Transition of Agricultural Land Ownership and Use

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Abstract

A natural propensity was found which indicates that most agricultural producers believe their land will be operated by one or more of their children when they retire. But results also indicate that producers will be responsive to selling their land for development if urban housing offers a higher return.

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Farmland preservation legislation has surfaced or been enacted near several populated urban centers. Arguments for keeping land in agriculture on urban fringes range from open space and scenic vistas to preservation of rural lifestyles and having a "safety-valve" for urban water requirements. Given that agriculture and urban centers compete with each other for water and land but can also compliment each other the debate regarding farmland preservation is likely to continue. From 1954 to 1992, urban land use increased from 18.6 to 58.0 million acres (Daugherty). While urban land use in 1992 only represented 12.6% of all cropland, the continued increase in urban relative to agricultural land use has been a concern for many individuals and political action groups.

Blank recently examined the issue of why land is leaving agriculture considering minimum financial obligations, lifestyle desires, and an opportunity cost or risk premium of farmers. The notion that farmers and ranchers are willing to accept a lower rate of return in order to preserve lifestyle has been around for some time (Brewster; Martin and Jeffries). He argued that producers get "squeezed up the Farming Food Chain" in order to stay in agriculture and/or seek higher rates of return. This occurs by farmers moving from producing low-value annual crops (e.g., cotton, corn, and rice) to at least some acreage of low-value perennial crops (e.g., alfalfa hay) then high-value annual crops (e.g., broccoli, carrots, and lettuce) and finally high-value perennial crops (e.g., almonds, grapes, oranges, plums, walnuts). Blank proposes that crops increase in risk and return as farmers

move up the Farming Food Chain. External shocks that decrease the profitability of farming force producers to either select a more profitable and risky portfolio or shift at least some assets out of agriculture, including land. However, land capable of producing the highest category of the Farming Food Chain can leave agriculture before the land owner tries these tree fruit and vine crops.

Utilizing county level data, Goetz and Debertin recently quantified how off-farm income and other explanatory variables effect the propensity of U.S. farmers to cease farming. An OLS analysis of all counties suggests that off-farm income has no statistical effect on the number of farmers quitting between 1987 and 1997. But a more elaborate model that separates counties that have gained farmers with those that have lost farmers revealed more subtle and less clear-cut effects on off-farm income. High rates of off-farm income reduce the odds of losing farmers and increase the odds of keeping the same number of farmers. But their results also showed that higher rates of off-farm income tend to accelerate the loss of farms, creating a counteracting effect. They also found that farmers tend to quit at a lower rate if they operate their own farm. Farmers quit at faster rates if the value of their land and buildings is high, they receive more government program payments, or they reside in a county or are adjacent to a county with a high population density.

In comparing the determinants of farm exits from Israel and Canada, Kimi and Bollman found the odds of farmers quitting to decline if they have off-farm employment.

But Kimhi also revealed that Israeli farmers seeking to exit from agriculture within the next decade were less likely to work off-farm on a full employment basis. Off-farm employment is closely related to farm survival since it accounts for 53% of the average farm operator's household income, up from 23% in 1945 (Goetz and Debertin).

Prior literature on the transition of agricultural lands to nonfarm use and the consolidation of agricultural lands has had a crop portfolio or off-farm income focus with an underlying annual return series that determines risks and returns. But most land ownership transitions to the next operator or nonfarm use probably follow more of a life-cycle earnings framework given that many older operators have low nonfarm employment opportunities due to the time needed to develop skills in an alternative trade. Given that 55 percent of the principal farm operators in the U.S. are 55 years of age, what producers anticipate will happen to their operation when they retire could be very helpful for policy makers and tax payers in the farmland preservation debate. Thus, the principal objective of this analysis is to quantify how the factors of age, education, nonfarm income, crop mix, technology, value of land for nonfarm use, land ownership, financial health, and heritage influence what agricultural producers anticipate will happen to their operation when they retire.

Data and Methods

The data to be used in this analysis is from a mail survey that was conducted in April of 2001 as a part of the "2001 National Agricultural, Food, and Public Policy Preference Survey." This study analyzes responses from the two states of Arizona (AZ) and Missouri (MO). Like many western states, AZ has been at the forefront of percentage population growth for the U.S. MO has farmland next to two large urban centers (St. Louis and Kansas City) and many rural areas, similar to much of the midwest. In addition, these were two states that asked an optional question surrounding technology adoption that reflects the level of investment in agricultural lands. The survey instrument and information regarding the average and overall composite responses of large (>$100,000 in agricultural sales) and small farms for all 27 participating states is available in Lubben et al.

The mail survey was conducted by the agricultural statistics services associated with Arizona and Missouri using a random sampling of both small and large farm strata. A post-card reminder to complete the survey was mailed to all addresses about 2 weeks after the survey was sent out. A response rate of 20% and 16% was obtained for Arizona and Missouri. A total of 113 and 704 responses were received from Arizona and Missouri, but only 513 (416 and 97 from AZ and MO) of these 817 respondents completed all the questions utilized in this analysis. The dependent variable for our analysis is derived from the question of "When I retire, I expect the farm or ranch I

operate to: a) be operated by one or more of my children, b) be operated by a relative who is not one of my children, c) be operated by someone unrelated to my family but currently involved in the operation, d) be transferred to individuals outside of the current operation, or e) be converted to nonfarm use.

Given that factors which influence the transfer of land ownership to children also impact whether land is transferred to nonfarm use, we hypothesize that an ordered response will exist for the five responses. That is, the most extreme response for land ownership to maintain its current status is to have land ownership transferred to children and the most dramatic change is for land to transition to nonfarm use. The three responses of transferring land to a relative, to someone unrelated but currently involved in the operation, and to individuals outside of the current operation fall between the two extremes of transferring land to children or nonfarm use. Thus, an ordered probit model which is cast in terms of a latent continuous random variable with five possible discrete values was used to estimate the dependent variable of land transition (LT_i) expected when operators retire (LT). The ordered probit model is given by

1) $$LT_i^* = \beta_0 + \beta_1 DSTATE_i + \beta_2 PRFATN_i + \beta_3 PRDAIRY_i + \beta_4 PRVPO_i + \beta_5 PRFOR_i + \beta_6 PRCRTSP_i + \beta_7 PRWFO_i + \beta_8 AGE_i + \beta_9 EDUC_i + \beta_{10} TINTER_i + \beta_{11} TGRREG_i + \beta_{12} TPREAG_i + \beta_{13} EQUITY_i + \beta_{14} PLOWN_i + \beta_{15} PHIF_i + \beta_{16} NGEN_i + \beta_{17} MEDRENT_i + \varepsilon_i$$

and

$$LT_i = \begin{cases} 0 \text{ if } LT_i^* \le 1 & \text{(nonfarm use)} \\ 1 \text{ if } 1 < LT_i^* \le \mu_3 & \text{(individuals outside operation)} \\ 2 \text{ if } \mu_3 < LT_i^* \le \mu_4 & \text{(someone involved in operation but not a relative)} \\ 3 \text{ if } \mu_4 < LT_i^* \le \mu_5 & \text{(relative who is not one of my children)} \\ 4 \text{ if } \mu_5 < LT_i^* & \text{(one or more of my children)} \end{cases}$$

where LT_i^* is the operator's unobserved land transition propensity, LT_i is the operator's observed land transition propensity, β_0 through β_{17} and μ_3 through μ_5 are unknown parameters to be estimated, and ε_i is a random variable with a normal distribution. The ordered probit model is well defined only for μ_k greater than zero.

Explanatory variables are as follows: $DSTATE_i$ equals 1 if the respondent is from Arizona and 0 if from Missouri. The percentage of cash receipts obtained from fruits and tree nuts ($PRFATN_i$); dairy ($PRDAIRY_i$); vegetables, pulses and other crops ($PRVPO_i$); forage crops ($PRFOR_i$); cotton, rice, tobacco, sugar, and peanut crops ($PRCRTSP_i$); and wheat, forage, and oil crops ($PRWFO_i$) -- livestock of pork, beef, sheep, and poultry make out the remainder of all cash receipts. AGE_i equals 1 through 6 if the age of the principal operator is under 25, 25-34, 35-44, 45-54, 55-64, and 65 and over. Education ($EDUC_i$) is quantified from 1 through 6 by using the last year of school completed by the principal operator as either grade school, some high school, high school diploma, some college, college Bachelor's degree, and an advanced college degree. $TINTER_i$ equals the number (0 to 2) of Internet related technologies (Internet for E-commerce transactions

and/or to collect information to manage risk) used by the respondent. $TGRREG_i$ indicates the number of technologies (0 to 6) used by the operator regarding the following: herbicide-tolerant crops, seed multiplied (increased) through tissue culture technology, genetically-modified seed, plant growth stimulants and regulators, insect growth regulators, and livestock production stimulants such as shots and implants. Responses regarding the use of precision irrigation (laser leveling, drip irrigation and low-pressure sprinkler systems), and precision agriculture (e.g., global positioning systems, variable rate applications) make up the variable of $TPREAG_i$ (0 to 2).

$EQUITY_i$ equals 1 if the operator had to draw on existing farm or personal equity to finance their farm or ranch in the past 3 years and 0 otherwise. The percentage of land operated by the respondent that is owned equals $PLOWN_i$. $PHIF_i$ equals the percentage of household or family income that the respondent typically earns from farming or ranching. The generation (including spouse's family) the current operator represents on this farm or ranch is defined by $NGEN_i$. The opportunity cost of keeping land in farming or ranching is quantified using the median monthly rental price ($MEDRENT_i$, 1992 Census data) for the county that the operator resides in. $MEDRENT_i$ ranges from $118 to $397 and has an average of $208.

The percentage of cash receipts obtained from crop and livestock mixes provide insight into what level producers are at in the "Farming Food Chain" and the degree that

government subsidies influence land transition decisions. Crops like cotton, rice, tobacco, sugar, and peanuts have historically received more payments than commodity crops of wheat, feedgrain, and oilseed crops on an absolute and relative percentage basis. The level of management associated with alternative crop mixes is captured by the number of technologies utilized in their operation (i.e., $TINTER_i$, $TGRREG_i$, and $TPREAG_i$). $EQUITY_i$ identifies operations that are facing financial and profit difficulties by having to draw on existing farm or personal equity to finance their operation in the past 3 years. $PLOWN_i$ may also reflect financial health related to cash flow but it probably mainly reflects the security offered to children in making their career as a farmer or rancher. AGE_i, $EDUC_i$, and $PHIF_i$ influence the ability of an agricultural operator to possibly retire from farming at an earlier age than otherwise and capitalize on nonfarm employment opportunities. The extent that agricultural producers have a desire to pass on their operations to their own children through heritage or tradition is measured by both the constant term of β_0 and the number of generations the operation has already been owned within the family ($NGEN_i$). How Ricardian or responsive producers will be to rents offered by urbanization or nonfarm land use is proxied by the median monthly rental value for the county the operator resides in ($MEDRENT_i$).

Empirical Results

Many variables were found to be statistically significant for explaining what producers feel will happen to their land when they retire and they are reported in table 1. First, high significance of the ordered response variables of μ_3, μ_4, and μ_5 (all having p-values of 0.000) suggest that the ordered probit framework is appropriate for the data. The positive constant term of β_0 is on par in statistical significance with the ordered response variables, indicating that most operations plan to pass their operation on to their children. However, the next most statistically prominent factor is the monthly median rental value or $MEDRENT_i$. The negative sign associated with $MEDRENT_i$ indicates that producers will respond to higher nonfarm rents for their land in the future by selling to urban developers or other nonfarm use.

The positive sign for $DSTATE_i$ indicates that producers in Arizona are more likely to keep their land in agriculture than Missouri producers, ceteris paribus. This result could be attributed to two different factors. First, farmland preservation legislation has recently surfaced in Arizona's legislature that would pay development rights to producers so that they could keep farming near the Phoenix metro area. Secondly, roughly 80% of the state of Arizona is federal, state, or Native American owned, making the transition of lands into nonfarm use much more rigid than in Missouri. For example, the Gila River Indian Tribes reservation near the Phoenix metro area has housing

developments on their north and southern boundaries. Yet agriculture land has actually increased on this reservation due to federal water right settlements. Many ranchers in Arizona operate almost exclusively on public lands, yet their grazing leases are fairly secure since they are tied to small private land holdings that they own. The percentage of land owned that the operator farms or ranches ($PLOWN_i$) is positive and statistically significant as well (p-value of 0.023). This most likely reflects the notion that owning a larger percentage of land in the operation reduces uncertainty, which attracts children into farming or ranching as a career..

The significant and negative sign of $EDUC_i$ indicates that producers with more education are less likely to pass their operation on to their children and more likely to sell out their land to nonfarm uses at retirement. More educated producers probably have more educated children so that nonfarm employment opportunities are probably greater for their children than less educated operators. In addition, more educated producers are probably more aware, able, and willing to respond to nonfarm investment opportunities. Operators that obtain a higher percentage of their family income from the farm ($PHIF_i$) are more likely to pass the farm onto their children than those that depend more on nonfarm income. However, $PHIF_i$ is marginally significant with a p-value of 0.114. AGE_i indicates that older operators believe the land in their operation is more likely to move to someone outside of their family or to nonfarm use. This result may reflect that a

higher percentage of young farmers operate large farms than small farms and that the children of older operators may already be employed in nonfarm activities. Thus, older operators realize that the farm is less attractive to their children and they are more conducive to selling their land for nonfarm use.

In general, results do not support the Farming Food Chain or the notion that farmers with a high-value crop mix are more likely to survive. In fact, the last development stage of tree fruit and nut crops ($PRFATN_i$) identified by Blank with very high investment and highly fixed asset structure has a statistically significant negative sign. Tree fruit and nut crops have high labor requirements and foreign competition with cheaper labor is driving the return of these crops down, in spite of their highly fixed investment structure. Thus, operators with a high percent of their revenues obtained from fruit and tree nuts ($PRFATN_i$) are not optimistic that their land will be able to be competitive with urban development pressures relative to beef, pork, and poultry livestock operations. In fact some nut producers in AZ have been known to maintain their trees without nut production so that their land will be more attractive for housing developments.

The only other statistically significant crop mix variable is wheat, feed grain, and oilseed crops ($PRWFO_i$) which has a p-value of 0.020. The positive sign of $PRWFO_i$ could reflect that many of these producers hope to survive in farming by moving further

up the Farming Food Chain, but it may also reflect that these operators believe their operation will be one of the future low-cost world producers for these commodities. Mechanization, large-scale farming practices, and rich natural soil and water resources favor the production of these commodities which primarily reside in MO. Operations with commodities that are highly dependent on government subsidies like cotton, rice, tobacco, sugar, peanuts ($PRCRTSP_i$), and dairy ($PRDAIRY_i$) appear to be no more likely to keep their land in agriculture in the future than those dependent on forage ($PRFOR_i$) and vegetable crops ($PRVPO_i$). Furthermore, $EQUITY_i$, which reflects the financial health of the operation was not a significant factor either, suggesting that few farmers and ranchers are actually being "squeezed out" of agriculture.

Technology use of the operator quantified by $TINTER_i$, $TGRREG_i$, and $TPREAG_i$ should reflect the level of sophistication, asset fixity, and variable cost structure of the operation. That is, greater technology use should reflect a lower marginal cost structure. However, technology use was found to be rather marginal and negative at influencing the land transition decision. The most statistically significant technology component is $TINTER_i$ with a p-value of 0.113. The negative sign associated with technology seems to indicate that those which are progressive with respect to adopting and taking advantage of new technologies also have little hesitation about transitioning their land to nonfarm use or someone outside their family if returns warrant these decisions.

Concluding Remarks

This analysis looks at how agricultural lands will transition to another operator or nonfarm use by asking current operators what they anticipate will happen to their land when they retire using the "Producer Preferences for the 2002 Farm Bill" mail survey. This approach fits with a life cycle earnings framework, suggesting that most older operators will not transition out of agriculture until they retire. Responses considered were for land transitioning to nonfarm use, someone outside the current operation but staying in agriculture production, a non-relative that is involved with the current operation, a relative that is not their child, and finally one of their children. Results suggest that an ordered probit framework is appropriate for the above responses.

Overall we find little support for the notion of the Farming Food Chain proposed by Blank or that producers get squeezed into growing at least some higher value crops in order to stay in agriculture. While there is a natural propensity and desire for farm land to be operated by one or more of their children when they retire, producers indicate that they will also be responsive to selling their land for development if urban housing offers a higher return. No evidence was found to support the notion that more off-farm income will keep land in agriculture longer than otherwise. Like Goetz and Debertin, results indicate that farms adjacent to metropolitan areas or in counties with high median rental rates are most likely to transition their land out of agriculture. While Goetz and Debertin found that counties with higher government payments lose farmers at a faster rate than

counties with lower government payments, we found little relation between crops that historically have received the highest subsidies and the operators anticipation of their land's use when they retire.

Farmland preservation has been around for sometime and continues to surface. If farmers and ranchers follow more of a life-cycle earnings behavior in exiting agriculture than an expected annual return and risk framework, an unusually large number of farms and ranches will transfer in ownership and/or use in the next decade. Policy makers should be informed as to how producers anticipate their current agricultural lands will be able to compete with international competitors and nonfarm land uses. Given that 55% of the principal farm operators are 55 years of age or older, the next decade appears critical for influencing farm preservation or open space legislation.

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Table 1. Estimated Land Transition Equation Estimates from the Ordered Probit Model

Variable	Estimates	Standard Errors	P –values
INTERCEPT	2.0648	0.4533	0.000
DSTATE (0 MO, 1 AZ)	0.5720	0.2111	0.007
PRFATN	-0.0069	0.0039	0.078
PRDAIRY	-0.0014	0.0049	0.778
PRVPO	0.0015	0.0024	0.539
PRFOR	-0.0028	0.0028	0.303
PRCRTSP	-0.0015	0.0038	0.685
PRWFO	0.0040	0.0017	0.020
AGE	-0.0968	0.0508	0.057
EDUC	-0.1059	0.0469	0.024
TINTER	-0.1454	0.0915	0.113
TGRREG	-0.0564	0.0419	0.178
TPREAG	-0.1663	0.1354	0.219
EQUITY	0.0183	0.1157	0.874
PLOWN	0.0989	0.0434	0.023
PHIF	0.0728	0.0461	0.114
NGEN	0.0383	0.0483	0.428
MEDRENT	-0.0032	0.0010	0.001
μ_3	0.7824	0.0695	0.000
μ_4	0.9302	0.0728	0.000
μ_5	1.0603	0.0752	0.000
Log-likelihood	-580.604		
Sample size	513		

Notes: μ_3, μ_4, and μ_5 are threshold parameters associated with the ordered probit model. The 5 ordered responses were obtained from the question of, "When I retire, I expect the farm or ranch I operate to: 1) be converted to a nonfarm use, 2) be transferred to individuals outside of the current operation, 3) be operated by someone unrelated to my family but currently involved in the operation, 4) be operated by a relative who is not one of my children, 5) be operated by one or more of my children.." The response frequency was 60, 104, 26, 24, and 299 for 1 through 5.