The Housing Boom and Its Effect on Farmland Acreage

Anton Bekkerman

North Carolina State University
Department of Agricultural and Resource Economics
Email: abekker@ncsu.edu

Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Portland, OR, July 29-August 1, 2007

The Housing Boom and Its Effect on Farmland Acreage

Anton Bekkerman

Abstract

This paper examines farmers land ownership decision to keep their farmland or sell the acreage to a non-agricultural enterprise. The boom in housing demand during the early 21^{st} century caused a subsequent rise in land demand by housing construction companies. This, in turn, has significant effects on farmers choice to sell their farmland endowment and leave farming. Data from several public sources, including the USDA-NASS, U.S. Census, BLS, and BEA-REIS, is used to analyze the relationship of farm acreage with housing permit values. The Arellano-Bond dynamic panel estimator is used within a GMM framework to examine land ownership behavior of forward-looking farmers. Results indicate that a rise in demand for new housing significantly influences a farmer's behavior to transfer agricultural acreage out of farming.

KEYWORDS: farmland ownership, housing values, dynamic panel estimator, GMM, forward-looking farmer.

The Housing Boom and Its Effect on Farmland Acreage

It is well-documented that the farming industry has been steadily shrinking over the past 100 years, both in the number of farms as well as the general farming population. Nevertheless, the decrease in farms has been complemented by the growth in the average farm size. An important question to consider, then, is whether the decline in farm numbers is due to a transfer of acreage within the agricultural industry or because of exogenous factors that shift the land out of farming. In answering this question, this study examines expected valuation of land by farmers, which drives their decision to retain land for farming or sell it to a non-farm enterprise, such as a home construction company.

There is voluminous literature devoted to exploring factors that affect land ownership status and on-farm labor choice. Research by Huffman (1976 [20], 1980 [21]), Huffman and Lange (1989 [22]), Sumner (1982 [34]), and Kimhi (2000 [24]) shows that off-farm labor decisions are significant influences on farmer behavior. Goetz and Debertin (1996 [15]), Leathers (1992 [27]), and Key and Roberts (2006 [23]) show that government programs also affect decision making. However, little attention has been devoted to examining farmers land ownership decisions with respect to indirect forces, such as land demand by the non-farming sector. These external interests might be powerful enough to significantly affect the farmer's decision making process. In particular, the housing boom during the early 21^{st} century could be considered a major catalyst for an increase in land value and acreage demand. In just a five year span (years 2000 to 2005) the median sales price of new housing increased by the same relative amount as it had in the fifteen previous years. In addition, housing permit[1] issuance, which remained relatively constant from 1987-1999,

[1] Authorizations issued by the local permit-issuing jurisdiction. After a permit is issued,

jumped by 70% from 2000 to 2005.[2]

These figures are indicative of an overall trend in the U.S. housing industry, and can provide a new perspective in explaining the continual decrease in agricultural land acreage. The purpose of this paper, then, is to investigate how an increase in farmland valuation by a non-farm enterprise might affect farmers decision to keep or sell their land.

In general, farmer decisions, which are reflected in their behavior, are made in anticipation of future economic events. For example, when choosing the type and quantity of a certain crop or whether to purchase crop insurance, the farmer cannot know with certainty the events that may affect that season's yields. She must make a rational, forward-looking decision based on past observations of economic conditions. Similarly, decisions about land ownership must be made prior to knowing true economic conditions. Specifically, a representative farmer[3] must consider the *future* (expected) marginal benefits and costs of keeping or selling her farmland.

In exploring this topic, the paper adheres to the following outline: first, a review of background literature and topics; next, a theoretical model of land ownership decisions by a forward-looking farmer; third, an explanation of data, a proposal of an empirical model, and a specification of an estimation method; finally, a description and assessment of results and implications. A proposal of future work concludes the study.

---

construction of the new structure begins within a one–three months period. (U.S. Census)

[2]U.S. Census

[3]County level data is used and it is assumed that each "farmer" in this analysis shares similar characteristics as other farmers in a particular county

1 Background Information

1.1 Farmland Ownership Decisions

There is vast literature that examines factors entering a farmers utility functions and driving decisions to remain or leave the agricultural industry. Sumner (1982), Huffman and Lange (1986), and Tokle and Huffman (1992) [37] show that off-farm labor choices are a vital part in analyses of farmers decision-making process. Off-farm labor allows farmers to diversify their income risks, as shown by Goodwin and Mishra (1994) [28], helping maintain their farms despite seasonal yield and price uncertainties. Ahituv and Kimhi (2006) [2] find a bimodal distribution of off-farm labor, indicating that off-farm labor is especially important for small farm operators.

Another determinant of farmer behavior is the U.S. government subsidy programs. The 1996 Food and Agricultural Improvement and Reform (FAIR) bill eliminated many production constraints and instituted a system of direct (decoupled) supports. This allowed payments to be independent of output specifications (output dependent payments are known as coupled). Goodwin and Mishra (2006) [**?**] as well as Ahearn et al (2006) [1] examine the FAIR act's impact on farmer's off-farm labor decisions, concluding that both coupled and decoupled payments significantly contribute to altering off-farm labor choices. Also, Goodwin et al (2003) [16] find that, in general, government transfers raise agricultural land values and economic rents to the farmer.

One of the ways that off-farm labor and government program implications have been examined is with respect to farm survival and exit rates. Weiss (1999) [42] examines county-level farm existence and points out various attributes that affect farm survival probability rates in Upper Austria. Similarly, Zepeda (1995) [43] looks at county-level data of Wisconsin dairy farmers to determine factors that may increase the chances of farm exits.

Implementing a Cox proportional hazard-function, Key and Roberts (2006) [23] investigate government payment influence on farm survival in the U.S. They find a small, yet significant, positive effect of government payments on farm survival rates. Kimhi and Bollman (1999) [25] find that the farmer's age, off-farm labor, farm size and institutional constraints significantly affect farm exit probabilities in Canadian and Israeli farms. Also, Goetz and Debertin (2001) [15] show opposing effects of off-farm employment on U.S. farm exit rates, indicating that higher off-farm labor rates might help preserve farms, but also could accelerate farm exits. The authors explain that farmers already in the non-farm labor force have significant opportunity costs for passing up full-time employment in the non-farm labor market.

1.2 Housing Market

To motivate the purpose of this study, it is helpful to examine the recent increase in housing demand, which began circa year 2000. Popular opinion shares the belief that this boom in demand is a result of historically low interest rates and speculative purchases by consumers, who hoped to profit from rapidly increasing housing prices. However, current research shows that these may not be the only significant factors that caused the price increases in the housing market (as evidenced by sharp rise in the Housing Price Index (HPI)[4]).

A publication by the Joint Center for Housing Studies of Harvard University (2004) [35] shows that demographic changes and innovations in the housing finance sector are important factors in the recent acceleration of housing demand. In addition, Fisher and Quayyum (2006) [13] conclude that the home ownership rates have risen due to two main causes: increases in consumer wealth and substitution away from renting. However, there is lacking research about the

[4]The HPI is the quarterly percentage change in housing values, with respect to the previous quarter. Published by the Office of Federal Housing Enterprise Oversight (OFHEO) [30], the index indicates an averaged value of 7.22 in years 2000-2002, compared to 2.97 in the 1990's.

relationship of the housing demand and the agricultural sector, which signals a need to devote closer attention to this topic.

1.3 Forward-Looking Behavior Models

Alston (1986) [3] and Burt (1986) [7] led the methodological innovations of using asset capitalization formulas to relate the dynamics of farmland prices to land rents. The dynamic nature of such land value models is crucial, as shown by Schnitkey et al (1989) [32], who analyze purchasing and selling decisions in central Illinois. Testing both a static capital budgeting and a dynamic programming models, the authors find that the dynamic programming specification outperforms the static model. Thijssen (1996) [36] also finds that static rational expectations models of farmer investment behavior produce theoretically inconsistent results.

The capital asset pricing model (CAPM) and the consumption-based capital asset pricing model (CCAPM) have also been used to represent the dynamics of preferences in land asset pricing (e.g. Epstein & Zin, 1991 [10]; Chavas & Thomas, (1999) [8]). However, the validity of such specifications in agricultural studies has been questioned. Clark et al (1993) [9] point out that farmland prices rise significantly faster than land rents, violating a necessary condition[5] for using capital asset models to measure land value as a function of rents. The authors challenge the often employed CAPM scheme because it uses a constant discount rate and assumes risk neutrality. Clark et al show that implementing CAPM may often lead to an inconsistent description of land prices over time.

An alternative specification might be an implementation of a more generalized methodology. One possibility is to estimate a dynamically constrained forward-looking farmer behavior model using a GMM framework. Fuhrer & Olevei (2004) [14] implement such an approach by using a set of “optimal in-

[5] See Falk (1991) [12]

struments" that empirically conform with a theoretical forward-looking specification.

2 Theoretical Model

An appropriate model of decision making by a forward-looking farmer must consider a lifetime utility maximization problem. Farmers seek to maximize their present value of future utilities by choosing to either keep or sell their farmland. By retaining the land, they consume up to the total earnings from on-farm and off-farm labor. However, by selling, they must forego any future on-farm gains in exchange for a lump-sum compensation and full-time off-farm income. Following Kimhi and Bollman (1999) [25], a farmer maximizes:

$$\begin{aligned} max\ U_t = (1-\sigma)\left\{\sum_{t=1}^{\infty}\beta_t \cdot U_1(C_t, L_t)\right\} + \ldots \\ \sigma\left\{\sum_{t=1}^{t^*}\beta_t \cdot U_1(C_t, L_t) + \sum_{t=t^*}^{\infty}\beta_t \cdot U_2(C_t, L_t)\right\} \end{aligned} \tag{1}$$

This utility function is constrained by an intertemporal budget requirement, such that:

$$
\begin{cases}
\sum_{t=1}^{\infty} R_t C_t = \sum_{t=1}^{\infty} \left\{ R_t (W_t^{M_F} \tau^{M_F} + I_t^F + G_t) + A_t^F \right\}, & \text{(2a)} \\
\qquad \text{if no sale, } \sigma = 0 & \\
\sum_{t=1}^{\infty} R_t C_t = \sum_{t=1}^{t^*} (10a) + \left\{ \sum_{t=t^*}^{\infty} R_t (E[\ W_t^{M_R} \tau^{M_R}\ ]) \right\} + \Delta - E[\ \rho\ ], & \text{(2b)} \\
\qquad \text{if sale occurs, } \sigma = 1 &
\end{cases}
\tag{2}
$$

The variables are defined as follows:

- C_t is consumption, L_t is leisure, and β_t is discount factor for some future period t.
- R_t is the market discount rate.
- $W_t^{M_F}$ is the off-farm wage rate and τ^{M_F} is the fraction of time spent working off the farm (if the farmer keeps her land).
- I_t^F is net farm income.
- G_t is government transfers, available only if the farmers chooses to keep the farm.
- A_t^F is the land value.
- $E[\ W_t^{M_R} \tau^{M_R}\ ]$ is the expected market income (if the farmer sells her land and relocates).
- Δ is the lump-sum compensation for sold farmland.
- $E[\ \rho\ ]$ is the expected relocation costs.[6]
- t^* is the time at which sale of farmland occurs (if sale occurs).
- σ is an indicator variable that denotes whether or not a farmer sells her farmland.

Additional necessary assumptions are as follows:

[6] See the Appendix for a brief discussion on choosing appropriate relocation costs variables.

$$\textbf{Total Available Time: } 1 - \tau^M - \tau^F - \tau^L = 0 \tag{3}$$

$$\textbf{Net Farm Income: } W_t^F \tau^F - c(y^F) = I_t^F \tag{4}$$

$$\text{Off-farm wage, } W_t^M, \text{ is common knowledge to all farmers, working and non-working off the farm.} \tag{5}$$

$$\text{If a farmer sells her farmland, she } \textit{must} \text{ relocate.}^7 \tag{6}$$

τ^F and τ^L are fractions of time allocated to farming and leisure, respectively, and $c(y^F)$ are total costs of producing agricultural output, y^F.

The maximized value of utility with respect to the first budget constraint (equation (2a)) is denoted as U^{Keep}, and the maximized value of U with respect to equation (2b) is defined as U^{Sell}. In other words, U^{Keep} is the maximum present value utility farmers can attain if they *stay* in the agricultural sector, and U^{Sell} is the maximized present value of utility if they decide to *leave* farming by selling their endowment of land. Characterization of the optimal behavior is as follows:

$$IF: \begin{cases} U^{Keep} < U^{Sell}, & \text{then sale occurs and acreage declines} \\ U^{Sell} < U^{Keep}, & \text{then no sale occurs} \end{cases} \tag{7}$$

Implicitly, a reduction in farmland acreage occurs once the farmer sells, because the buyer is a known non-agricultural enterprise. This implies that the purchased land will no longer be used for farming purposes. This notion is exploited to construct a tractable empirical framework that analyzes the effect of increases in land values on farmers land ownership decision.

3 Empirical Framework

3.1 Data

The data used in this study is collected from multiple public sources, including the United States Department of Agriculture (USDA) [40], the U.S. Census Bureau [38], the U.S. Department of Commerce [41], and the U.S. Department of Labor. The USDA maintains Census of Agriculture files, which are managed by the National Agricultural Statistics Service (NASS) and collected every five years. This statistical source offers a large variety of county-level survey records that present useful information about the farm and farm operators, such as farmland acreage, net farm incomes, etc. In addition to agricultural attributes, the U.S. Census is used to gather county-level data about housing permits.[8]

Next, information is assembled about on- and off-farm market conditions, including the unemployment rate, net farm income, government farm subsidies, and off-market income. This data is located in the REIS database, maintained by the Bureau of Economic Analysis, which operates as part of the U.S. Department of Commerce. To account for the inverse relationship between government payments and crop yields (seasons with high yield prices are matched by low government payments, and vice versa) averaged values are used for government subsidies.

The study examines 2,524 U.S. counties, with data corresponding to the agricultural census in years 1978, 1982, 1987, 1992, 1997, and 2002.[9]

[8] Building permits are issued by local permit-issuing jurisdictions, and typically, signal that new housing construction will begin one to three months after the permit is issued.

[9] See *Table 1 – County Summary Statistics*

3.2 Empirical Specification

In general, the purpose of this paper is to analyze the effects of economic variables on farmers decision to sell or retain their farmland. Estimation of these effects would allow an understanding of how and by how much these influence a farmer's utility. For example, finding that housing values are strongly related to the change in farm acreage is a signal that rational, forward-looking farmers will place weight on this information when deciding their land ownership status.

First, it is necessary to specify an estimable model that correctly represents a farmer's ability to prepare for future economic conditions based on the available set of current and past information. An econometric framework that is useful in examining this type of economic problem is the generalized method of moments (GMM) [19]. A GMM model is fairly simple to estimate and yields consistent results for a set of proper instruments.

To illustrate how GMM is applied in this study, it is necessary to specify a model that captures a farmer's forward-looking behavior. This paper implements a double-log linear specification, which seeks to find whether farmers plan to keep or sell their land, based on expectations of applicable socioeconomic variables.[10] The model is as follows:

$$\ln(\Delta\delta_{i,t,t+1}) = \theta\mathbf{X_{t+1}} + \gamma_i + \ \alpha_t + \varepsilon_{i,t+1} \tag{8}$$

where $\mathbf{X_{t+1}}$ is a matrix of explanatory variables, γ_i and α_t are cross-sectional and time-series fixed effects, and,

[10]The choice of this specification may be questioned, as some previous literature (discussed in section (1.3)) suggests that other models such as CAPM and CCAPM may be more useful in measuring farmer expectations of land prices. It is necessary to point out, though, that such intertemporal asset pricing models make specific assumptions about the form of the consumer's utility function. As Richard King [26] astutely notes, there are empirical consequences to all modeling assumption about consumer behavior and a very specific utility function can limit the measurements and interpretations of the econometric results. Thus, the simpler, yet less restrictive specification is chosen.

$$\Delta\delta = \frac{\text{Farmland Acreage}_{i,t+1} - \text{Farmland Acreage}_{i,t}}{Total\ Acreage}$$

NOTE: Descriptions of variable names are available in *Table 1 – County Summary Statistics* of the Appendix.

Applying the GMM methodology, this straight-forward model is *fitted* according to the available data. This allows for less theoretical restrictions than if selecting a specific functional form for farmers utility.

This analysis utilizes a rich panel data set, so that a natural approach is to use Arellano & Bond's dynamic panel estimator (Arellano & Bond, 1991 [5]). This estimator applies the GMM framework to both cross-sectional and time-series characteristics of the panel data set. Exploiting the orthogonality condition between the error term and a set of exogenous and predetermined instruments, the moment condition is defined as $E[z_t \cdot \Delta\varepsilon_t(\theta)] = 0$. The GMM estimator of θ_0 minimizes the GMM minimand, such that:

$$\widehat{\theta} = argmin_{\theta\in\Theta} \left\{\Delta\varepsilon(\theta)'Z\right\} \Omega_N \left\{Z'\Delta\varepsilon(\theta)\right\} \tag{9}$$

Rewritten:

$$\widehat{\theta} = \left[\left(\sum_i \Delta y_i' Z_i\right) \Omega_N \left(\sum_i Z_i' \Delta y_i\right)\right]^{-1} \left(\sum_i \Delta y_i' Z_i\right) \Omega_N \left(\sum_i Z_i' \Delta y_i\right) \tag{10}$$

where Z_i is the matrix of instruments and Ω_N is the weighting matrix, which is defined as follows:

$$\Omega_N = \left(\frac{1}{N} \sum_{i}^{N} Z_i' H_i Z_i \right)^{-1} \quad (11)$$

such that H_i is a $(T-2) \times (T-2)$ matrix, and Z_i contains the lagged dependent variable ($\Delta\delta$), a purely exogenous variable ($Primary\_Occupation$), and lagged predetermined variables ($expFarmInc$, $LandValue$, $unrate$, $expGovt$, $E\_NF\_Inc\_cnty$, $PermitValue$, $chgPermit$, $avgDist$, $avgMedHome$, $avgIncome$, $lnFarmAcres$).[11]

4 Econometric Results[12]

An iterated GMM procedure for the Arellano-Bond dynamic panel estimator converges in 3,814 iterations,[13] with parameter estimates provided in *Table 2 – Iterated Arellano-Bond GMM Estimator Results* of the Appendix. All of the variables exhibit appropriate (theoretically expected) relationships with the dependent variable, and all but one ($expFarmInc$) are highly significant. Although some experimentation with altering the instruments resulted in better statistical performance of parameters, it worsened the fit and overidentifying statistic or caused non-convergence.

Among the on-farm attributes, it is not surprising that the expected off-farm income has the strongest effect on reducing the rate of decline of farmland acreage. This supports the results in previous studies (Goodwin & Mishra, 1994; Ahituv & Kimhi, 2006), which point out that non-farm labor can significantly aide farmers in maintaining ownership of their farms. Land value and expected government payments also indicate inverse relationship with the decline rate of

[11] For the structure of both the H_i and Z_i matrices, see Arellano & Bond (1991) [5].

[12] Empirical analyses were performed using SAS statistical software, version 9.2. Code is available from author upon request.

[13] The tolerance levels for the weighting matrix and parameter vector were set at $1e-8$ and $1e-6$, respectively.

acreage. The unemployment rate in the county, which can be viewed as a proxy for the farmer's ability to gain off-farm employment, appropriately illustrates that as the opportunity to find off-farm work falls (unemployment rate rises), there is an increase in the rate of land decline. In other words, the decrease in the ability for farmers to diversify their incomes increases their incentive to sell their land and leave the agriculture industry.

Variables that represent costs and benefits of relocation imply correct outcomes in both sign and magnitude, as well. The average distance from the county of a "representative" farmer to the relocation city has the strongest effect, because it encompasses both monetary and psychic costs. Monetary relocation costs might include attributes such as renting a moving truck or hiring a moving service, travel expenses, opportunity costs of missing work, etc. Psychic costs could be hardships of moving away from friends and family and information costs, which are incurred from learning customs and intricacies of a new location.[14] As the average distance increases, the farmer is less apt to relocate, which is indicated by the inverse relationship of this variable with the decline rate of farm acreage. The average median home price, which is another major cost, exhibits the same inverse relationship as average distance, albeit with a much smaller magnitude.

Average income has a relatively strong direct relationship, since it represents a farmer's potential benefits if she was to sell and relocate. An increase in off-farm full-time income might create enough incentive (for marginal farmers) to sell their land and move to a location with the higher earning potential. This, in turn, would cause an increase in the rate of farm acreage decline.

Finally, the most pertinent estimate in this study is the effect of housing permit values on the rate of farm acreage decline. As expected, the variable $PermitValue$ is highly significant and positively correlated with the acreage

[14]See the Appendix for a further discussion of psychic relocation costs.

rate. This might imply that an increase in the value of new housing would induce the construction companies to pay a higher price for the farmland, thus increasing a farmer's incentive to sell her land.

Specifically, the elasticity measure between rate of farmland decline and housing permit values is 0.3192%. Evaluating at mean values, the model indicates that a one dollar increase in house permit values would result in a 0.00393 relative decrease of farmland acreage. This, then, can be used to determine specific acreage losses due to increases in new housing values. For example, between years 1997 and 2002, there was a 72% rise in the housing price index (HPI) [30]. During the same time, the rise in housing permit values, ceteris paribus, caused, on average, a 1.8% drop in relative farm acreage across counties. In comparison, during the periods 1992-1997 and 1982-1987, the rise in housing permit values contributed to 50% less decrease in relative farm acreage than in 1997-2002.

5 Conclusions

The increase in housing demand during the 21^{st} century has lead a rise in the quantity and value of newly constructed homes. Due to the scarcity of land, acreage that has historically been used for farming might be bought by non-agricultural industries, so as to meet the escalated demand for construction land. To examine the validity and magnitude of this phenomenon, this study models the decision making process of forward-looking farmers, who must rationally determine whether to keep or sell their farmland.

This study shows that the rise in demand for new housing significantly influences a farmer's choice to reallocate agricultural acreage to the non-farming sector. The intuitive justification is relatively straightforward, considering that increased demand for housing raises the opportunity cost of land shortage for the construction industry. This induces the housing industry to offer higher compensation to farmland owners, which might result in farmers maximized lifetime utility to become larger if they sell and relocate. Ultimately, this sequence of events and behavior is revealed in the relationship between housing permit values and the rate of farm acreage decline.

Using the GMM framework to fit the Arellano-Bond dynamic panel estimator, the parameters of the model satisfied statistical signficance, theoretical intuition, and results of past studies. The variable of main interest, $PermitValue$, reveals a relevant effect on acreage decrease, indicating that forward-looking farmers are influenced by changes in housing permit values when making the decisions to retain or sell their agricultural land.

One issue that should be explored further (as data become available) is the potential effect of housing values during the peak of the housing boom (between years 2003 and 2005). With data from the upcoming 2007 Agricultural Census, this research can be expanded by testing the forecasting ability of this model, and performing a structural breakpoint analysis that might reflect potential peculiarities of the recent rise in housing demand.

Appendix

Relocation Costs

Farmers decision to sell or retain their land is an outcome of a utility maximization problem, which is subject to scenario-specific budget constraints (see equation (1)). Ultimately, they must select the combination of labor and consumption that yields the greatest expected utility. If farmers opt to keep their land, then they must consume according to the budget constraint in equation (2a). However, in the case where they choose to sell the farmland, the budget constraint takes on the form of equation (2b).

In choosing the second scenario, farmers face a consumption condition that is characterized by economic conditions at an expected new location, to which farmers move after selling the farmland. Forward-looking farmers must take these attributes into account when making inferences about farmland ownership choices, since these will affect the farmers future expected income and consumption.

There are a significant number of factors that have been shown to be empirically important in determining relocation decisions. Barkley (1990) [6] points out that farmer's income at their current location plays a large role in their choice to move. Additionally, income characteristics at the potential relocation center are integral because they are used to analyze *relative* economic benefits between the initial and final location (Greenwood, 1975 [17]).

Studies also show that psychic components are important in migration analyses. Schwartz (1973) [33] states that there are significant costs to detachment from family and friends, and that these costs rise with an individuals age. O'Bryant & Murray (1986) [29] and Fabricant (1980) [11] support this argument with empirical results that show that proximity to family and friends, as well attachment to a specific region, are important factors in relocation choice. Anjomani (2002) [4] indicates that distance between the initial and final locations can be used as a proxy for both monetary and psychic relocation costs.

This analysis uses Metropolitan Statistical Areas (MSA)[15] as locations of potential relocation. This is primarily due to previous research that indicates migratory patterns to locales with large population growth (see Greenwood, 1975 [18]; Anjomani, 2002 [4]). There are 248 metropolitan areas with various economic attributes, from years 1978 to 2002. Longitude and latitude coordinates are used to calculate the distance between the county and an urban center using the Great Circle distance formula.[16]

[15]MSAs are geographic locales used by the U.S. Office of Management and Budget for collecting and publishing various statistics. This is a region with a population of at least 50,000, and consists of one or more counties that contain the main urban center. For a more extensive definition of Metropolitan Statistical Areas, refer to the U.S. Census Bureau [39]

[16]See Figure 1 of the Appendix.

Tables and Figures

TABLE 1 – County Summary Statistics, Year 2002

Variable	Description	N	MIN	MAX	MEAN	STD
expFarmInc	Expected Net Farm Income (per farm acre)	2459	-10.43	0.78	-2.91	1.22
unrate	Unemployment Rate in Farmer's County	2524	0.77	2.97	1.72	0.29
LandValue	Farmland Value (per farm acre)	2524	4.42	10.18	7.41	0.78
expGovt	Expected Government Payments (per farm acre)	2524	-1.92	4.34	2.39	0.98
E_NF_Inc_cnty	Expected Non-Farm Market Income in Farmer's County (per farm acre)	2524	-4.28	9.52	1.12	1.86
Primary_Occupation_	Farmer's Whose Primary Occupation is Farming	2524	2.83	8.38	5.84	0.72
chgAcres	Relative Change in Farmland Acres	2524	-1.81	0.94	-0.02	0.12
PermitValue	Value of Housing Permits (per farm acre)	2524	0	777.41	1.27	16.02
chgPermit	Relative Change in Housing Permit Values	2399	-4.65	4.9	0.29	0.72
lnFarmAcres	Relative Farm Acres	2524	-11.69	-6.11	-7.34	0.83
avgDist	Average Relocation Distance (miles)	2524	68.09	250.99	109.38	20.9
avgMedHome	Average Median Home Value at Relocation Locale (in thousands)	2524	1766.86	27096.86	8667.23	4772.42
avgIncome	Average Non-Farm Income at Relocation Locale (in thousands)	2524	86.03	1639.97	439.82	231.74

NOTE: Summary statistics across counties for years 1978 – 1997 are omitted to conserve space, but available upon request from author.

TABLE 2 – Iterated Arellano-Bond Dynamic Panel GMM Estimator Results

Variable	**Estimate**	**Std. Error**
Intercept	0.106336*	0.00539
PermitValue	0.319157*	0.00114
expFarmInc	-0.00649	0.0211
unrate	0.04277*	0.00799
LandValue	-0.22925*	0.0141
expGovt	-0.40028*	0.0276
E_NF_Inc_cnty	-0.74752*	0.0282
avgDist	-0.00357*	0.000291
avgMedHome	-0.00005*	0.000012
avgIncome	0.00189*	0.000223

where (*) indicates significance at the 1% statistical level.

Figure 1 – Great-Circle Distance Equation

$$dist_{ij} = \arctan\left\{\frac{\sqrt{[\cos\phi_j \sin\Delta\lambda]^2+[\cos\phi_i \sin\phi_j - \sin\phi_i \cos\phi_j \cos\Delta\lambda]^2}}{\sin\phi_i \sin\phi_j + \cos\phi_i \cos\phi_j \cos\Delta\lambda}\right\}$$

where ϕ_i and ϕ_j are the latitudes of each location, and $\Delta\lambda = (\lambda_j - \lambda_i)$, such that λ is the longitude of each respective location.

References

[1] Ahearn, Mary Clare, El-Osta, Hisham S. and Dewbre, Joe, "The Impact of Coupled and Decoupled Government Subsidies on Off-Farm Labor Participation of U.S. Farm Operators." American Journal of Agricultural Economics, 88 (2006):393-408

[2] Ahituv, A. and Kimhi, A., "Simultaneous estimation of work choices and the level of farm activity using panel data." Eurp. Rev. of Agr. Econ. 33(2006):49-71

[3] Alston, J.M., "An Analysis of Growth of U.S. Farmland Prices." Amer. J. Agr. Econ. 68(1) (Feb. 1986):1-9

[4] Anjomani, A. "Regional Growth and Interstate Migration." Socio-Economic Planning Sciences. 36 (2002):239-65

[5] Arellano, M., Bond, S. "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations." Rev. Econ. Studies. 58(2) (Apr. 1991): 277-297

[6] Barkley, A. "Determinants of Migration of Labor out of Agriculture in the U.S." Amer. J. Agr. Econ. 72(3) (Aug. 1990):567-73

[7] Burt, O.R. "Econometric Modeling of the Capitalization Formula for Farmland Prices." Amer. J. Agr. Econ. 68(1) (Feb. 1986):10-26

[8] Chavas, J.P. and Thomas, A.J. "Dynamic Analysis of Land Prices." American Journal of Agricultural Economics." 81 (1999): 772-784.

[9] Clark, J.S., Fulton, M., Scott Jr., J.T. "The Inconsistency of Land Values, Land Rents, and Capitalization Formulas." Amer. J. Agr. Econ. 75(1) (Feb. 1993): 147-155

[10] Epstein, L.G., and Zin, S.E. "Substitution, Risk Aversion, and the Temporal Behavior of Consumption and Asset Returns: An Empirical Analysis." J. Polit. Econ 99 (April, 1991): 263-86

[11] Fabricant, R.A. "An Expectational Model of Migration." J. Reg. Sci. 10(1) (April 1970):13-24

[12] Falk, B. "Formally Testing the Present Value Model of Farmland Prices." Amer. J. Agr. Econ. 73 (Feb. 1991): 1-10

[13] Fisher, J.D.M. and Quayyum, S. "The Great turn-of-the-century housing boom." Economic Perspective: Federal Reserve Bank of Chicago(3Q, 2006):29-45

[14] Fuhrer, J.C., Olivei, G.P. "Estimating Forward-Looking Euler Equations with GMM Estimators: An Optimal Instruments Approach." FRB Working Paper. (Revised: July, 2004)

[15] Goetz, S.J., and D.L. Debertin. "Rural Population Decline in the 1980s: Impacts of Farm Structure and Federal Farm Programs." Amer. J. Agr. Econ. 78(1996):517:29

[16] Goodwin, B. K., A. K. Mishra, and F. N. Ortalo-Magne. "What's Wrong With Our Models of Agricultural Land Values?" American Journal of Agricultural Economics 85(2003):744-52

[17] Greenwood, M.J. "Research on Internal Migration in the U.S.: A Survey." J. Econ. Lit. 12 (1975):397-433

[18] Greenwood, M.J. "Simultaneous-Equations Model of Growth and Migration." J. Amer. Stat. Assc. 70(352) (Dec. 1975):797-810

[19] Hansen, L.P. "Large Sample Properties of Generalized Method of Moments Estimators." Econometrica. 50(4) (Jul. 1982): 1029-1054

[20] Huffman, W.E. "A Cross-Sectional Analysis of Nonfarm Work of Farm Family Members." DLMA91-19-75-18-1. Springfield, PA: Nat. TLCA Inf. Service, Jan. 1976.

[21] Huffman, W.E. "Farm and Off-Farm Work Decisions: The Role of Human Capital." Rev. Econ. Statist. 62(February 1980):14:23.

[22] Huffman, W.E., and M.D. Lange. "Off-Farm Work Decisions of Husbands and Wives: Joint Decision-Making." Rev. Econ. Statist. 81(August 1989):471:80.

[23] Key, N. and Roberts, M.J. "Government Payments and Farm Business Survival." Amer. J. Agr. Econ. 88(2) (May 2006): 382-92

[24] Kimhi, A. "Is Part-Time Farming Really a Step in the Way Out of Agriculture?" Amer. J. Agr. Econ. 82(February 2000):38:48

[25] Kimhi, A., and R. Bollman. "Family Farm Dynamics in Canada and Israel: The Case of Farm Exits." Agricultural Economics 21(1) (1999):69:79

[26] King, R.A. "Choices and Consequences." Amer. J. Agr. Econ. 61(5) (Dec. 1979):839-848

[27] Leathers, H. "The Market for Land and the Impact of Farm Programs on Farm Numbers." American Journal of Agricultural Economics 74 (1992):291:98.

[28] Mishra, A.K. and Goodwin, B.K., "Farm income variability and the supply of off-farm labor." Amer. J. Agr. Econ. 79(3) (1994): 880-7

[29] O'Bryant, S.L. and Murray, C.I. "Attachment to Home and Other Factors Related to Widows' Relocation Decisions." J. Housing for the Elderly. 4(1) (1986):53-72

[30] Office of Federal Housing Enterprise Oversight (OFHEO). Housing Price Index. www.ofheo.gov

[31] Porell, F.W. Models of Intraurban Residential Relocation. Kluwer-Nijhoff Publishing (Boston: 1982) pgs. 64-80

[32] Schnitkey, G., Taylor, C.R., Barry, P.J. "Evaluating Farmland Investments Considering Dynamic Stochastic Returns and Farmland Prices." Western J. Agr. Econ. 14(1) (1989): 143 - 156

[33] Schwartz, A. "Interpreting the Effect of Distance on Migration." J. Polit. Econ. 81(5) (Sept. 1973):1153-69

[34] Sumner, D.A., "The Off-Farm Labor Supply of Farmers." Amer. J. Agr. Econ. 64(August 1982):499:509.

[35] "The State of the Nation's Housing." Joint Center for Housing Studies of Harvard University. (2004)

[36] Thijssen, G. "Farmers' Investment Behavior: An Empirical Assessment of Two Specifications of Expectations." Amer. J. Agr. Econ. 78 (Feb. 1996): 166-174

[37] Tokle, J.G., and W.E. Huffman. "Local Economic Conditions and Wage Labor Decisions of Farm and Rural Nonfarm Couples." Amer. J. Agr. Econ. 73(August 1992):652:70.

[38] U.S. Census Bureau, USA Counties Data (various years). censtats.census.gov

[39] U.S. Census Bureau. www.census.gov

[40] U.S. Department of Agriculture (USDA-NASS). Census of Agriculture (years 1997 and 2002). www.nass.usda.gov

[41] U.S. Department of Commerce (Bureau of Economic Analysis : REIS). Various Tables. www.bea.gov/bea/regional/reis

[42] Weiss, C. "Farm Growth and Survival: Econometric Evidence for Individual Farms in Upper Austria." American Journal of Agricultural Economics 81(February 1999):103:16

[43] Zepeda, L. "Asymmetry and Nonstationarity in the Farm Size Distribution of Wisconsin Milk Producers: An Aggregate Analysis." American Journal of Agricultural Economics 77(4) (1995):837-52.