Chapter 5

Effect of Payments on Growth and Survival of Farms

The change in concentration from one period to the next depends on the size of farms that survive, how much they grow if they survive, and the size of newly entering farms. Thus, to better understand how payments might be leading to higher concentration levels, it is useful to examine the relationship between payment levels and the survival and growth of individual farm businesses over time. These farm-level analyses complement the ZIP Code-level analysis and further indicate how payments could have altered farm structure. The farm-level analyses consider only producers who specialized in program crops.[12] This focus facilitates comparisons between farms with similar attributes. The study begins with an examination of farm survival, followed by an analysis of farm growth.

[12] The survival analyses focus on those farms specializing in wheat, rice, corn, soybeans, cash grains, or cotton. The growth analyses exclude rice and cotton producers because there were too few observations to perform crop-specific regressions. See Key and Roberts (2006) and Key and Roberts (2007) for more details.

Payments and Farm Survival

For the survival analysis, the study compares the mean lifespans of farms that received different levels of commodity program payments. The study then estimates how a farm's probability of surviving changes over its lifespan, and compares this relationship for farms with high and low levels of payments (see box, "Measuring the Duration of Farm Business Survival"). Finally, the study estimates the effect of program payments on the rate of farm business exit, and uses these estimates to simulate the effect of a policy that reduces payments by 50 percent for each farm.

The census of agriculture illustrates how survival rates change with the age of the operation for farms with different commodity specializations (SIC codes). Table 8 presents the survival rates by SIC code for program crop farms that were first observed in the 1982 census (these farms might have initiated production between 1979 and 1982, as 1978 was the year of the previous census). About 50 percent of new farms exited within the first 5 years. After 10 years, about 32 percent of the new farms remained in business, and after 15 years, 22.5 percent remained in business. These survival rates are comparable to what has been reported for non-agricultural firms (e.g., Audretsch, 1991; Mata et al., 1995; Disney et al., 2003). Findings are also consistent with earlier studies showing the probability of survival generally increases with the age of the firm (Evans, 1987a; Evans, 1987b; Audretsch, 1991), as well as a recent ERS report that shows the larger a farm and the more experienced its operator, the less likely the farm is to exit (Hoppe and Korb, 2006).

Comparing Survival Rates of Farms With Different Levels of Program Payments

To examine the relationship between program payments and farm business survival, the study first compares the mean observed lifespan for farm businesses of different sizes and different shares of payments in total sales. Total agricultural sales, like cropland or farmland area, is a measure of farm

Measuring the Duration of Farm Business Survival

Data used to estimate the relationship between commodity program payments and farm business survival are from the census of agriculture conducted in 1987, 1992, and 1997 (individual records from the 2002 census were not available at the time this analysis was performed). The census provides information about the duration of a farm business only if it was continuously operated by the same individual and tracks operations over time using a Census File Number (CFN). The census defines a farm as out of business if there is no response to the census questionnaire or if it is returned stating that the farm is no longer operating. However, if a farm changes operators through a business transaction or inheritance, the CFN may change even though the business is still operating. Hence, it is not possible to estimate the duration of a farm business based on how long the CFN appears in the census. Consequently, for the analysis, a surviving farm is defined as one remaining in business and having the same operator; farms remaining in business with a different operator were removed from the sample because it is not possible to observe why an operation transferred ownership.[1]

This study examines the survival of farms that were operating in 1987—the first year the census of agriculture began collecting information on commodity program payments. To increase sample homogeneity, the study focuses only on farms with Standard Industrial Classification (SIC) codes indicating they were primarily producers of wheat, rice, corn, soybeans, cotton, or "cash grains." The sample includes the 200,187 farms that had at least 10 acres of land and $10,000 in sales in 1987 and for which information on all variables was available.[2] The census allows one to identify whether a farm business ceased operating between 1987 and 1992, or between 1992 and 1997, or whether it was still operating in 1997. In addition, the census records the year in which the current operator began managing the operation. Therefore, the observed lifespan of the farm business is defined as 1987 minus the year the operator initiated farming on the operation plus 2.5, 7.5, or 10, depending on whether the operation ceased operating by 1992, ceased operating by 1997, or remained in business in 1997.

The data have two characteristics that must be accounted for in the estimation of the duration of farm business survival. First, if a farm operation remained in business in 1997, it is not possible to observe the lifespan of the business; only that the business was operating as of 1997. Second, the sample does not include businesses that exited prior to 1987. For example, of all businesses initiated in 1980, only those businesses in 1987 that survived at least 7 years are observed. Farms that exited before 1987 are not observed. The regression technique used accounts for these data issues.

The regression controls for many other factors that might be associated with farm survival, including specialization as indicated by the farm SIC code, operator age, the year the farm began operating, the farm's organizational structure, the State in which the farm operates, and the farm's debt-to-asset ratio. Controlling for the year a farm began operating captures effects stemming from time-specific events, such as changes in farm policy and the farm crisis of the early 1980s. More details can be found in Key and Roberts (2006).

[1] A farm was considered to have the same operator if the age of the operator differed by 5 years between consecutive censuses.

[2] Deleting farms with less than $10,000 in sales (which represent about a fifth of the observations) focuses the analysis on farm households where farm business income is a larger share of total household income and where commodity program payments are thus more likely to play an important role in the decision to continue farming. Whether or not these small farms are included in the analysis has little influence on the results.

Table 8
New program crop farm (1982) survival rates by farm type

Farm category	1982	1987	1992	1997
All program crop farms				
Number surviving	140,876	70,478	45,122	31,630
Survival rate (%)		(50.0)	(32.0)	(22.5)
Wheat (SIC = 111)				
Number surviving	20,592	10,534	6,678	4,697
Survival rate (%)		(51.2)	(32.4)	(22.8)
Rice (SIC = 112)				
Number surviving	1,750	864	525	330
Survival rate (%)		(49.4)	(30.0)	(18.9)
Corn (SIC = 115)				
Number surviving	46,150	23,091	14,876	10,363
Survival rate (%)		(50.0)	(32.2)	(22.5)
Soybean (SIC = 116)				
Number surviving	34,875	15,398	9,311	6,392
Survival rate (%)		(44.2)	(26.7)	(18.3)
Cash Grain[1] (SIC = 119)				
Number surviving	32,643	18,330	12,396	8,927
Survival rate (%)		(56.2)	(38.0)	(27.3)
Cotton (SIC = 131)				
Number surviving	4,866	2,261	1,336	921
Survival rate (%)		(46.5)	(27.5)	(18.9)

Notes: The first column (1982) reports the number of new farm operations in 1982 that specialized in program crops. Subsequent columns indicate the number and share (in parentheses) of farms that began in 1982 that remain in each of the three subsequent censuses. Data from census of agriculture 1982, 1987, 1992, and 1997. Sample limited to farms with SIC codes indicating production of wheat, rice, corn, soybean, cash grains, or cotton.

[1]Cash grain farms include those growing sorghum, oats, barley, and/or other grain crops not otherwise classified.

size. Commodity program payments per dollar of sales scales payments relative to farm size, much like payments per acre of cropland did in the ZIP Code analysis. With few exceptions, within each sales quartile, a larger share of payments in sales corresponds to a longer mean lifespan (table 9).[13] For example, in the highest sales quartile, farms where payments comprise less than 12 percent of sales have a mean lifespan of 26.16 years, versus 28.29 years for those where payments comprise more than 36 percent of sales. The last column shows that the mean lifespan of farms in the highest payments-as-a-share-of-sales quartile is significantly longer (2.13 to 2.5 years) than the mean lifespan of farms in the lowest quartile.

Controlling for Differences Between Operators and Operations

A statistically significant difference between estimated lifespans is not conclusive evidence that commodity program payments influence survival because other factors might be correlated with both payments and survival. For example, high-payment farms are larger on average, are more concentrated in certain regions (such as the Corn Belt and Mississippi Delta), and are more likely to grow certain crops (such as corn, soybeans, wheat and cotton). If these factors are correlated with both program payments and duration of farm survival, one might observe a relationship between payments and survival that is not causal. To address this issue, the study

[13] Average observed lifespans reported in table 9 do not account for the data issues discussed in the box, meaning these averages do not provide unbiased estimates of the true lifespans (see Key and Roberts (2006) for further discussion).

Table 9

Farm business lifespan by sales and commodity program payments as a share of sales

	Quartiles (Commodity program payments as a share of sales)				
	Q1	Q2	Q3	Q4	Q4 – Q1
Sales quartile	(0-11.99%)	(12-21.99%)	(22-35.99%)	(36% +)	
Q1 ($10,000-$23,990)					
Years	25.37	25.22	26.24	27.87	2.50***
(Std. Err.)	(0.119)	(0.163)	(0.157)	(0.124)	(0.172)
Obs.	17,031	8,615	9,253	15,145	
Q2 ($23,991-$50,600)					
Years	25.94	26.60	28.00	28.48	2.54***
(Std. Err.)	(0.137)	(0.136)	(0.129)	(0.120)	(0.182)
Obs.	12,130	11,153	12,320	14,441	
Q3 ($50,600-$104,390)					
Years	26.04	27.45	28.66	28.28	2.24***
(Std. Err.)	(0.138)	(0.137)	(0.114)	(0.117)	(0.181)
Obs.	9,952	13,343	13,642	13,114	
Q4 ($104,390 or more)					
Years	26.16	27.80	28.03	28.29	2.13***
(Std. Err.)	(0.156)	(0.077)	(0.083)	(0.118)	(0.195)
Obs.	6,141	24,039	21,994	11,696	

Notes: The table shows the average lifespan of farms in the sample. All farms were operating in 1987, but some ceased operation by 1992 or 1997. The business lifespan is defined as 1987 minus the year the operator began operating plus 2.5, 7.5, or 10, depending on whether the operation ceased operation by 1992, ceased operation by 1997, or remained in business in 1997. Three asterisks (***) indicate that the null hypothesis of equal mean lifespan for the first and fourth payments as a share of sales quartiles is rejected at the 0.001 significance level. Data from census of agriculture 1987, 1992, and 1997. Sample limited to farms with SIC codes indicating production of wheat, rice, corn, soybeans, cash grains, or cotton.

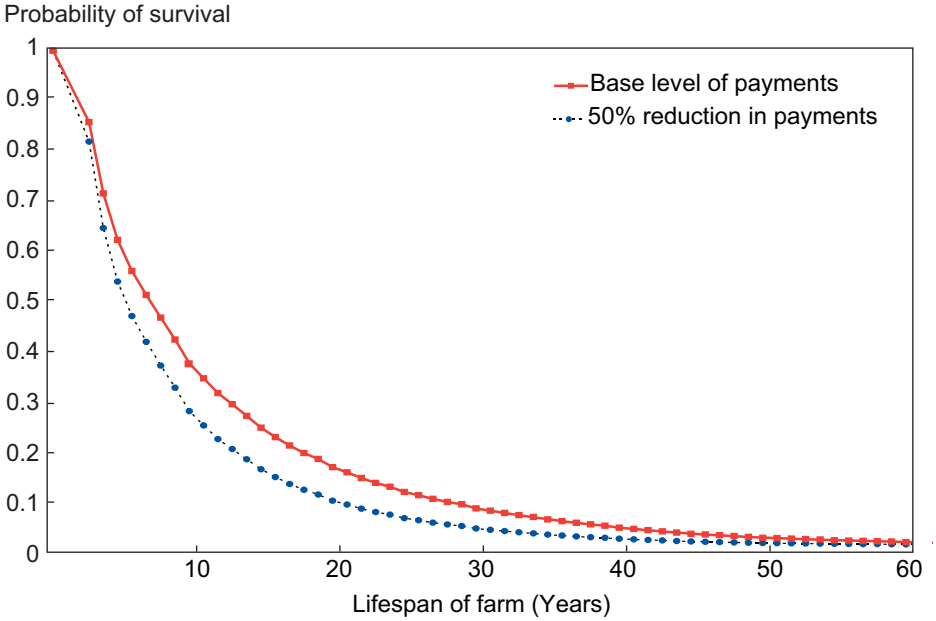
estimates the effect of program payments on the exit rate (in any year, the chance that a farm business will exit the sector within a year, given that it has survived up to that point in time) using an empirical approach that controls for characteristics of the operation and the operator (Key and Roberts, 2006).

An increase in commodity program payments as a share of sales is associated with a statistically significant reduction in the farm business exit rate. Specifically, a 10-percent increase in program payments is associated with a reduction in the exit rate of 0.35, 0.50, 0.74, and 0.90 percent for a representative farm in successive quartiles. For example, for a farm in the highest sales quartile with a 50-percent chance of exiting in the next period, a 10-percent increase in payments as a share of sales would decrease the chance of going out of business to 49.5 percent. While not particularly large, these numbers pertain to exit rates in a single year, and support the hypothesis that commodity program payments may affect farm structure.

With regard to the control variables, the study finds larger enterprises are less likely to exit than smaller ones, which is consistent with other studies of nonfarm businesses. In particular, a 10-percent increase in farm sales is associated with an estimated 4.3-percent decline in the hazard rate (the

Figure 8

Survival function estimates



Notes: The figure shows the average estimated probability of survival for all farms with observed levels of 1987 payments and with half the observed level. Estimates are based on the Cox proportional hazard model described in the appendix. Data are from census of agriculture 1987, 1992, and 1997. Sample limited to farms with SIC codes indicating production of wheat, rice, corn, soybeans, cash grains, or cotton.

probability the business will exit at any point in time). Younger farmers have a lower probability of exiting than older farmers: holding all else constant, the hazard is smallest for operators age 30-34 and it increases gradually with age until farmers are age 50-54, after which the probability of exiting increases rapidly, corresponding to the retirement of the operator.[14]

These estimation results can be used to explore the effect of a reduction in commodity program payments on farm survival. Program crop farms receiving the mean level of payments have about a 35-percent chance of surviving to 10 years, versus only a 25-percent chance for program crop farms receiving half the mean level of payments (fig. 8).

Table 10 illustrates the effect of a 50-percent reduction in farm commodity program payments on the expected lifespan of program crop farms of different sizes. The effect of the hypothetical policy is shown separately for payment recipients and for all program crop farms with at least $10,000 in sales. Larger operations would experience a greater reduction in lifespan for two reasons. First, the marginal effect of a reduction in payments is greater for larger operations. Second, a greater percentage of large farms receive program payments (97.0 percent for the largest sales quartile, compared with 78.6 percent for the smallest quartile). A 50-percent drop in payments would shorten the expected lifespan of the largest farms by 5.4 percent (from 14.25 to 13.48 years, or about 9 months) and the smallest farms by 1.7 percent (from 8.83 to 8.68 years, or about 2 months).

[14] A further discussion of the model results can be found in Key and Roberts (2006).

Table 10

Estimated effect of a 50-percent reduction in commodity program payments on the duration of farm businesses

	Estimated life of farm business in years (standard error)					
	Farms receiving payments			Farms with $10,000 in sales		
Sales quartile	Base	50 percent of base	Percent change	Base	50 percent of base	Percent change
Q1	9.44	9.24	-2.06	8.83	8.68	-1.71
	(0.021)	(0.020)		(0.020)	(0.019)	
Q2	10.93	10.58	-3.22	10.38	10.08	-2.89
	(0.024)	(0.023)		(0.022)	(0.022)	
Q3	12.91	12.32	-4.59	12.43	11.88	-4.38
	(0.027)	(0.026)		(0.026)	(0.025)	
Q4	14.67	13.86	-5.53	14.25	13.48	-5.41
	(0.031)	(0.029)		(0.030)	(0.029)	

Notes: The table reports average estimated life of farm businesses in each of four sales quartiles both with observed payment levels and payment levels of half the level observed. Estimates are based on the Cox proportional hazard regression model described in the appendix. Standard errors for the estimated lifespans are given in parentheses. The "percent change" column indicates the percentage difference in lifespan. Data are from the census of agriculture 1987, 1992, and 1997. Sample limited to farms with SIC codes indicating production of wheat, rice, corn, soybeans, cash grains, or cotton.

Payments and Farm Growth

Commodity program payments could influence farm size over time by altering both the probability of surviving in farming and the scale of those who survive (see box, "Estimating the Relationship Between Payments and Individual Farm Size"). The conditional expected farm size is the expected size of a farm conditional on its surviving to the next period, and the unconditional expected farm size is the average size that current farmers can expect to be, allowing for the fact that some farms will exit. Since farms have some probability of ceasing production (in which case they would have a farm size of zero in the next period), the unconditional expected farm size is smaller than the conditional expected farm size.

For the four crop types considered (wheat, corn, soybeans, cash grains), payments have a stronger link with the unconditional expectation in size than with the conditional expectation. For example, with no reduction in commodity program payments, wheat farms in 1987 have an expected farm size of 565.3 acres in 1992 (table 11). With a 50-percent reduction in payments, the expected farm size is 522.6 acres (a 7.5-percent reduction). Wheat farms that survive from 1987 to 1992 have an expected farm size of 960.3 acres without a payment reduction and 943.5 acres (a 1.8-percent decline) with a 50-percent reduction in payments. The change in the conditional expected farm size is smaller than for the unconditional expected farm size because program payments are associated with a reduction in the likelihood of exiting between periods.

A 50-percent reduction in commodity program payments is associated with a decline in farm size for all program commodity groups and all farm sizes. The drop in farm size is larger for the smallest farm size categories, reflecting a larger effect on the probability of survival.

Table 11

Unconditional and conditional expected farm size

Type of farm in beginning period	Unconditional expected farm size (farmland acres)		Conditional expected farm size (farmland acres)		Observations
	Status quo	50% reduction in payments	Status quo	50% reduction in payments	
Principal commodity					
Wheat					
1987-1992	565.3	522.6	960.3	943.5	37,012
1992-1997	663.0	616.1	1059.3	1040.7	34,352
1997-2002	703.9	653.5	1138.2	1118.3	32,312
Corn					
1987-1992	214.6	198.5	361.9	355.6	86,871
1992-1997	272.1	252.9	433.8	426.2	97,825
1997-2002	304.9	283.4	485.6	477.1	98,576
Soybeans					
1987-1992	166.4	153.7	288.6	283.5	87,405
1992-1997	167.5	155.1	281.7	276.8	52,035
1997-2002	222.4	206.5	360.0	353.7	68,700
Cash grains					
1987-1992	368.6	344.2	556.3	546.5	88,034
1992-1997	429.4	402.3	623.4	612.4	81,604
1997-2002	491.8	460.9	711.1	698.6	81,224
Total farmland					
10-249 acres					
1987-1992	57.0	51.9	118.1	116.1	149,591
1992-1997	59.6	54.5	117.2	115.1	120,725
1997-2002	61.4	56.2	119.9	117.8	121,427
250-499 acres					
1987-1992	200.3	185.0	343.5	337.5	60,812
1992-1997	204.6	189.5	338.4	332.5	51,788
1997-2002	204.6	189.6	339.1	333.2	53,998
500-999 acres					
1987-1992	419.4	389.9	662.3	650.7	51,232
1992-1997	431.6	402.4	659.9	648.3	49,598
1997-2002	431.0	401.7	662.6	651.0	52,922
1,000-1,999 acres					
1987-1992	822.3	766.5	1,261.4	1,239.2	25,989
1992-1997	853.9	798.9	1,256.9	1,234.7	29,559
1997-2002	858.9	803.2	1,270.9	1,248.5	34,306
2,000+ acres					
1987-1992	1,966.3	1,830.2	3,069.3	3,015.3	11,698
1992-1997	2,029.7	1,897.0	3,025.8	2,972.5	14,146
1997-2002	2,051.1	1,916.8	3,062.1	3,008.1	18,159

The table presents estimates of the unconditional and conditional farm size with and without implementation of a hypothetical policy that reduces commodity program payments by 50 percent. Data are from the Census of Agriculture 1987, 1992, and 1997, and 2002. Sample limited to farms with SIC codes indicating production of wheat, corn, soybeans, or cash grains.

Estimating the Relationship Between Payments and Individual Farm Size

An estimation of the relationship between commodity program payments and individual farm size must address the fact that the sample of farms that survive is not randomly selected from the population of all farms. Because it is only possible to observe the size of farms that survived, using an ordinary least squares regression to estimate the unconditional effect of commodity program payments on farm size could produce inaccurate estimates if unobservable factors are correlated with the likelihood of survival and farm growth. For example, if commodity program payments and an unobservable factor such as "farming ability" are both positively correlated with the probability of survival and the rate of farm growth, then farmers with high ability would be overrepresented among the sample of survivors. Within the sample of survivors, ability would be negatively correlated with commodity program payments: farmers would need high levels of ability to overcome low commodity program payments, and farmers with low ability would need high payments to survive. Estimates of the effect of payment on farm size would therefore tend toward zero. To address this potential problem, the study uses a maximum likelihood approach to obtain consistent parameter estimates.

Data for this analysis are from the census of agriculture, 1987, 1992, 1997, and 2002. To perform separate regression analyses for each type of crop producer, this analysis limits the sample to producers specializing in one of the four largest crops. The sample consists of 845,950 farms that had at least 10 acres of land and were identified as primary producers of wheat, corn, soybeans, or "cash grains." The data were organized into three panels: 1987-92, 1992-97, and 1997-2002. The regression specification allowed for separate effects by SIC code, year, and size of operation. More details can be found in Key and Roberts (2007), which develops the empirical model used in the policy simulations reported here. Unlike Key and Roberts (2007), which was developed before 2002 census data were available, results reported here are based on data that include observations from the 2002 census.