SOME EVIDENCE ON THE DECLINING EFFECT OF FARM CONSOLIDATION ON FARM REAL ESTATE PRICES

Fred C. White, Wesley N. Musser and A. R. Sheffield

Rapid technological change has been a dominating factor in American agriculture in the last quarter of a century. Impact of this factor on the farm real estate market is well documented in agricultural economics literature. As Heady [5] and Fuller and Van Vuuren [3] have noted, technological change has been both land-substituting and land-embodying. This characteristic has resulted in positive pressure on land prices as farmers bid up prices of land for farm enlargement so they can more fully employ their fixed labor and capital resources [2, 10]. As adjustments in farm numbers and sizes have slowed in recent years, the dominating influence of farm consolidation is expected to be moderated. Fuller and Van Vuuren noted this possibility as: "... given the combination of numbers, ages, and alternatives, intensive efforts to salvage underemployment of operator and family labor by farm enlargement or by substantial employment on other farms have to be approaching an ultimate plateau" [3, p. 166]. The objective of this paper is to examine impact on farm real estate prices of changing economic conditions in rural areas. Particular attention is given to factors other than farm consolidation. The effect of these structural changes on the land market is empirically tested by reestimating Tweeten and Nelson's model [10] with Georgia data for 1960-1974.

CONCEPTUAL FRAMEWORK

Net farm income has a strong theoretical basis for being the major land value determinant. Modern rent theory used to explain variations in land draws heavily on the marginal productivity approach, which treats rent simply as surplus of income above cost [1, pp. 162-164]. Capitalization of this net income to land provides a value estimate, but it is the stream of expected future net income that should be used in the capitalization approach. A higher stream of expected future returns would normally be associated with higher land values [7, pp. 328-329]. Adjustments to technological change may increase net income to land and hence increase farmland prices. For example, with large labor-saving farm machinery, farmers are able to handle more acreage effectively and can, therefore, expand farm size without further having to increase fixed costs of machinery. Thus, returns to a land parcel for consolidation purposes are higher than for operation as a separate unit, and differential returns would be capitalized into land values. As Fuller and Van Vuuren stressed, this influence of consolidation depended on imperfect adjustment of farm labor to technological change. As these adjustments are completed, the authors hypothesize that consolidation would have less influence on land prices.

Value of farmland can reflect a number of additional factors other than net farm income potential. An important determinant around major metropolitan areas is potential future nonagricultural use of farmland which generates speculative influences on price [2, p. 1265; 8, pp. 28-30]. A related factor is land use for rural residencies, recreational activities and part-time farming. This demand for farmland for consumptive purposes is related to off-farm income potential. Historically, this demand would have been concentrated around metropolitan areas due to concentration of available jobs in these areas. However, manufacturing employment began to decentralize to

Fred C. White is Associate Professor, Wesley N. Musser is Assistant Professor and A. R. Sheffield is Graduate Assistant, Agricultural Economics Department, University of Georgia.

rural areas during the 1960s [4]; thus, consumptive demand for farmland would be expected to become a more general influence on price. Fuller and Van Vuuren hypothesized that such consumptive use of farmland would produce a dual farm structure: "It seems quite possible that resilient small, essentially noncommercial units may develop, and that before 1980 a polarity of extremes may emerge toward around 1 million or less highly commercial farms and 1-1.5 million mini-units" [3, p. 166].

In summary, labor resource adjustment is hypothesized to have less influence on the present farmland market. Earlier consolidation of many uneconomical farming units, plus creation of nonfarm job opportunities in rural areas, has reduced the need for purchasing farmland to salvage excess farm labor. Decline in influence of this adjustment process would be expected to result in improved linkage of the farmland market to nonagricultural capital markets. If adjustment is not a primary motivating factor in farmland purchases, investors in farmland would be expected to consider more fully opportunity costs of their investment. For commercial farmers as well as other investors, farmland is simply an alternative to other investments. Hence, farmland prices would be bid up to the point where returns on farmland and nonfarm investments would be comparable after allowing for differences in such factors as risk and illiquidity. There are, however, other motives for owning farmland than maximizing economic returns; for example, many investors like farming as a way of life and choose to own farmland for consumptive purposes while receiving most of their income from nonfarm employment. Influence of opportunity costs on consumptive investors is not straightforward; however, opportunity costs of the investment do influence costs of farmland consumption. Thus, opportunity costs of farmland investment would be expected to be more important as adjustment becomes less important.

OPERATIONAL MODEL

Interplay of market forces is observed in farmland price. The quantity of farm real estate transactions is subject to modifications by investors' decisions on the demand side, but also by changing availability and productivity on the supply side of the market. However, no single quantity variable appropriately encompasses all dimensions expressed in the preceding discussion. Consequently, several quantity variables have been incorporated in previous studies. As an operational model of farmland supply and demand, Tweeten and Nelson [10] specified a five-equation system with the following dependent variables: number of farms A; farm transfers T; cropland C; land in farms L; and farmland price P. The simplified structural form of the endogenous relationships appears as follows:

(1) Number of Farms: $A = f(X_1)$
(2) Farm Transfers: $T = f(X_2)$
(3) Cropland: $C = f(X_3)$
(4) Land in Farms: $L = f(C{:}X_4)$
(5) Land Price: $P = f(L, T, A{:}X_5)$

where X_j represents exogenous variables including lagged endogenous variables. The five-equation formulation, termed Model I, is used to measure consolidation impact on farmland price. Regression coefficients for number of farms A and transfers T in the farmland price equation can be interpreted as contribution to land prices of pressures for farm enlargement.

Number of farms A in equation (1) is explained by net farm income, the ratio of farm-to-nonfarm income and farm numbers in the previous year. Net farm income is expected to have a positive effect on farm numbers; declines in farm numbers would thus tend to occur when net farm income is low. Reduction in farm numbers is dependent on the farm situation relative to the nonfarm situation. If nonfarm employment and income are high relative to farm income, then movement off farms would be expected to be high. Consequently, variable farm-to-nonfarm income is expected to be positively related to farm numbers.

The number of transfers per 1,000 farms in equation (2) is specified as a function of net farm income, stock of machinery, ratio of farm-to-nonfarm income, and transfers in the previous year. When net farm income is high and/or farm income is high relative to nonfarm income, fewer farm transfers would be expected. Increase in machinery stock would probably give farmers an economic incentive to expand farm size and thus increase the number of farm transfers.

The cropland equation includes the following independent variables: net farm income, land retired by government programs and cropland acreage in the previous year. Net farm income is expected to have a positive effect on cropland if an increase in net income would encourage farmers to plant more acreage. Land retired under government programs would tend to reduce cropland acreage but not necessarily on a one-for-one basis. In general, some slippage is expected to occur in the land retirement programs. Land in farms, equation (4), is explained by cropland acreage, nonfarm income and land in farms the previous year. According to theory, land used for crops (C) would be expected to be endogenously and positively related to total farmland since cropland is a major portion of it. On the other hand, land in farms would be expected to be adversely affected by nonfarm personal income, if better income outside farming increases demand for conversion of farmland to urban and nonfarm uses.

Land price or the land demand equation under the farm consolidation hypothesis is specified as equation (5). Land in farms, farm transfers and number of farms are endogenous quantity variables expected to be negatively related to land price. Net farm income is an exogenous variable included to reflect changes in rent to land and is expected to have a positive effect on land price. Under the alternative hypothesis of a limited consolidation effect, farm transfers and number of farms would not be expected to be significantly related to price; in fact, the number of farms would be expected to have a positive effect if consumptive demand was dominant. Hence, a second formulation, Model II, is specified without equations for number of farms and farm transfers, equations (1) and (2), respectively. Under the alternative hypothesis, returns on common stock would also be expected to be negatively related to land values as an indication of opportunity costs to land investment.

DATA AND METHODS

Data used in this study are time series data for Georgia from 1960 through 1974. The relatively short time period was chosen because of greater interest in explaining farmland market structure in recent years. The study was limited to Georgia rather than the nation because recent evidence suggests labor resource adjustment to technological change is approaching completion in Georgia: Nixon, White and Miller recently found that wages for farm laborers are equivalent to manufacturing employees in Georgia [6]. Data used in the present study were obtained from various secondary sources. Table 1 contains a list and description of all variables, as well as their sources.

The Nerlove distributed lag model was specified for each equation characterizing the farmland market. Rationalization for this type model is that adjustment to desired equilibrium levels may not occur instantaneously. Instead, equilibrium value for the dependent variable may be approached in a distributed lag fashion following a change in an independent variable.

The entire five-equation model was formulated as a recursive system. Use of the recursive model assumes that decisions concerning the current quantity variables are made exogenously of the current price of farmland. In the recursive model, predicted values of cropland from equation (3) are entered into equation (4) land in farms. Predicted values for farmland from equation (4), farm numbers from equation (1) and farm transfers from equation (2) are then entered into equation (5) land price, thus completing the recursive chain for the farmland price model. Effects on land price of variables not included directly in equation (5) but linked to land price through the recursive chain, can be ascertained by substituting estimated equation (1) through (4) into

TABLE 1. VARIABLES USED IN REGRESSION ANALYSIS TO EXPLAIN LAND PRICE PER ACRE IN GEORGIA, 1960-1974

Variable Name	Description
Land Price per Acre[a]	Deflated[b] price of farmland and buildings in dollars per acre
Land in Farms[a]	Acreage reported in million acres
Cropland Acreage[c]	Acreage reported in million acres
Number of Farms[a]	Number reported in thousands
Transfers per 1,000 Farms[d]	Total number of transfers per thousand farms
Net Farm Income[e]	Deflated realized net farm income in dollars per acre
Nonfarm Income[f]	Deflated nonfarm per capita personal income
Farm-to-Nonfarm Income	Net farm income divided by nonfarm income
Stock of Machinery	Calculated by taking the ratio of Georgia depreciation to U.S. depreciation[g] and multiplying by U.S. value of farm machinery and equipment[h]
Land Retired by Government[i]	Land retired from production by government programs in million acres
Return on Common Stock[j]	Rate of return on common stock as a percentage. Includes price appreciation and earnings per share.

[a]Sources: U.S. Department of Agriculture, Economic Research Service, *Farm Real Estate Historical Series Data: 1850-1970,* Washington, D.C., June 1973, and *Farm Real Estate Market Developments,* CD-80, July 1975.

[b]All deflated variables were deflated by Consumer Price Index (CPI).

[c]Sources: U.S. Department of Agriculture, Statistical Reporting Service, *Georgia Agricultural Facts,* Georgia Crop Reporting Service, Athens, Ga., 1959-66, 1964-72, 1973-74.

[d]Source: U.S. Department of Agriculture, Economic Research Service, *Farm Real Estate Market Developments,* CD-66 through CD-80, Washington, D.C., July 1961-July 1975.

[e]Source: U.S. Department of Agriculture, Economic Research Service, *Farm Income Statistics,* Stat. Bull. 547, Washington, D.C., July 1975.

[f]Source: U.S., Department of Commerce, Bureau of Census, *Statistical Abstract of the U.S.,* Washington, D.C., 1961-1975.

[g]Source: U.S. Department of Agriculture, Economic Research Service, *Farm Income Situation,* FIS-225, Washington, D.C., 1975.

[h]Source: U.S. Department of Agriculture, Economic Research Service, *Balance Sheet of the Farming Sector,* Supp. 1, Agriculture Information Bulletin No. 376, Washington, D.C., 1975.

[i]Source: U.S. Department of Agriculture, Georgia ASCS State Office, *Georgia ASCS Annual Report,* Athens, Ga., 1960-1974.

[j]Source: Standard and Poor's Trade and Securities Statistics, *Security Price Index Record:* 1975 Ed., Orange, Connecticut: Standard and Poor's Corporation Publishers, 1975.

equation (5). Solving for the reduced form equation explaining land price in this manner is considered to be more reliable than direct estimation of the reduced form.

As a test for autocorrelation, autoregressive least squares was also used to estimate each of the equations. However, these results are not reported because the autocorrelation coefficient was never statistically significant, indicating that no real problem of autocorrelation existed.

ESTIMATION RESULTS

Estimated regression equations for the farmland market are presented in Table 2. The table also includes student t-values and the level of statistical significance for each regression coefficient. Two alternative specifications of the land price equation are reported to reflect the alternative hypotheses presented in this paper.

All coefficients in equation (1) were positively related to land in farms, as expected. Net farm income and lagged farm numbers were statistically significant, but the ratio of farm-to-nonfarm income was not significant. Overall explanatory performance of this specification was quite good, because this data series was well behaved, declining throughout the period.

Transfers per 1,000 farms, a much more erratic data series, was more difficult to explain. In the transfers equation, two variables — net farm income and stock of machinery — were not statistically significant, although all variables had the expected signs. Stock of machinery had a t-value of 1.22, but its lack of statistical significance can probably be attributed to a measurement error in the approximation of its true value (see Table 1). The ratio of farm-to-nonfarm income and lagged transfers appeared to be important in explaining transfers. As expected, the number of transfers was high when the ratio of farm-to-nonfarm income was low, indicating favorable conditions for movement from farm to nonfarm employment.

Each regression coefficient in the cropland equation had the correct sign and was statistically significant. Cropland acreage responded positively to increases in net farm income and was reduced by government programs to retire cropland. It is interest-

TABLE 2. ESTIMATED REGRESSION EQUATIONS USED TO EXPLAIN LAND PRICE PER ACRE IN GEORGIA, 1960-1974[a]

Variable	Number of Farms	Transfers per 1,000 Farms	Cropland Acreage	Land in Farms	Land Price per Acre	
					Model I	Model II
Constant	1.686	22.610	20.361	1.673	223.948	249.830
Net Farm Income[b]	0.001 (1.62)*	-0.265 (-0.61)	0.019 (1.96)*		2.316 (2.00)*	2.584 (3.01)**
Nonfarm Income[b]				-0.059 (-1.56)*		
Farm-to-Nonfarm Income[b]	1.459 (1.21)	-24.650 (-2.57)*				
Stock of Machinery		0.076 (1.22)				
Land Retired by Government			-0.393 (-3.79)**			
Return on Common Stock[b]						-8.697 (-1.57)*
Dummy Variable for 1960-65						12.529 (1.86)*
Number of Farms	0.898 $A_{t-1}^{c/}$ (45.35)**				1.412 $\hat{A}_t$ (0.70)	
Transfers per 1,000 Farms		0.603 $T_{t-1}^{c/}$ (3.12)**			-0.009 $\hat{T}_t$ (-0.02)	
Cropland Acreage			0.478 $C_{t-1}^{c/}$ (2.76)**	0.370 $\hat{C}_t$ (3.14)**		
Land in Farms				0.839 $L_{t-1}^{c/}$ (8.59)**	-19.382 $\hat{L}_t$ (-0.75)	-12.852 $\hat{L}_t$ (-1.61)*
Land Price per Acre					0.788 $P_{t-1}^{c/}$ (2.00)*	0.719 $P_{t-1}^{c/}$ (2.97)**
R^2	0.99	0.77	0.90	0.99	0.99	0.99

[a]Numbers in parentheses are Student t-values which are used to test for statistical significance. *Indicates statistical significance at the 0.10 level. **Indicates statistical significance at the 0.01 level.

[b]Lagged exogenous variables (t-1).

[c]Nerlovian geometric lag parameter.

ing to note the high rate of slippage in the program. Each thousand acres of land retired by these government programs reduced cropland acreage only 393 acres. Predicted cropland acreage was used in estimating land in farms, equation (4). All coefficients in this equation were statistically significant. Land in farms increased with cropland acreage and decreased with nonfarm income, *ceteris paribus*.

The fifth and final equation in the model is the land price equation. First specification of this equation (Model I) includes predicted values for land in farms, transfers and number of farms and finally net farm income. This specification is similar to the one used by Tweeten and Nelson when they concluded that farm expansion was an important determinant of land values [10, p. 34]. Results for this equation are very unsatisfactory. Net farm income had the only statistically significant regression coefficient. Signs of coefficients for land in farms and transfers were both opposite their hypothesized signs. Several similar specifications did not significantly improve the results.

The land price equation was respecified (Model II), assuming farm expansion was not an important factor in explaining land price since 1960. Consequently, number of farms and transfers were omitted from the equation. Results from this formulation were much better than Model I results. The equation included predicted land in farms, net farm income, return on common stock, lagged price and a dummy variable to indicate a time series difference for the years 1960-1965. All signs of coefficients are as expected, and all independent variables are highly significant.

In general, results from the two land price models strongly support the hypothesis that importance of farm adjustment in explaining farmland price is declining in Georgia. Neither farm numbers nor transfers proved to be statistically significant in Model I; thus variables used to represent the influence of consolidation in previous studies indicated no relationship to farmland values in Georgia during this period. Furthermore, the positive sign of the coefficient for number of farms is inconsistent with the consolidation hypothesis; in fact, the positive sign supports the alternative hypothesis of a consumptive demand for small farm units. Results of Model II also support the alternative hypothesis in that the coefficient for returns on common stock has a statistically significant negative relationship to land price which is expected if labor adjustment is completed.

SUMMARY AND CONCLUSIONS

Historically, agricultural economists have considered adjustment of farm size as an important determinant of farmland prices. The combination of large past migration of farm populations to urban areas and decentralization of nonfarm employment into rural areas suggests this adjustment may currently be of declining importance. In addition, the latter influence would increase demand for small land tracts for operation as part-time farms; this economic trend could result in economic pressures opposing consolidation.

This paper tested the hypothesis of declining importance of farm adjustments by reestimating a model previously used to demonstrate the influence of farm consolidation on land prices. With data for Georgia from 1960-1974, the empirical results indicated that variables measuring adjustment had no statistically significant influence on farmland prices. A reformulated equation of farmland price that included net farm income, returns on common stock, and land in farms in a distributed lag formulation satisfactorily explained farmland prices without consideration of adjustment influences.

It must be stressed that results in this paper are tentative. The hypothesis of declining importance of farm adjustments was tested for only one state and with only one particular model formulation. However, results do indicate that more research on farmland price determination is appropriate. Furthermore, results indicate that linkages between farmland and nonfarm investments are becoming more important in that net farm income and opportunity costs are of primary importance in determining farmland price.

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