CHANGES IN THE NUMBER OF FARMS-- THE WEST AND THE UNITED STATES

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Introduction

The large decrease in total farm numbers and the attendant increase in the average age of farm operators observed in the 1950's brought recent attention to the effects of changes in total farm numbers on the age distribution of farm operators.[1/] A series of studies by Kanel (6, 7), Clawson (2), and Tolley and Hjort (9) in the early 1960's approached this area of inquiry by examination of farm operator cohorts; that is, they looked at the number of farm operators both within a given time period who were active in farming as the cohort is traced through time.[2/] These studies generally concluded that the advancing age structure of farm operators is the consequence of differing adjustment abilities of age groups to "pressures" reducing the total number of farms. Young men refuse to stay in (or to enter) farming if income prospects are poor. Mobility decreases with age, however, so that after farmers reach middle age, they tend to remain in farming and change occupations very slowly despite "pressures" which reduce farm numbers. These differing age-specific mobilities of rural people making decisions about continuing (or even entering) farming effect changes in the age distribution of farm operators with changes in total farm numbers.

In the earlier studies mentioned, most of the emphasis was on description of changes in cohort size and patterns. The basis of results presented in this paper are due to a model which departs from cohort analysis in that observable and systematic variations in cohort patterns are analyzed in a framework of occupational supply response.

Suppose that the relative income prospects between farming and nonfarming are the "pressures" alluded to previously which tend to reduce total farm numbers. In a framework consistent with findings from cohort analysis, the model specifies that the several age groups share in differing degrees to changes in total farm numbers. The framework is then modified by suggesting that observed changes in farm numbers are reflections of changing income situations in agriculture. In periods when farm numbers have been observed to decline, career choosers may have been faced with incomes in farming which were low relative to those available in nonfarming occupations. Thus, low incomes in farming relative to those in possible nonfarming alternatives may have led to reduced numbers in farming.

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1/ Farm numbers declined from 5.379 to 3.933 million in the period 1950-1959, while the average age of farm operators increased from 48.3 to 50.5 years. Preliminary reports from the 1964 Census reveal a continuation of these two trends--farm numbers fell to 3.153 million and average age increased to 51.3 years.

2/ For example, consider cohort figures for farm operators both in the decade 1855 to 1895. In thousands of farm operators, the 1910 Census reported that there were 419 twenty-four years of age or less. There were, subsequently, 1,333 in 1920--25 to 34 years old; 1,452 in 1930--35 to 44; 1,428 in 1940--45 to 54; 1,000 in 1950--55 to 64; and 617 in 1959 when members of the cohort were 65 years and older.

The model incorporates both age and income as variables determining occupational choice, and is specified as

$$(1) \quad f_{it} = a_i + \beta_i z_t + \gamma_i s_{it} + u_{it}$$

where all variables are expressed in logarithms. The variables are:

f_{it}: Farm operators in the i^{th} group at the end of the t^{th} decade;

z_t: Ratio of farm-to-nonfarm income facing career choosers;

s_{it}: Rural farm males surviving to the i^{th} group from the previous decade, i.e., males of this age who would be residing on farms in the absence of any net migration during the preceding ten years; and

u_{it}: Random variable.

The i subscript refers to the six farm operator age groups identified in the Census of Agriculture, i.e., less than 25, 25-34, 35-44, 45-54, 55-64, and 65 and over; the t subscript corresponds to census periods which provide data for the analysis of which there are five, namely, 1920, 1930, 1940, 1950, and 1960 (1959). Census of Population estimates of rural farm males expected to survive through the next census period serve as the shifter in the supply model. By use of census survival ratios, 3/ the "survived" rural farm males are estimates of how many persons of a given age will be alive ten years later and are cast as predetermined variables affecting the potential supply of farm operators in the subsequent decade. Equation (1) suggests that changes in the relative income ratio affects all age groups, but the response to income change varies by age group. 4/

It is assumed that any change in the number of survived rural farm males yields an exactly proportionate shift in the supply of farm operators, so that

$$(2) \quad v_{it} = a_i + \beta_i z_t + u_{it}$$

where the dependent variable v_{it} is the ratio of farm operators to survived rural farm males. The v_{it}'s are observable; there are a total of 30 observations--6 age groups and 5 census periods.

If conventional income measures are acceptable, equation (2) depicts a straightforward regression analysis. However, the ratio of average measures of farm and nonfarm incomes are probably not adequate for this analysis since persons making career choices are more likely to be affected by incomes best described as marginal rather than average. That is, persons on the margin between one career and another are likely to face earnings prospects which differ from present average incomes in those occupational alternatives. Earnings ratios on the margin are those upon which occupational decisions are probably based rather than upon inadequate approximations of average sector incomes.

3/ Census survival ratios are discussed in Lee (8).

4/ Equation (1), an occupational supply model, lends itself to the following behavioral interpretation: the logarithm of the number of farm operators in a given age group (i) in time period (t) is equal to an age-specific constant (a_i) plus the product of an age-specific elasticity of supply with respect to income and the log of the relative income ratio in that time period ($\beta_i z_t$) plus the effect of the supply shifter ($\gamma_i s_{it}$) and the random variable (u_{it}).

The upshot of the above is that there are no available income estimates suitable to the purpose of the occupational response model. However, an iterative procedure can be used to yield information about parameters of interest, namely, age-specific elasticities of response to income change (β_i's) and time-specific income ratios (z_t's). Estimation is based entirely on observation of v_{it}.[5/]

The estimation procedure was applied to data for the United States and various regional subaggregates. In all cases, estimates from the procedure converged after a few iterations.[6/] Certain general findings may be of interest.

One, the iterative procedure gives estimates which explain a significant proportion of the variability observed in the v_{it}'s (the independent variable). For the United States 95 percent of the variability is explained.

Two, the iterative procedure yields only estimates of relative age group responses to income change rather than individual β_i's. In the analysis of United States data, the relative response of β_1 (operators less than 25) is over five times as large as the response for β_3 (i.e., $\beta_1/\beta_3 = 5.16$). Other relative responses are $\beta_2/\beta_3 = 2.70$, $\beta_4/\beta_3 = .93$, $\beta_5/\beta_3 = .87$, and $\beta_6/\beta_3 = .92$. The pattern resulting from all analyses is that the largest response occurs for the youngest age group (less than 25) and the response to income changes decline monotonically with increasing age with only few exceptions.

Three, for the United States and the majority of subregions, results from the iterative estimating procedure infers that the farm-nonfarm income ratio has decreased each decade from 1920 to 1960. All analyses of United States and regional data yield estimates which would rank the farm-nonfarm income ratio for 1960 below that of 1950.

Results from the analysis for the 11 western states differ from the general pattern of findings about relative age group responses. For the West, the relative age group responses to income are $\beta_1/\beta_3 = 10.26$, $\beta_2/\beta_3 = 5.74$, $\beta_4/\beta_3 = 1.60$, $\beta_5/\beta_3 = 2.87$, and $\beta_6/\beta_3 = 2.45$. These indicate a much higher relative response at lower ages, probably reflecting better overall employment opportunities for young rural men. The contrast to the usual monotonic decline in age group responses for older ages may reflect older farmers' decisions to convert their capital investments in agriculture into nonfarm assets given prospective adverse tendencies in relative farm-nonfarm incomes. "Early retirement" is clearly more feasible for commercial farmers than for owners of marginal farms more common in other parts of the United States.

5/ Estimates and properties of estimates, as well as a general discussion of the iterative procedure itself, are discussed in Johnston and Tolly (5). In short, the estimation procedure recognizes that the least-square estimator of β_i is

$$\hat{\beta} = \sum^{t}(V_{it}Z_t) \div \sum^{t}(Z_t)^2$$

where capital letters refer to deviations of logarithms from their time means. Similarly,

$$\hat{Z}_t = \sum^{i}(\beta_i V_{it}) \div \sum^{i}(\beta_i)^2.$$

The iterative procedure then is a solution to the simultaneity of the two sets of estimators. The least-squares solution does not lead to unique estimates of β_i's and Z_t's, but does uniquely determine ratios of β_i's and ratios of differences between the Z's.

6/ Results for the United States and regional subaggregates are given in Johnston and Tolley (5). Analysis of state data including that for both white and nonwhite subpopulations in southern states is reported in Johnston (4).

Projections of farm operator numbers through 2000 were made assuming no change from the most recent relative earnings ratio, i.e., the projections were based upon estimates of a_i and β_i from (2) and the estimate of z_t for the most recent year in the anslysis (t = 1960). The earnings ratio used does not appear to lead to unreasonable estimates since resultant projections for the U.S. are of the same approximate magnitude as other available projections of future farm numbers (1, 2, 3). It was also necessary to assume constant age-specific ratios of rural farm males to "projected" numbers of farm operators in each decade throughout the period to obtain estimates for the "shifter" and, hence, to quantify the dependent variable, v_{it}. Farm numbers projected by this procedure for the United States and major regions are given in Table 1.

The age distribution is likely to continue its present trend toward a higher average age for farm operators. There is, however, indication that pronounced trends in aging of the United States farm operator population might be arrested by the end of the century if the necessary adjustments implied by these projections are fulfilled. Farmers less than 35 years of age who made up 26.9 percent of farm operator numbers in 1920 declined to only 12.5 percent of the farm operator population in 1960. A continued decline in their relative numbers is projected through 1990 at which time they are estimated to constitute only 9.8 percent of the farmers. Projections for year 2000 indicate 10.7 percent less than 35 years old and there is in that year for the first time a lesser relative increase in farm operators 55 years and older. (See Table 1). Only if total farm numbers were to exceed the projection estimates, implying more favorable relative earnings in farming than were estimated to hold in the 1950's, would there be likely significant reductions in the average age of farm operators.

The projections indicate a continued reduction in farm numbers. The agricultural sector is unlikely to have the capacity to absorb not only ex-farm operators, but also other agricultural work-force participants whose services would be no longer required in production.

For the United States, the results would imply a long-term concern for adequate education for rural youth, vocational rehabilitation for those forced from farming, and rural development programs for pocket areas of low mobility because of few near-at-hand nonfarming occupational alternatives. It is true that the impact of prospective reductions in total farm numbers is less severe in the West than in more typically noncommercial farming areas of the Nation. However, Table 1 suggests that these same human adjustment programs need to be of concern in the West, although they need not be of the same scale as those required in more acute problem areas such as the South.

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Table 1. Farm Operator Numbers, 1920-1960, with Projections to 2000 and Percentage of Farm Operators 55 Years and Older

Year	United States	Northeast	North central	South White	South nonwhite	West
	Thousands					
1920	6,448	581	2,182	2,284	923	478
1930	6,288	482	2,079	2,342	881	504
1940	6,097	483	2,097	2,326	680	510
1950	5,379	399	1,868	2,097	553	461
1960[a/]	3,933	269	1,500	1,502	293	367
1960[a/]	3,701	254	1,460	1,379	266	342
1970	2,593	168	1,115	998	138	249
1980	1,657	102	772	640	67	170
1990	1,000	59	504	390	31	110
2000	585	34	320	211	14	71
	Index 1960 = 100					
1920	164	216	145	152	315	130
1930	160	179	139	156	301	137
1940	155	180	140	155	232	139
1950	137	148	125	140	189	126
1960	100	100	100	100	100	100
1970	70	66	76	72	52	73
1980	45	40	53	46	25	50
1990	27	23	35	28	12	32
2000	16	13	22	15	5	21
	Farm Operators 55 years and older					
	percent					
1920	24.8	35.7	25.0	23.4	20.9	25.0
1930	28.7	39.4	30.4	26.3	23.1	32.1
1940	33.8	43.9	35.0	31.6	28.5	36.5
1950	34.6	40.5	34.1	34.4	31.7	35.5
1960[b/]	37.7	40.0	36.2	40.1	40.5	37.2
1970	47.4	46.0	44.8	53.6	48.3	41.4
1980	54.4	52.5	51.9	52.7	51.1	48.6
1990	54.7	51.9	53.0	64.3	49.4	49.0
2000	54.9	51.5	52.6	64.0	49.8	48.1

a/ The two sets of estimates for farm numbers in 1960 represent estimates for the "old" and "new" definitions of the farm introduced in the 1959 Census of Agriculture. Projections have been adjusted to the "new" definition.

b/ Farm operators under the "new" definition.

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