	0.0004	0.0016*	0.0004
	1,600–10,000	0.0011	0.0007	0.0018*	0.0007	0.0016	0.0007	0.0009	0.0007
Scale	10–200	0.0007*	0.0001	0.0007*	0.0001	0.0007*	0.0001	0.0008*	0.0001
	200–400	0.0005*	0.0001	0.0004*	0.0001	0.0004*	0.0001	0.0005*	0.0001
	400–800	0.0005*	0.0001	0.0005*	0.0001	0.0005*	0.0001	0.0005*	0.0001
	800–1,600	0.0004*	0.0001	0.0004*	0.0001	0.0004*	0.0001	0.0004*	0.0001
	1,600–10,000	0.0003*	0.0001	0.0002*	0.0001	0.0003*	0.0001	0.0002*	0.0001
Soybeans:									
Survival	10–200	0.0005*	0.0002	0.0007*	0.0002	0.0008*	0.0002	0.0002	0.0003
	200–400	0.0017*	0.0003	0.0018*	0.0003	0.0017*	0.0003	0.0009	0.0004
	400–800	0.0032*	0.0004	0.0030*	0.0004	0.0027*	0.0004	0.0021*	0.0005
	800–1,600	0.0043*	0.0006	0.0042*	0.0006	0.0036*	0.0006	0.0031*	0.0007
	1,600–10,000	0.0033	0.0015	0.0038*	0.0015	0.0032	0.0015	0.0033	0.0017
Scale	10–200	0.0012*	0.0001	0.0011*	0.0001	0.0012*	0.0001	0.0014*	0.0002
	200–400	0.0009*	0.0001	0.0007*	0.0001	0.0008*	0.0001	0.0006*	0.0002
	400–800	0.0006*	0.0001	0.0006*	0.0001	0.0007*	0.0001	0.0007*	0.0002
	800–1,600	0.0004*	0.0002	0.0004	0.0002	0.0005*	0.0002	0.0004	0.0002
	1,600–10,000	0.0023*	0.0005	0.0023*	0.0005	0.0024*	0.0005	0.0017*	0.0006
Cash Grains:									
Survival	10–200	0.0004	0.0002	0.0003	0.0002	0.0004	0.0002	-0.0001	0.0003
	200–400	0.0011*	0.0003	0.0008*	0.0003	0.0007*	0.0003	0.0006	0.0004
	400–800	0.0018*	0.0004	0.0016*	0.0003	0.0015*	0.0003	0.0008*	0.0003
	800–1,600	0.0029*	0.0004	0.0032*	0.0004	0.0034*	0.0004	0.0024*	0.0004
	1,600–10,000	0.0024*	0.0007	0.0037*	0.0007	0.0041*	0.0008	0.0029*	0.0008
Scale	10–200	0.0007*	0.0001	0.0006*	0.0001	0.0007*	0.0001	0.0007*	0.0002
	200–400	0.0007*	0.0001	0.0006*	0.0001	0.0007*	0.0001	0.0007*	0.0001
	400–800	0.0004*	0.0002	0.0004*	0.0001	0.0005*	0.0002	0.0004	0.0002
	800–1,600	0.0005*	0.0001	0.0004*	0.0001	0.0006*	0.0001	0.0006*	0.0001
	1,600–10,000	0.0006*	0.0002	0.0005	0.0002	0.0007*	0.0002	0.0008*	0.0003

Notes: An asterisk (*) denotes coefficient is significant at the 1% confidence level. Column [3] is the full model with all the explanatory variables reported in table 3; column [2] removes county fixed effects; column [1] further removes the occupation, land tenure, and organization fixed effects. Column [4] is the full model estimated for the subset of farms with operators who work fewer than 50 days off-farm (these samples contain 31,054, 84,198, 54,926, and 88,514 observations for wheat, corn, soybeans, and cash grains, respectively).

similar farms—to estimate a reduced-form relationship between government payments per acre of farmland and subsequent farm size and survival, controlling for fixed effects associated with the county where the farm is located, the crop produced by the farm, and other operator and operation characteristics.

This approach has several advantages. First, by examining how payment levels are associated with *subsequent* farm growth and survival, it is more likely that the observed association indicates causation going from payments to growth or survival, rather than the opposite. Second, by using a very large sample and a regression analysis, we were able to narrow our comparisons to farms that were very similar except for their level of payments. Finally, by conditioning current farm size on past farm size, we were able to remove much of the individual heterogeneity of farms that might be spuriously correlated with payment levels.

Government payments were found to be positively associated with the likelihood of farm survival, and the magnitude of this association was generally greater for larger farms. Also, a small but statistically significant positive association was found between payments and farm size growth, and the magnitude of this effect increased with the size of the operation. Because payments were positively associated with survival, the effect of payments on expected farm size *not* conditional on farm survival was larger than the effect on only surviving farms. The results were generally robust to an alternative definition of farm size and to alternative model specifications.

There are several important caveats to these findings. First, the estimates are relevant for average marginal changes in government payments holding the current distribution of payments constant. In other words, our analysis does not address how farm size and exit rates would change if government payments were eliminated or if the aggregate level or distribution of payments were changed by a large amount. Second, the analysis assumes farmers respond to realized rather than expected payments. In 1987 and 1992, realized payments provided a noisy estimate of expected payments because large components of realized payments were transitory. Consequently, if farmers respond to expected payments, we likely underestimate the effect of a change in expected payments. Third, during the period of analysis, farmers faced limits on the amount of agricultural payments they could receive.[11] The results provide estimates of the effect of payments on survival and farm size given the payment cap policy that was in effect. If these caps were binding (a point of significant controversy), then the estimated effects might have been larger had the caps not been in place—but it is not feasible to quantify by how much.

The finding that government payments are negatively associated with farm exit rates could be explained by several factors. Higher government payments raise net returns, which could reduce the likelihood of financial insolvency and allow farms to remain in business longer. Higher payments may also make agriculture more profitable relative to alternative occupations, which could reduce the incentive to quit farming, especially if alternative occupations are in different locations or require a significant degree of

[11] In 1986, Congress amended the Food Security Act of 1985, establishing a new combined limit of $250,000 on a range of farm program payments, including loan deficiency payments and marketing loan gains. In 1990, the Food, Agriculture, Conservation, and Trade Act (FACTA) included marketing loan gains and loan deficiency payments in a group of payments that were subject to an annual per person limit of $75,000. Under the 1996 FAIR Act, loan deficiency payments and marketing loan gains were subject to a limit of $75,000, and production flexibility contract (PFC) payments were limited to $40,000 (USDA, 2003).

specialization. The finding that higher payments result in significantly larger farm size could mean that farmers face binding liquidity constraints which inhibit farms from achieving an optimal scale, and payments relieve these constraints.

The findings of this study are consistent with the hypothesis that government payments contribute to an increase in the scale of production: payments increased the likelihood of survival more for larger farms, and payments increased expected farm size more for larger farms. However, the consequences of an increase in payments for agricultural structure remain ambiguous. Because this investigation did not account for the size of farms entering production, it is not possible to conclude how a change in payments would influence the size distribution of farm businesses. In addition, it is possible that our estimates of the average marginal effect of payments failed to detect substantial effects of payments on farm structure. To illustrate, consider a hypothetical scenario where all farms are initially the same size and an increase in agricultural payments causes half of the farms to increase in size, and half to decrease in size by the same amount. In this case, the estimated average marginal effect of payments on farm size would be zero, but the concentration of landholdings would increase substantially. Future work could seek to determine the consequences of government payments for farm structure using aggregate measures of land concentration, such as the acre-weighted median or acre-weighted average farm size.

Evidence that agricultural payments are associated with farm survival and scale suggests payments might also have affected farm output. With increasing returns to scale, it is possible that payments allowed farms to expand to a more efficient scale, resulting in greater production. However, the paper's empirical results are based on farm-level responses to agricultural payments in 1987 and 1992. The 1996 FAIR Act significantly changed how payments were allocated—most importantly, payments were largely decoupled from current production. As a consequence, the effect of payments on farm survival, size, and production could be substantially different for payments received after 1996. The extent to which payments stimulate agricultural output is an important area for future research.

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