DETERMINANTS OF NET FARM EXITS: A COUNTY-LEVEL ANALYSIS

by

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STATEMENT BY AUTHOR

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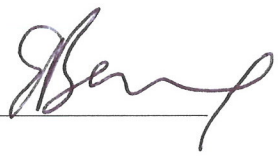
SIGNED: 

APPROVAL BY THESIS DIRECTOR

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ABSTRACT

This study uses multivariate regression analysis to estimate which factors significantly contribute to net farm exits from 1997 to 2006. The dependent variable is percent change in farm proprietorships and separate analyses are conducted for all counties and for the sub-sample of counties that experienced net losses of farm proprietorships from 1997-2006. Counties where a greater percentage of farm operators worked off-farm 200 days or more had lower rates of net exits. This was true in the total sample and in the net-loss county sub-sample. Government payments slowed the rate of net exits in both the full and sub-sample, but although statistically significant, the regression coefficients were so small, that payments do not appear to have been of economic significance. Measures of urban influence and population density contributed to faster rates of exit. Farm property values and extent of irrigation were also associated with faster rates of exit. This may because water rights are a valuable asset that can be sold, thus increasing gains from exiting farming. Likewise, demand for agricultural land for development may bid up the value of agricultural property. Finally, state fixed effects greatly enhanced model goodness of fit and coefficients were highly significant. State effects were important even when including variables for regional differences in agricultural specialization and climate as controls. Moreover, the impact of these state effects on net exit rates was large relative to other explanatory variables. This suggests that examining differences in state-level policies that affect net farm exits may be an important area of future research.

CHAPTER ONE: INTRODUCTION

Edwards, Smith and Peterson (1985) argue that farm exits were among the most prominent economic and social phenomena of the 20th Century in the United States. By 1997, 1.9 million farms were reported in the USDA's Census of Agriculture, less than one-third the peak numbers of 6.4 million in the 1930's (Edwards, Smith, and Peterson, 1985). About 9 to 10 percent of U.S farms go out of business every year (Hoppe and Korb, 2006). Between 1950 and 1990, the number farms in the United States fell by more than 62 percent (i.e. from 5,648,000 to 2,135,000) (Jones and Canning, 1993).

Farm exits have been a policy concern in the United States. One rationale for special farm credit, income support, and bankruptcy laws is reduction in net farm exits. The farm financial crisis of the 1980s and farm bankruptcies raised concerns about farm exits and prompted several changes in agricultural bankruptcy laws (Stam and Dixon, 2004). Concerns have been raised about the effect of farm exits on exiting farmer welfare, rural communities, demand for government services, concentration of agricultural production, and preservation of rural value systems (Zepeda, 1995).

Although many studies suggest that changes in productivity result from adjustment made by individual farms, many changes may result from the entry-exit cycle where new, larger farms with new management skills replace smaller, less productive farms (Tolley, 1970; Jackson-Smith, 1999; Gale, 2003). Hence, the entry–exit cycle is still considered a determinant of the agricultural sector's efforts to maintain global competitiveness and in resource allocation between agricultural and other sectors. In most cases, older farm operators decide to transfer management of the farm to a successor or quit farming because of poor health or death (Bentley and Suape, 1990; Gale 2003). Financial

problems, a change in lifestyle, or a career change may cause many young farmers to leave. Financial stress is more likely to cause farm exit among farm operators who are in the early or middle phases of their careers, although many of them still use debt financing to expand their business (Gale, 2003). Farm exits play a role in the introduction of technology and productivity growth in the farming industry. (Hoppe and Korb, 2006).

Data from the Census of Agriculture indicate that the total number of farms in the United States stabilized in the 1990's. Table 1 shows the total number of farms recorded in 1992, 1997 and 2002 in the U.S.

Table 1. Total Number of Farms

Year	1992	1997	2002
Total Farm Number	1,900,000	2,215,876	2,128,982

Using data from the 1997 Census of Agriculture Longitudinal File, Hoppe and Korb (2006) estimated that, while 717,100 farms exited from 1992 to 1997, 703,700 entered. Thus, the total number of farms fell by just 13,400. The five-year net exit rate fell from 7.8 percent from 1987-1992 to 0.7 percent from 1992-1997 (Hoppe and Korb, 2006). However, many counties continued to lose farms at a steady rate. Still others gained farms. While the number of full-time farmers continued to decline, the number of part-time farmers increased (Bowers and Gale, 2000).

This study uses multivariate regression analysis to estimate which factors significantly contribute to net farm exits from 1997 to 2006. Following Goetz and Debertin (2001) the dependent variable is percent change in farm proprietorships and separate analyses are conducted for all counties and for the sub-sample of counties that

experienced net losses of farm proprietorships from 1997-2006. Separate data are not available measuring entry and exits from farming. Rather, only data on the total number farm proprietors are available. Thus, the study can only examine the net change in the total number of farms.

Among the hypotheses tested in the study is the effect of agricultural program payments on net farm exits. Another issue is whether off-farm work is a transition out of farming or whether it helps farmers adapt to change better and continue farming longer. This thesis also examines the effects of population growth and urbanization on net farm exits in counties. Individual states may have different economic policies that could encourage or discourage farm exits. These include differences in agricultural property tax policies, in inheritance taxes, in farmland preservation programs, or purchase of development rights and conservation easements. It is beyond the scope of this thesis to consider all these programs. However, the econometric model does account for state-level fixed effects and these fixed effects turn out to be quite significant.

CHAPTER TWO: LITERATURE REVIEW

Tweeten (1984) argued the major factors in determining farm size and numbers are technology, national economic growth, and off-farm income. Weiss (1999) reported the economic determinants of farm exit in the United States have not received much of attention from agricultural economists. Farm numbers declined very slightly from 1978-1982, as gross entry was only slightly less than gross exits in the period (Gale, 2003). Gale and Henderson (1991) documented a 23% decline in farm entries from 97,000 during 1978-1982 to 75,000 during 1982-1987. The number of farms in the United States has been relatively stable between Agricultural Censuses in recent decades, but further studies have shown that farming is a more dynamic venture than the total farm count suggests (Hoppe and Korb, 2006).

The increasing importance of off-farm work for families has well been documented (Ahearn, Johnson, Strickland (1985); Jensen and Salant (1985)). Under normal circumstances, one might expect a farmer who engages in an off-farm work to have less time for farming. This could finally lead to farm exit. However, Goetz and Debertin (2001) counter that off- farm work, by stabilizing household income, could reduce the odds that a farm will exit.

Several studies focus on the role of off-farm work and part-time farming on farm exits. Goetz and Debertin (2001) found that combining counties that are gaining and those that are losing farmers, off-farm work has no statistical effect on the rate of net exit. However, they found that higher rates of off-farm work reduced the probability that a county had net farm losses, but higher rates of off-farm work accelerated the rate of net farm loss among net-loss counties. Using county-level data for 326 regions in Western

Germany, Glauben, Tietje and Weiss (2003) find rates of net farm exit are lower in regions with high share of part-time farms. Pfeffer (1989) also found that, in Germany, part-time farmers were less likely to expect that they would continue farming in the future. Weiss (1997; 1999) reported that off-farm employment had a positive impact on the exit probability of Austrian farmers (Weiss 1997 and 1999). Bollman and Kapitani (1981), using data from Canada, found that the odds of exiting from farming declined among farmers who worked off the farm, but increased among farmers working more days off the farm. Kimhi and Bollman (1999) used data on individual farms owned by families to compare the determinants of farm exits in Canada and Israel. They found the probability of a farm going out of business declined with the degree of off-farm work in both countries. In the United States, Kimhi (2000) examined how farm exits were affected by the decision to work full-time off the farm, work part-time off the farm, or to not work off the farm at all. He reports that the probability of farm exit decreases with off-farm work. In addition, farmers view off-farm work, especially a full-time job, as a complement to farming, rather than as a way to get out of agriculture. His results showed that the probability of a exiting from farming was higher for farmers that did not work off the farm at all than the probabilities for those that worked off the farm part-time or full-time.

Government program payments are also found to be a major determinant of net farm exit. Goetz and Debertin (2001) found that larger government program payments per farm decreased the odds that a county had a net loss in the number of farms from 1987 to 1997. However, for counties that did have net farm losses, larger payments per farm increased the rate of net loss. Breustedt and Glauben (2005) emphasize that income

assistance in the form of subsidy payments and price support slows down structural change since it discourages farmers from leaving farming. In their econometric analysis, an increase in price supports and other agricultural subsidies decreased the rate of farm exits.

In contrast, Barkley (1990) argues that government payment do not necessarily have any influence on the changes in agricultural employment and thus the number of farms. Barkley (1990) found there is an indirect impact of agricultural policy on labor migration, but government interventions might have retarded the rate of migration through the imposition of higher land prices.

Several studies focus on specific characteristics of farm households as drivers of farm exits. Using data from 110 regions in the Western Europe, Breustedt and Glauben (2005) find that exit rates from 1993 to 1997 were influenced strongly by farm and family characteristics. Exit rates were faster in regions with more small farms, with a high share of crop production to total production, with a relatively low proportion of older farmers, and a small number of family workers. Huang and Orazem (1997), using data from Southern and Midwestern rural counties, found the number of farmers increased more rapidly or fell less rapidly between 1950 and 1990 in counties in which farmers had a relatively high incomes.

Gale (2003) disaggregates farm exit into age group and found exit by older farmer past customary retirement ages differed from exits by operators between the working ages of 18 and 64. Operators that were at least 65 years old were responsible for almost half of the farm exit that occurred during 1978-1982.

Hoppe and Korb (2006) using micro-level, longitudinal data found farms operated by Blacks or females were more likely to face exit than those operated by Whites or males. Farms specializing in hogs or cash grains were more likely to exit than those specializing in beef production were. In general, new entrants in farming were more likely to exit than were existing farmers.

One might expect smaller farms to exit faster than larger farms, but Kumbhakar (1993) finds there is strong empirical evidence suggesting that small farms can be more economically efficient than larger ones. Kimhi and Bollman (1999) suggest that farm size or farm value would positively contribute to farm survival because larger farms are more likely to provide the farmers and their families with a reasonable and sustainable income. Weiss (1996) found smaller farms grew faster towards some minimum efficient scale of production than farms at or above this threshold size.

CHAPTER THREE: MODELS AND METHODS

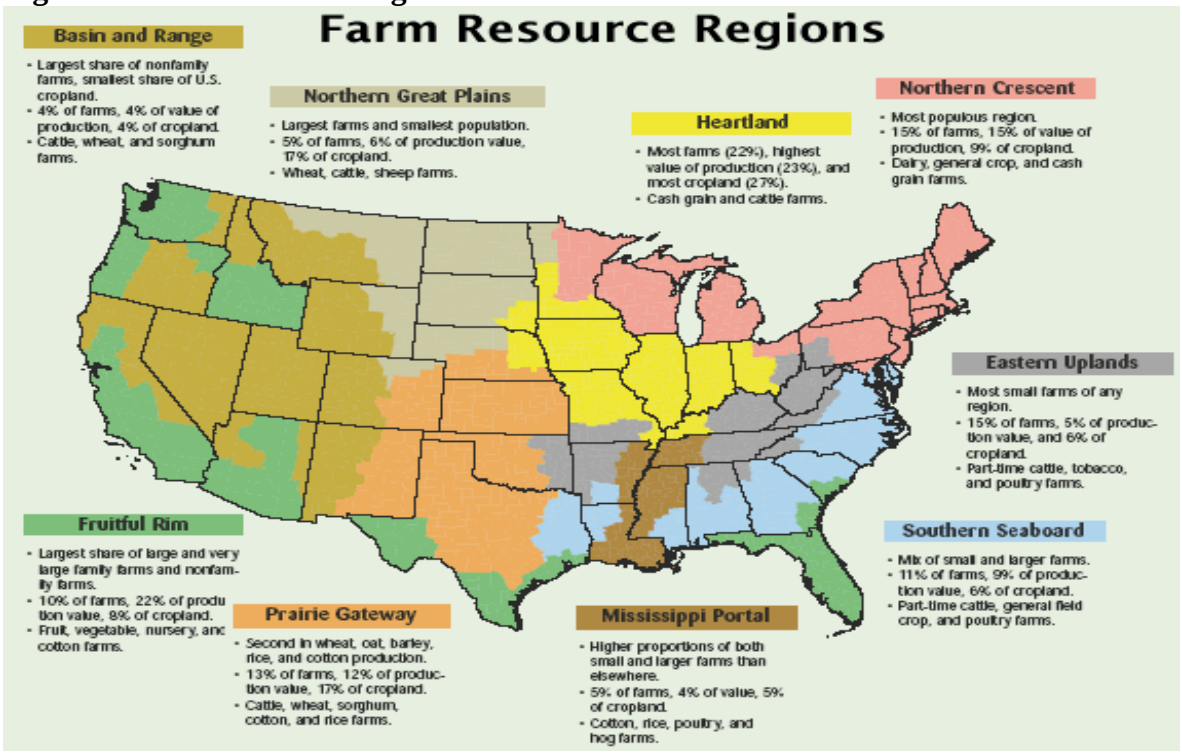
3.1 Data

U.S. county-level data for the 48 contiguous states were used for this analysis. Each county is treated as a unit of observation. In the 48 states, there are 3,068 counties. However, after excluding urban counties and counties with missing data for explanatory variables, 2,571 counties remained in the sample. Out of these, 1,864 counties experienced a net decrease in the number of farms and 707 counties experienced a net gain or no change in farm numbers from 1997 to 2006.

Data were combined from three different sources (1) the 1997 USDA Census of Agriculture, County-Level data files; (2) U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System (REIS); and (3) Data from USDA's Economic Research Service; specifically, county-level natural amenity data (McGranahan, 1999), county identification by Farm Resource Region (Heimlich, 2000), and urban influence codes (Ghelfi and Parker, 2004; Parker and Ghelfi, 2004). The Census of Agriculture data includes county-level data on farm characteristics. The REIS includes more general county-level economic and demographic data. Importantly, it includes the number of farm proprietors in each county for the years 1997 and 2006. While the Census of Agriculture reports the number of farm operators as well, USDA changed their method of counting farms from their 2002 to 2007 Census. Therefore, it would be difficult to determine how much of the change in USDA farm numbers were true changes and how much of the difference was because of changes in counting methods. Natural amenity data includes long-run climate variables. McGranahan (1999) found that climate (and other amenity variables) had a significant impact on migration

and rural population change. He used county-level measures, measuring long-term climate based on averages from 1941 to 1970. Urban influence codes measure the extent of urbanization in a county as well as count proximity to urban centers of different size. Farm resource regions classify counties based on their specialization in producing U.S. farm commodities (Figure 1). Goetz and Debertin (2001) found agricultural specification indexes constructed by Sommer and Hines (1991) were important predictors of net farm exits. The farm resource regions represent a revision and updating of Sommer and Hines' (1991) earlier classification system, dividing the U.S, into nine regions based on production specialization.

Figure 1. Farm Resource Regions



Source: Heimlich

Because REIS only reports the total number of farms in a county, separate information on entering and exiting farmers is not available. Thus, we only observe the net change in the number of farm proprietorships from 1997 to 2006 (the most recent

year that county-level data is available). From 1997 to 2006, the net change (NC_i) in farm proprietors for a particular county *i* is $NC_i = FP_{06i} – FP_{97i}$. The relative change in farm numbers will be $\ln (FP_{06i}) – \ln (FP_{97i})$. Following previous studies, the dependent variable will be relative change in farms (Goetz and Debertin, 2001; Glauben, Tietje and Weiss, 2003).

We include different sets of dummy variables to account for state, region, and crop specific effects. State dummies are included since different states have different policies regarding agricultural taxation, farm preservation, bankruptcy laws etc., which can affect a county's net farm exit. We also include dummies for the nine ERS production regions that capture production specialization.

Table 2 shows the definition and summary statistics for the variables used in analysis.

Table 2. Definitions and Summary Statistics of Variables

Variable	Definition and Unit of Measure	Mean	Min	Max	Std Dev
Farm exit (e_i)	ln (farm proprietors in 2006 over those in 1997 av)	-0.012	-1.502	2.289	0.188
Net loss counties	0, 1 dummy variable (1= net loss)	0.69	0.00	1.00	0.46
Off-farm work	Farmers working off-farm 200days or more, % 1997	0.39	0.06	0.62	0.09
Family farms	Farm that are owned by families, % of total, 1997.	0.86	0.45	0.98	0.07
Operator age	Average farm operator age, Years, 1997.	54.2	44.7	62.0	2.1
Operator age^2	Operator age squared	2,937	1,998	3,844	229
Irrigated farmland	Farmland in irrigation % of total, 1997	0.06	8.62e-6	0.89	0.12
Government payments	Federal farm payment $'000 per farm, 1997	6.13	0.07	44.15	5.25
Population density	Population per square mile, 1997 (000)	0.14	3.0e-4	5.69	0.33
Population growth	Population growth rate, 1989-2000	-0.13	-0.97	5.59	0.26
Unemployment	Local Unemployment rate, 1997	0.05	0.01	0.33	0.03

Table 2. Continued

Variable	Definition and Unit of Measure	Mean	Min	Max	Std Dev
Farm Proprietorships	Number of farms	784	50	7,293	575
	Proprietorships, 1997 av				
Large metro area		0.13	0	1.0	0.34
Small metro area		0.23	0	1.0	0.42
Micropolitan adj to large metro		0.03	0	1.0	0.17
Micropolitan adj to small metro		0.04	0	1.0	0.19
Noncore adj to small metro		0.10	0	1.0	0.30
Net farm income	Net income gained from the farm, 1997 ($000)	19.48	- 37.68	662.44	31.86
Full farm ownership	Percent of farmers that fully own the farm, 1997	0.61	0.18	0.93	0.13
Value of land	Value of land per farm, $1997	4.55	0.86	36.50	3.03
CV of Net Income	Coefficient of variation of Net farm income, 1997av	8.64e-4	-0.29	0.72	0.02
Farm proprietorships	Number of farm Proprietorships, 1997av	783.6	49.3	8,048	589.9
Age-Years Farming	Age minus years of farm Experience	34.6	25.1	43.8	3.4

Table 2. Continued

Variable	Definition and Unit of Measure	Mean	Min	Max	Std Dev
Climate					
Mean Temperature	Jan 1941- 1970	33.1	1.4	67.2	11.9
Mean Temperature	July 1941-1970	76	55.9	93.7	5.3
Sunshine	Mean hours of sunshine Jan 1941-1970	152.1	48	266	33.6
Humidity	Mean relative humidity July 1941-1970	55.4	14.0	80.0	14.7
Farm Resource Regions					
Heartland		0.17	0	1.0	0.37
Northern Crescent		0.14	0	1.0	0.34
Northern Great Plains		0.06	0	1.0	0.23
Prairie Gateway		0.14	0	1.0	0.35
Eastern Uplands		0.13	0	1.0	0.34
Southern Seaboard		0.16	0	1.0	0.36
Fruitful Rim		0.09	0	1.0	0.29
Basin and Range		0.06	0	1.0	0.24
Mississippi Portal		0.05	0	1.0	0.22
Census regions					
South		0.43	0	1.0	0.49
West		0.12	0	1.0	0.33
Midwest		0.33	0	1.0	0.47
North east		0.07	0	1.0	0.26

3.2 Model Specification

The model specification here is similar to that used by Goetz and Debertin (2001). They estimated two separate linear regressions. The first included observations from all the counties in their sample. The second regression used data from the sub-sample of counties that experienced net losses in the number of farms. They also estimated the factors affecting the probability that a county would be a "net loss" county using a probit regression on their full sample.

In our analysis, we also run linear regressions for the full sample and the "net loss" sub-sample. A logit regression was estimated to estimate the factors affecting the probability that a county would be a "net loss" county. For the linear regressions the following model was estimated

(1) $$ln\,(FP_{06i}/FP_{97i}) = \alpha + \boldsymbol{\beta}'\boldsymbol{S}_i + \boldsymbol{\gamma}'\boldsymbol{RR}_i + \boldsymbol{\delta}'\boldsymbol{AC}_{i97} + \boldsymbol{\mu}'\boldsymbol{CC}_{i97} + \boldsymbol{\rho}'\boldsymbol{NA}_i + \varepsilon_i$$

where

FP_{06i} = number of farm proprietorships in county i in 2006

FP_{97i} = number of farm proprietorships in county i in 1997

$\boldsymbol{S}_i$ = vector of state dummy variables

$\boldsymbol{RR}_i$ = vector of farm resource region dummy variables

$\boldsymbol{AC}_{i97}$ = vector of agricultural characteristics

$\boldsymbol{CC}_{i97}$ = vector of county characteristics

$\boldsymbol{NA}_i$ = vector of county natural amenities (such as climate)

ε_i = stochastic error term

and α, $\boldsymbol{\beta}$, $\boldsymbol{\gamma}$, $\boldsymbol{\delta}$, $\boldsymbol{\mu}$, and $\boldsymbol{\rho}$ represent parameters to be estimated. For the logistic model, $ln\ (FP_{06i}\ /FP_{97i})$ is replaced with a 0-1 binary variable that equals one if the county experienced a net loss of farms from 1997 to 2006 and equals zero otherwise, such that

$$P(NC_i < 0) = \exp(\boldsymbol{X'\eta}) / (1+ \exp(\boldsymbol{X'\eta})) + e_i$$

where X is a vector of the same explanatory variables as in equation (1) and $\boldsymbol{\eta}$ is a vector of parameters to be estimated.

CHAPTER FOUR: EMPIRICAL RESULTS AND FINDINGS

In the linear regressions, the dependent variable is ln (FP_{06i}/FP_{97i}). A positive coefficient for a regressor means that the variable contributes to the rate of net gain of farms in the county or slows the rate of net loss. Table 3 shows results for the linear regression using the full sample of data. Table 4 reports coefficients and standard errors for the state-specific fixed effects. The default state is New Hampshire. Because we are dealing with a cross-sectional data, heteroskedasticity cannot be overlooked. Using White's test, a Chi-square test statistic was value of 852.69, implying a p-value of <.0001. This means we can reject the null hypothesis of homoskedasticity. We used a weighted least squares (WLS) estimator to correct for heteroskedasticity in both the full sample and the sub-sample of net loss counties. Goetz and Debertin (2001) do not report conducting a test for heteroskedasticity in their study using data similar to (but older than) the data used here. Neither do they report measures of goodness of fit (such as R^2).

Table 3. WLS Regression Results of Net Farm Exits for All Counties Model

Variable	Parameter Estimate	Std Error
Intercept	0.03	0.069
Off-farm work	0.02	4.61e-3***
Family farms	-2.12e-3	4.47e-3
Operator age	2.76e-3	0.003
Operator age²	-2.79e-5	2.39e-5
Value of land	-3.39e-4	8.81e-5***
Government payment	1.99e-4	4.09e-5***
Population density	-3.21e-3	7.27e-4***
Population growth	-1.61e-3	8.28e-4
Unemployment	-3.45e-4	0.006
Irrigated farmland	-0.003	1.65e-3*
Age – Years Farming	6.58e-4	1.09e-4***
Net farm income	4.26e-7	5.94e-6
CV of Net farm income	1.52e-3	0.002
Adjacency		
Large metro area	-8.84e-4	5.22e-4*
Small metro area	-1.15e-3	3.54e-4***
Micropolitan adj to large metro	-1.36e-5	6.59e-4
Micropolitan adj to small metro	-1.51e-3	5.76e-4***
Noncore adj to small metro	-1.07e-3	4.46e-4**

Number of Observations= 2,571 R-squared = 0.9914

Table 3. Continued

Variable	Parameter Estimate	Std Error
Full farm ownership	0.01	2.80e-3***
Climate		
Mean Jan Temp	-1.59e-4	5.99e-5***
Mean July Temp	-4.73e-5	5.96e-5
Jan Sunshine	-1.15e-5	1.52e-5
July Humidity	-3.72e-5	2.77e-5
Northern Crescent	9.09e-4	6.91e-4
Northern Great Plains	-4.38e-5	6.45e-4
Prairie Gateway	1.26e-3	6.76e-4*
Eastern Uplands	-7.93e-5	5.93e-4
Southern Seaboard	8.54e-4	7.73e-4
Fruitful Rim	3.46e-4	8.65e-4
Basin and Range	-9.53e-6	7.99e-4
Mississippi Portal	3.18e-4	9.75e-4

Notes: Significance levels: *10%, **5%, ***1% or lower.

Table 4 WLS Regression Results of the State Dummies in the All Counties Model

Variable	Parameter Estimate	Std Error
Alabama	-0.25	0.003***
Arizona	0.12	0.004***
Arkansas	-0.18	0.003***
California	-0.26	0.003***
Connecticut	-0.09	0.003***
Delaware	-0.30	0.004***
Rhode Island	0.03	0.004***
Nevada	-0.13	0.003***
Nebraska	-0.27	0.002***
Pennsylvania	-0.14	0.002***
Massachusetts	-0.10	0.002***
Maryland	-0.20	0.003***
Maine	-0.12	0.002***
Montana	-0.08	0.003***
South Carolina	-0.14	0.003***
South Dakota	-0.16	0.002***
Michigan	-0.12	0.002***
Mississippi	-0.12	0.003***
Missouri	-0.17	0.002***
Minnesota	-0.14	0.002***

Notes: Significance levels: *10%, **5%, ***1% or lower

Table 4 Continued.

Variable	Parameter Estimate	Std Error
Tennessee	-0.23	0.003***
Texas	-0.10	0.003***
Utah	-0.12	0.003***
Vermont	-0.17	0.003***
Virginia	-0.17	0.003***
Washington	-0.27	0.003***
West Virginia	-0.11	0.003***
Wisconsin	-0.16	0.002***
Wyoming	-0.13	0.003***
North Carolina	-0.32	0.003***
North Dakota	-0.16	0.003***
Idaho	-0.09	0.003***
Iowa	-0.22	0.002***
Ohio	-0.16	0.002***
Oklahoma	-0.12	0.003***
Oregon	-0.12	0.003***
Illinois	-0.21	0.002***
Indiana	-0.23	0.002***
Georgia	-0.13	0.003***
New York	-0.21	0.003***
New Mexico	-0.01	0.003***

Notes: Significance levels: *10%, **5%, ***1% or lower

Table 4 Continued.

Variable	Parameter Estimate	Std Error
New Jersey	-0.09	0.003***
Kentucky	-0.21	0.002***
Louisiana	-0.23	0.003***
Florida	-0.21	0.004***
Kansas	-0.14	0.003***

Notes: Significance levels: *10%, **5%, ***1% or lower

Number of Observations=2,571.

The WLS regression run on all counties and including state-specific fixed effects had an R^2 of 0.99. However, the R^2 dropped markedly when state effects were excluded. Looking at the standard errors of the coefficients, the state effects are not only significantly different from New Hampshire, but it appears that many state effects are quite different from each other. Thus, unobserved state fixed effects appear to be quite important. A possible area of future research might be to explore how differences in state-level tax (or other) policies affect farm exits. Only one farm resource region was significant in the regression. This may be because of the correlation between resource regions and state dummy variables.

The rate of net exits <u>decreases</u> for counties where:

- A greater percentage of farm operators work 200 or more days off the farm
- Average government payments per farm are greater
- Average farmer age minus average farmer experience on the farm was greater

- A greater share of farmers in were full owners (as opposed to part owners or tenants).

All these explanatory variables were measured in 1997 from the Census of Agriculture. Farm operator age minus farm experience was meant to be a proxy for education. We did not have data on average farm education. This variable captures years not engaged in farming, of which years in school would be a major part. Given the significance of this variable, future research might consider more explicitly the relationship between farm operator education and exits.

The rate of net exits increases for counties where, in 1997:

- Average values of land and buildings were higher
- A higher percentage of agricultural land was irrigated
- Population density was greater
- Mean long-term January temperature is higher
- There is more urban influence as measured by the urban influence codes.

All the urban influence code dummy variables were significant, but one. All had the expected negative sign suggesting that greater urban influence increases the rate of farm exits. The default for these dummy variables were counties in the seven remaining, least urban categories.

In general, several measures of urban development pressure seem to accelerate farm exits. In addition to the urban influence codes, population density is also associated with a faster rate of exit. Population growth in the previous decade (1990 – 2000) was not

significant, but did have a negative sign. McGranahan (1999) found that warmer winters (higher January temperatures) increased population growth in rural counties. Here, warmer Januarys were associated with greater farm exit rates. McGranahan's other natural amenity variables had negative signs (except for humidity) suggesting that natural factors that encourage greater population growth were associated with faster farm exits. These other variables were not statistically significant, however.

Greater land values and a higher percentage of irrigated acreage were also associated with faster exit rates. Again, these may reflect development pressure. Development potential may inflate farmland values. Goetz and Debertin argued that higher rates of irrigation could slow the rate of farm exits by reducing production risk. However, agricultural water rights can be sold for profit by exiting farms. Thus, availability of irrigation water may increase gains from leaving farming.

For the logistic model, the dependent variable equals one if the county was a "net loss" county and zero. This binary response variable is then run on the independent variables. A positive coefficient estimate means that an *increase* in that particular independent variable will increase the probability the county is a net loss county. Since the parameter estimates in binary response models do not tell much about the impacts of the independent variables (Park, 2004), in order to make the interpretation of the co-efficient estimates more intuitive, we then calculate the marginal effects of every independent variable on the probability of a county experiencing farm exit.

Marginal effects are computed by taking the first partial derivative with respect to corresponding independent variables. They vary depending on the values of the independent variable and other independent variables (Park, 2004).

$$\partial F(z_i)/\partial z_i = f(\beta X_i)\,\beta$$

The f (.) represents the logistic density function; β represents a vector of estimated parameters and X_i is the square matrix of the regressors.

In the logistic regression, census region dummy variables were used instead of state dummy variables. The large number of state variables created quasi-complete separation and hence the model would not converge. The default census region was the Northeast.

Logistic regression results are shown in Table 5. In general, the results are consistent with the WLS regression. Counties with higher unemployment rates were less likely to be net loss counties. Again, this is consistent with a story of development pressure spurring exits. Areas with higher unemployment may be generating less pressure to move from farming. Warmer and more humid Julys also increase the probability of being a net loss county. None of the marginal effects in the logistic regression appears to be significant, however.

Following Goetz and Debertin, we also estimate the rate of net farm exits for a sub-sample of net loss farms (Table 6). Using regional instead of state dummies, the model fit is relatively poor (R-squared = 0.15). Again, however, government payments and off-farm work tend to slow the rate of net exits. Average farmer age is significant in this regression. The effect is quadratic. Exit rates are lower in counties with the lowest average age (44 years). Exit rates increase until average age is 53, then decrease as average age increases toward the maximum of 62.

Table 5 Logit Model Results of Net Farm Exit for All counties

Variable	Parameter Estimate	Std Error	Marginal Effect	ME Stdev
Intercept	54.97	38.92	-	-
Off-farm work	-1.19	1.283	-0.182	0.139
Family farms	-1.25	1.542	- 0.136	0.104
Operator age	-2.06	1.422	-0.009	0.009
Operator age^2	0.02	0.013	-	-
Value of land	0.09	0.033	0.009	0.007
Government payment	-0.08	0.017***	- 0.009	0.007
Population density	-0.28	0.209	- 0.025	0.019
Population growth	-0.19	0.206	0.018	0.014
Unemployment	-3.46	2.29*	-0.196	0.150
Irrigated farmland	1.23	0.687	0.134	0.103
Age-Years Farming	-0.26	0.043***	-0.026	0.019
Net farm income	3.91e-3	2.94e-3	4.17e-4	3.19e-4
CV of Net farm income	0.72	2.559	0.028	0.021
Adjacency				
Large metro area	0.58	0.227**	0.061	0.046
Small metro area	0.37	0.170**	0.039	0.031
Micropolitan adj to large metro	0.57	0.328	0.063	0.049
Micropolitan adj to small metro	0.59	0.229*	0.069	0.053
Noncore adj to small metro	0.61	0.232***	0.062	0.048

Notes: Significance levels: *10%, **5%, ***1% or lower

Table 5 Continued

Variable	Parameter Estimate	Std Error	Marginal Effect	ME Stdev
Full farm ownership	0.42	0.955	0.021	0.016
Climate				
Mean Jan Temp	0.02	0.013	0.002	0.001
Mean July Temp	0.09	0.026***	0.010	0.008
Jan Sunshine	-5.63e-3	0.002	-6.06e-4	4.64e-4
July Humidity	0.12	0.008***	0.012	0.009
Census Regions				
South	0.65	0.227***	0.069	0.053
West	3.29	0.364***	0.345	0.265
Midwest	3.26	0.270***	0.347	0.266

Notes: Significance levels: *10%, **5%, ***1% or lower.

Number of Observations=2,571

Table 6. WLS Regression Results of Net Farm Exit for the losing counties

Variable	Parameter Estimate	Std Error
Intercept	1.72	0.560***
Off-farm work	0.04	0.023*
Family farms	-0.02	0.029
Operator age	-0.07	0.02***
Operator age²	6.18e-4	1.94e-4***
Value of land	-8.50e-4	7.39e-4
Government payment	0.001	4.01e-4**
Population density	-4.76e-3	0.003*
Population growth	2.79e-3	0.006
Unemployment	0.17	0.057***
Irrigated farmland	-0.05	0.015***
Age-Years Farming	2.01e-3	8.96e-4**
Net farm income	-5.34e-5	5.88e-5
CV of Net farm income	0.20	0.051***
Adjacency		
Large metro area	4.61e-3	0.004
Small metro area	-3.78e-3	0.003
Micropolitan adj to large metro	-8.16e-3	0.007
Micropolitan adj to small metro	9.10e-3	0.005*
Noncore adj to small metro	-5.47e-3	0.004

Notes: Significance levels: *10%, **5%, ***1% or lower

Table 6 Continued

Variable	Parameter Estimate	Std Error
Full farm ownership	0.03	0.019*
Climate		
Mean Jan Temp	-8.75e-4	2.90e-4***
Mean July Temp	-1.53e-4	7.14e-4
Jan Sunshine	1.29e-4	6.03e-5**
July Humidity	-1.29e-3	2.27e-4***
Census Regions		
South	-0.02	0.004***
West	-0.08	0.011***
Midwest	-0.01	0.004***

Notes: Significance levels: *10%, **5%, ***1% or lower.

Number of Observations=1,864.
R-squared=.1548

CHAPTER FIVE: CONCLUSIONS

The econometric results suggest that counties where a greater percentage of farm operators worked off-farm 200 days or more had lower rates of net exits. This was true in both the total sample and in the net-loss county sub-sample. Government payments slowed the rate of net exits in both the full and sub-sample as well. However, although government payments were statistically significant, the regression coefficients were so small, that payments do not appear to have been of economic significance. Measures of urban influence and population density contributed to faster rates of exit. Farm property values and extent of irrigation were also associated with faster rates of exit. This may be because water rights are a valuable asset that can be sold, thus increasing gains from exiting farming. Likewise, demand for agricultural land for conversion and development may bid up the value of agricultural property. Finally, state fixed effects were highly significant. Moreover, the affect of the regression coefficients was large relative to other explanatory variables. This suggests that examining differences in state-level policies that affect net farm exits may be an important area of future research.

REFERENCES

Ahearn, M., J. Johnson, and R. Strickland. "The Distribution of Income and Wealth of Farm Operator Households." *American Journal of Agricultural Economics.*67 (1985): 1087-1097.

Barkley, A.P. "The Determinants of the Migration of Labor Out of Agriculture in the United States: 1940-85". *American Journal of Agricultural Economics*.72 (1990):567-73.

Bentley, S.E., and W.E. Saupe. "Exits from Farming in Southwestern Wisconsin, 1982-86.Washington, DC": U.S Department of Agriculture, ERS, AER-631,Februray 1990.

Bollman, R.D; and M. Kapitani. "Entry and Exit Functions for Farmers" Paper presented at Rural Sociology Society annual meeting Guelph ON, August 1981.

Bowers, D. and F. Gale. Rural Conditions and Trends: Rural Industry Issue, No.2 (RCAT-111) ERS, USDA. June 2000.

Breustedt, G. and T. Glauben, "Driving Forces Behind Exiting From Farming in Western Europe", *Journal of Agricultural Economics*, no.1, (2005):115-127.

Edwards, C., M. Smith, and N. Peterson. "The Changing Distribution of Farms by Size: A Markov Analysis." *Agricultural Economics Resources*. 37(Fall 1985):1–16.

Gale, H. F. "Age-Specific Patterns of Exit and Entry in U.S Farming"; 1978-1997, *Review of Agricultural Economics* (2003): 594-604.

Gale, H. F. "Age Cohort Analysis of the 20th Century Decline in U.S. Farm Numbers." *Journal of Rural Studies*.12 (January 1996):15–25.

Gale, F., and D. Henderson. "Estimating Entry and Exit of U.S. Farms" Washington, DC: U.S. Department of Agriculture, ERS, AGES 9119(March 1991).

Ghelfi, L., and T. Parker. "Developing a County-Level Measure of Urban Influence" Amber Waves (April 2004): 47.

Glauben, T., H, Tietje, and C Weiss,. "Agriculture On the Move: Exploring regional Differences in Farm Exit Rates in Western Germany" *Work Paper EWP 0308.* (October 2003).

Glauben, T., H, Tietje, and C Weiss. "Agriculture On the Move: Exploring regional differences in farm exit rates in Western Germany" *Review of Economics of the Household* (2006):103-118.

Glauben, T., H. Tietje, and Weiss, C. "Intergenerational Succession in Farm Households: Evidence From Upper Austria", *Review of Economics of the Household* (2004):443-461.

Goetz, S. J., and D.L, Debertin. "Why Farmers Quit: A County-level Analysis". *American Journal of Agricultural Economics* (2001):1010-1023.

Hallam, A. "Economics of Size and Scale in Agriculture: An Interpretative Review of Empirical Measurement". *Review of Agricultural Economics* 13, no.1 (1991):155-172.

Hamilton, Barton H. "Does Entrepreneurship Pay? An Empirical Analysis of the Returns to Self-Employment". *The Journal of Political Economy*108, no.3 (2000):604-31.

Heimlich, R. Farm Resource Regions. Agricultural Information Bulletin No. (AIB760). U.S. Department of Agriculture, Economic Research Service. August 2000.

Hoppe, R.A. and P. Korb, "Understanding U.S Farm Exits". ERS, USDA,Economic Research Service Report No. 21, June 2006.

Huang, T.L., and P.F Orazem. "Rural Population Growth 1950-1990: The Roles of Human Capital, Industry Structure and Government Policy". Journal Paper No.J-17205, Iowa Agricultural and Home Economics Experiment Station, Ames IA, 1997.

Huffman, W.E. "Farm Labor: Key Conceptual and Measurement Issues on the Route to Better Farm Cost and Return Estimates". Dept. Econ. Staff Paper No.280, ISU, April 1996.

Jackson-Smith, D. "Understanding the Microdynamics of Farm Structural Change: Entry, Exit, and Restructuring among Wisconsin Family Farmers in the 1980's" *Rural Sociology 64(March 1999):66-91.*

Jensen, H., and P. Salant. "The Role of Fringe Benefits in Operator Off-Farm Labor Supply." *American Journal of Agricultural Economics* (December 1985):1095-1099.

Jerome, M. Stam and B. L. Dixon. "Farmer Bankruptcies and Farm Exits in the United State", ERS/USDA, *Agricultural Information Bulletin* (1899-2002).

Jones, J., and P.N, Canning. (1993) "*Farm Real Estate: Historical Series Data, 1950-92".*Statistical Bulletin 855, Economic Research Service, US Department of Agriculture, Washington, DC.

Key N., and Michael J. Roberts. "Commodity Payments, Farm Business Survival, and Farm Size Growth" *Economic Research Report* No.ERR-51, November 2007.

Kimhi, A. “Is Part-Time Farming Really a Step in the Way Out of Agriculture?” *American Journal of Agricultural Economics* (February, 2000):38-48.

Kimhi, A., and R .Bollman. “Family Farm Dynamics in Canada and Israel: The Case of Farm Exits”. *Agricultural Economics* .21(1999): 69-79.

Kumbhakar, S.C. “Short-Run Returns to Scale, Farm-Size, and Economic Efficiency” *The Review of Economics and Statistics,* no 2 (May, 1993):336-341.

McGranahan, D. Natural Amenities Drive Rural Population Change. Agricultural Economic Report No. (AER781). U.S. Department of Agriculture., Economic Research Service, October 1999.

Park, H.M. “Presenting Binary Logit/Probit models using the SAS/IML”. Available at http://www.masil.org/documents/Binary_Logit.pdf.

Parker, T. and L. Ghelfi. “Using the 2003 Urban Influence Codes to Understand Rural America.” Amber Waves. (April 2004):13.

Pfeffer, M.J. “Part-Time Farming and the Stability of Family Farms in the Federal Republic of Germany” *European Review of Agricultural Economics.16 (1989):425-44.*

Pietola, K., M. Vare, and A. Oude Lansink. “Timing and Type of Exit from Farming: Farmers early retirement programs in Finland”, *European Review of Agricultural Economics*, (2003):99-116.

Shepard, L.E., and R.A. Collins. “Why Farmers Fail? Farm Bankruptcies 1910-78.” American Journal of Agricultural Economics.64 (1982):609-15.

Sommer, J.E., and F.K. Hines. Diversity in U.S. Agriculture: A New Delineation by Farming Characteristics. Washington DC: ARED, ERS, USDA, *Agricultural Economics Report* No. 646, July 1991.

Tolley, G. S., “Management Entry into U.S .Agriculture”, *American Journal of Agricultural Economics*, (1970):485-493.

Tweeten, L., Causes and Consequences of Structural Change in the Farming Industry (Washington, D.C: National Planning Association, Food and Agriculture Committee, Planning Report No. 207, 1984).

U.S Congress, Office of Technology Assessment. *Technology, Public Policy and the Changing Structure of American Agriculture*. A Special Report for the 1985 Farm Bill.OTA-F-272, Washington DC, March 1985.

Weiss, Christoph R., "Do They Ever Come Back Again? The Symmetry and Reversibility of Off-Farm Employment". *European Review of* Agricultural *Economics* 24(1997):65-84.

Weiss, Christoph R., "Exits From a Declining Sector: Econometric Evidence From a Panel of Upper-Austrian Farms 1980-1990" Working paper no. 901, Dept. of Econ., University of Linz, February, 1996.

Weiss, Christoph. R., "Farm Growth and Survival: Econometric evidence for individual farms in Upper Austria", *American Journal of Agricultural Economics,* (1999): 103-116.

Zepeda, L., "Asymmetry and Nonstationarity in the Farm Size Distribution of Wisconsin Milk Producers; An Aggregate Analysis", *American Journal of Agricultural Economics*. 77 (November 1995):837-852.