NC

ERR-42

ECONOMICS
RESEARCH
REPORT

RETURNS TO INVESTORS IN FLUE-CURED TOBACCO ALLOTMENTS 1975-1980

J. A. SEAGRAVES
and
FRED E. WILLIAMS

ECONOMICS RESEARCH REPORT NO. 42
DEPARTMENT OF ECONOMICS AND BUSINESS
NORTH CAROLINA STATE UNIVERSITY
RALEIGH, NORTH CAROLINA
ERR 42
SEPTEMBER 1981

RETURNS TO INVESTORS IN FLUE-CURED TOBACCO ALLOTMENTS 1975-1980

J. A. SEAGRAVES

and

FRED E. WILLIAMS

Economics Research Report No. 42
Department of Economics and Business
North Carolina State University
September 1981

ABSTRACT

This study outlines procedures that can be used to estimate the capitalized value of flue-cured tobacco allotments. Such estimates should be of interest to farmers, bankers, and real estate appraisers.

Data on farm sales including information on the value of buildings and timber, acres of cropland, other land, and the pounds of tobacco allotment are used to estimate that part of the sale price of a farm which may be attributed to the tobacco allotments. For 11 flue-cured tobacco counties in the central part of eastern North Carolina, allotment values were estimated to be about $3.50 per pound in 1975, increasing to $4.61 in 1977, and falling to about $3.42 in 1980. Converting these to 1980 dollars, there was a decline in real terms of about 40 percent from $5.40 in 1975 to $3.24 per pound in 1980. These estimates come from a multiple regression equation which was chosen over many other single-equation models that were tried. The discussion in the final section of Appendix A provides a summary of the preferred models that were tried and the estimated allotment values from them. The standard error of the estimated value of $3.24 for 1980 was $0.60 per pound. This means that we are reasonably confident that the true value fell in the range $2.05 to $4.44 per pound.

In order to estimate the rate of return to allotment owners, one must also take into account the reduction in the allotted pounds per farm. Flue-cured tobacco allotments were reduced by 21.5 percent from 1974-75 to 1980. A typical Pitt County farm which had 15,000 pounds of tobacco in 1975 would have had only 11,755 pounds in 1980. Allotments worth $52,500 per farm in 1975 ($81,000 in 1980 dollars) were estimated to be worth only $38,086 per farm in 1980. This represents a capital loss of 14 percent per year in real terms.

Offsetting this, the owner of tobacco allotments would have had an expected annual net return to allotments, or cash rent, of about 10 percent or $.48 per pound. This means that a typical owner of a tobacco allotment who rented it out lost about 5 percent per year on his investment in allotments over the period 1975-1980.

Offsetting this estimated capital loss in allotment values was a 14.4 percent per year estimated capital gain in land values. This, plus an estimated annual income of 4.7 percent from land, leaves a combined return on a typical tobacco farm of 6.7 percent per year before taxes. During this period of time, and especially since 1977, a person would have been much better off owning a farm without a tobacco allotment than one with an allotment. Also, tobacco producers who rented in allotments during these years enjoyed higher returns than those who just produced their own allotments.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

The authors wish to thank Mr. Walter Langley of the Federal Land Bank of Columbia for both providing the farm sales data and patiently checking for possible errors in the data submitted to them. Local Farm Credit offices also are thanked for both reporting the sales data and for providing estimates of rental rates.

Special thanks go to Ms. Ellen Berry who ran regression equations, to Ms. Beth Garner who patiently typed earlier drafts, and to Ms. Ruth Good for editorial suggestions.

We are also very grateful to Professors G. A. Carlson, J. S. Chappell, A. R. Gallant, D. M. Hoover, Thomas Johnson, F. E. McVay, D. F. Neuman, E. C. Pasour, C. R. Pugh, and R. A. Schrimper for suggestions on earlier drafts.

I. INTRODUCTION

The purpose of this study is to develop a procedure for obtaining current estimates of the capitalized values of tobacco allotments and the rates of return to owners of allotments. The results should be of interest to persons who have invested in farmland, or are considering doing so, and to bankers, realtors, and farm appraisers. In addition to providing reasonably current estimates, we hope to provide some insight into recent trends in capitalization rates.

Maier, Hedrick, and Gibson (1960) used multiple regression techniques with acutal farm sales data to estimate allotment values per acre for 1954-57. Seagraves (1969) explained Manning's (1965) estimates for 1934-62 which were based on census data. Williams (1980) estimated tobacco allotment values for eastern North Carolina based on census data for 1945-74, and on sales data from the Federal Land Bank for the period 1974-78. Regression procedures reported here represent further improvements on those developed by Williams.

Area of the Study

This study uses data from 26 counties of eastern North Carolina. Emphasis is given to regression results from 11 central flue-cured tobacco-producing counties identified in Figure 2 as area F.

Definition of Terms

Tobacco allotments or quotas--The government supply restrictions on the production of flue-cured tobacco based on pounds marketed.

Capitalized values--The present values of the expected future net revenues or the prices of a capital asset. A quota acquires a capitalized value because of net returns generated by quota. Because quotas are attached to the land, part of the sale price of the land represents the value of the quota.

Net revenues--The monetary returns to growing tobacco after all expenses including those imputed to labor, land, and management have been paid.

Cash rents--The prices paid by farmers in order to rent the tobacco allotments for one year (see Appendix B).

Capitalization rates--The rates of interest which investors use to discount expected future net revenues assuming an infinite time horizon. Cash rents expressed as a percent of capitalized values.

The Capitalization Process

Capitalization is a process of discounting to the present the expected future returns of an asset ans summing these discounted values over all future years. The sale price of a farm or other asset represents our best estimate of its capitalized value. Quotas cannot legally be sold apart from a sale of farmland,[1] so we don't have a market price which indicates the capitalized value. However, farmland with a quota attached will be priced higher than farmland of equal productive capacity without a quota. The capitalized value of the expected future returns from the quota program accounts for the higher price. Multiple regression may be used to estimate the value per unit of the separate components: cropland, other land, and pounds of tobacco quota.

---

[1] An exception exists in the case of land that is declared of nonagricultural use or that is condemned for such uses. In such cases the allotments can be sold.

Expected returns are assumed to become increasingly more uncertain as they are projected into the more distant future. Two approaches are commonly used to quantify and describe greater uncertainty over time: (1) a shorter time horizon is used in the equation for the present value of an annuity; or (2) a higher rate of interest is used in calculating the present value of a perpetuity.

(1) The present value of an annuity is expressed as:

$$V = \sum_{t=1}^{T} \frac{R_t}{(1 + i)^t} = \left[\frac{1 - (1 + i)^{-T}}{i}\right] R \tag{1}$$

where

V is the present value of discounted future returns;

R_t is the net revenue that it is expected will be generated by an asset in year t. In the second equality these annuities are assumed to be a constant, R;

T is the time horizon which is solved for given V and R; and

i is the riskless real interest rate.

The time horizon can be used as an indicator of uncertainty. A shorter time horizon indicates greater uncertainty about the future of the quota program.

(2) The present value of a perpetuity is expressed as:

$$V = \sum_{t=1}^{\infty} \frac{R}{(1 + r)^t} = \frac{R}{r}, \text{ or } r = \frac{R}{V} \tag{2}$$

where r is the capitalization rate. A time constraint is not included in this formula because the asset is assumed to generate the same return over an infinite time period. The capitalization rate is used as an alternative method of expressing uncertainty. Greater uncertainty about the future is implied by a larger capitalization rate. Uncertainty, u, can be viewed as a percentage and added to i to explain r, *i.e.*, r = i + u. In this study we will use the second approach; estimate R and V, and use them to calculate r's. We will observe that in recent years V, the estimated value of tobacco allotments, has been falling in real terms and r has increased. It is very likely that owners of tobacco allotments are less certain about the long-run future of the tobacco programs than they were a few years ago. When uncertainty increases, the equilibrium rate of return, r = i + u, increases; but while that is happening the transition, or year-to-year, return, r*, is reduced due to the loss in capitalized value, ΔV. Let

$$r^* = i + u + \frac{\Delta V}{V}, \qquad (3)$$

and observe that while ΔV is negative the year-to-year realized rate of return, r*, can be negative even though u is increasing.

Theory of Property Values

Farms consist of a bundle of assets or property rights. These include rights to use buildings, to sell timber, to grow crops on certain acres, and, in this case, to sell flue-cured tobacco. Our theory is simply that the value of these components can be added up to obtain the value of the farm. Location also affects values and there is a premium for land in smaller holdings. Equations (2) and (3) could be applied separately to most of these components. However, they are actually only applied in Section IV to a discussion of the returns to ownership of tobacco allotments and land plus allotments for the period 1975-80.

Overview of the Study

This report emphasizes average rates of returns and capital gains over periods of years. Section II provides background on these concepts for U.S.

agriculture. Section III describes our data and results, the estimated values of land and tobacco allotments for the model that was chosen. Section IV explores the implications of our estimates for the returns on an investment in a typical Pitt County tobacco farm purchased in 1975 and sold in 1980.

II. BACKGROUND ON RATES OF RETURN AND CAPITAL GAINS

Returns to investors in U.S. agriculture have been running about 8 percent per year in real terms ("real" means adjusted for inflation). If the rate of inflation is 10 percent, then 8 percent in real terms corresponds with a return of over 18 percent as a nominal or conventional rate of interest. Table 1 presents real rates of return for four regions of U.S. agriculture for the period 1940-79. Total returns range from 5.1 percent in central Kansas to 12.7 percent for the upper delta region of Mississippi. The simple average for these four regions was 8.3 percent. The average rate of appreciation (real capital gains) was 3.8 percent per year and the average net rent was 4.7 percent. (Net rent equals cash rent minus the USDA's estimates of land owner expenses and farm real estate taxes.) In general, the regions with the highest rates of appreciation had the lowest rents, which is what one would expect.

Agricultural returns have been favorable compared with the returns to the owners of common stock, which were only 6.3 percent per year for the period 1940-79 (real returns to owning a portfolio consisting of the Standard and Poor's 500 stocks). If one picked a more recent period, say 1972-79, returns to the owners of common stocks would be much lower than those in agriculture. This may be because uncertainty about inflation has caused investors to prefer real assets such as farmland over common shares and other financial assets. For purposes of comparing returns to agricultural investments and to ownership of common stocks, the period 1940-1972 is more representative than the more recent years. Over this period agricultural returns in the four regions mentioned above averaged 7.8 percent while returns to common stocks were 7.3 percent. Real returns to ownership of all of the common shares traded on

Table 1. Inflation adjusted rates of returns to owners of farmland in four regions of the U.S. and to owners of common stock, 1940-1979

Item and Region	Real rates of return, percentages		
	Net rent plus appreciation	Appreciation alone	Net rent as a residual
Agriculture:[a]			
Central Illinois	6.3	4.0	2.2
Central Kansas	5.1	1.7	3.3
Upper delta, Miss.	12.7	3.0	9.4
Montana ranching	9.1	6.4	2.5
Simple averages for four regions	8.3	3.8	4.4
Common stocks, Standard and Poor's 500, 1940-79	6.3	1.5	4.7
Common stocks, 1926-76[b]	6.7	1.9	4.7

[a] Source Gertel and Lewis (1980). The first column gives internal rates of return which are found by solving the following equation for i_c

$$V_0 = \sum_{t=1}^{T} \frac{R_t}{(1 + i_c)^t} + \frac{V_t}{(1 + i_c)^T}$$

where V_0 is the market value in the initial year

V_T is the market value in the terminal year

R_t is the net rent in year t.

t = 0, 1, . . . , T are numbers assigned to the year, and all dollars are converted to the same point in time using the CPI. Rates of appreciation in the second column are found by solving the following equation for i_a

$$V_0 = \frac{V_T}{(1 + i_a)^T} .$$

Average annual rent as a residual is found by solving the following equation for i_r

$$(1 + i_c) = (1 + i_r)(1 + i_a) .$$

[b]Source: Fisher and Lorie (1977, Tables XX and XXVI). These are internal rates of return for a portfolio consisting of all the common stocks listed on the New York Stock Exchange, with initial weighting by value, deflated using the CPI, and exempt of all taxes.

the New York Stock Exchange for the half century, 1926-76, averaged 6.7 percent. Gertel and Lewis (1980, p. 9) conclude that "The advantages of farmland investment--lower risk, potential for higher leverage, somewhat lower income taxes, and greater psychic income--might outweigh the advantage of greater liquidity of common stocks. Although the effect of these differences has not been quantified, long-run returns from investment in farmland and common stocks, as calculated here, are considered competitive if returns from farmland fall slightly below returns from common stocks."

USDA's indices of land values (1967 = 100) reflect wide differences in capital gains among states. Selected values for 1980 are: North Carolina 326, South Carolina 368, Iowa 570, Pennsylvania 591, and for the United States as a whole, 404. Deflating by the Consumer Price Index (1980 = 247.6) and expressing some of these as real annual rates of capital gains we find: North Carolina +1.9 percent, Iowa +5.9 percent, and +3.6 percent for the United States. Land values have generally increased more than the rate of inflation, and especially during periods of rising inflation. Obviously, these patterns cannot be projected to the decade ahead. Figure 1 shows that North Carolina land values increased faster than United States land values from 1970-74 and much more slowly during the period 1974-78. Also, the index of prices paid by farmers has increased faster than the cost of living index since 1971.

Table 2 provides the data and results for the estimation of returns to North Carolina agriculture for the period 1973-80. The USDA has estimated gross rent per acre and the value of land and buildings for each year since 1973. Rent as a percent of land values is given in the final column. It makes no difference whether the ratio of rent to value is calculated using the columns for nominal dollars or those for constant 1980 dollars. In any case, rental

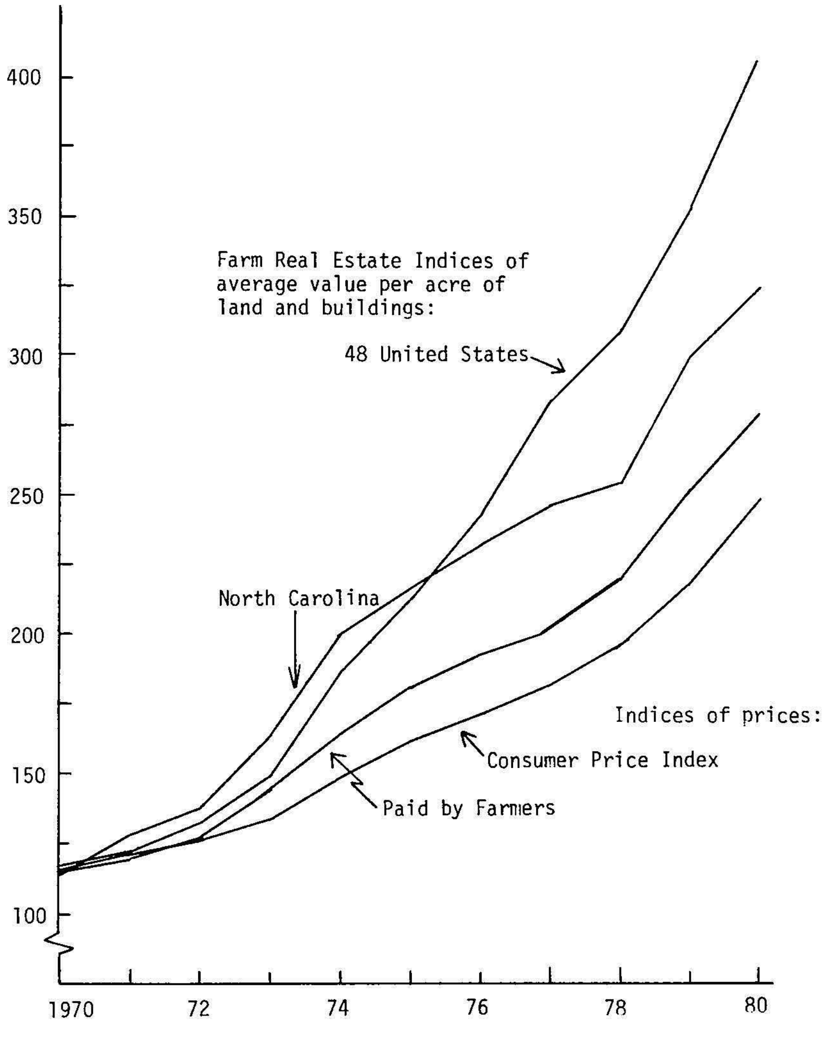


Figure 1. A comparison of Farm Real Estate Indices and two price indices, 1970-80

rates, or earnings/price ratios, are real rates of interest. The simple average of these annual rental rates is 4.24 percent. Nationwide, and in North Carolina, there has been a slight trend downward in recent years as the rate of inflation has increased. The combined rent plus appreciation is estimated as a rate of return, i_c, using the formula given in Table 1. These results are given in the lower portion of Table 2. They show a nominal return of 14.2 percent and a real return of only 4.0 percent. The nominal rate of appreciation of North Carolina farmland values for this period was 9.03 percent, but, given the 9.85 percent increase in the CPI, this means that land values have fallen 3/4 of 1 percent in real terms. The average rental rate for these years calculated as a residual was 4.7 percent. Since rental rates have been coming down, it might be better to assume a rate of 4.0 percent in 1981-82. In other words, if one wants to estimate the value of cropland, he can use the rental rate as one indicator. Theoretically, land that rents for $80 per acre should sell for 80 ÷ .04 = $2,000 per acre, just for agricultural purposes. In Section IV we will present an analysis similar to that in Table 2 for a flue-cured tobacco farm. Before doing that, several intermediate steps should be explained.

Census data for the main flue-cured tobacco counties in eastern North Carolina reveal rates of increase in land values that are different from those for the rest of the country. Some of these differences could be due to changes in the tobacco program. Table 3 provides a comparison of land values for census years since 1940 for the United States, for North Carolina as a whole, and for 11 central flue-cured tobacco counties of eastern North Carolina (Duplin, Edgecombe, Green, Johnston, Lenoir, Martin, Nash, Pitt, Sampson, Wayne, and Wilson). These counties, which are identified as the shaded areas A + E on the map in Figure 2, enjoyed a slightly higher rate of increase in land values over these 38 years

Table 2. Gross cash rents, values of farmland, and rates of return to investors in farmland in North Carolina, assuming the land was purchased in 1973 and sold in 1980 [a]

Year	Gross cash rent in dollars per acre per year		Value per acre in		Annual gross rents as a percentage of land values[c]
	Nominal dollars	1980 dollars[b]	Nominal dollars	1980 dollars[b]	
1973	--	--	$483	$932	--
1974	26.0	44.07	551	934	4.8
1975	26.4	40.76	590	910	4.2
1976	26.8	38.80	637	922	3.9
1977	36.4	50.08	675	929	4.5
1978	34.5	43.78	694	881	4.3
1979	37.1	41.25	819	911	4.1
1980	38.4	38.40	885	885	3.9

Rates of return: Using the data above and the equations from Table 1, the following internal rates of return were calculated:

	In nominal dollars	In real terms
Combined rent plus appreciation, i_c	14.2%	4.0%
The rate of appreciation alone, i_a	9.03%	-0.75%
Average gross rent as a residual, i_r	4.78%	4.74%

The average annual rate of inflation in the Consumer Price Index for 1973-80 was 9.85%.

[a] Source: USDA surveys, Farm Real Estate Market Developments, (1976-1980).

[b] Using the Consumer Price Index to convert nominal dollars to 1980 dollars.

[c] These percentage rental rates are real returns and should not be confused with nominal interest rates. They can be found by simply dividing the gross rent figures by the corresponding values per acre.

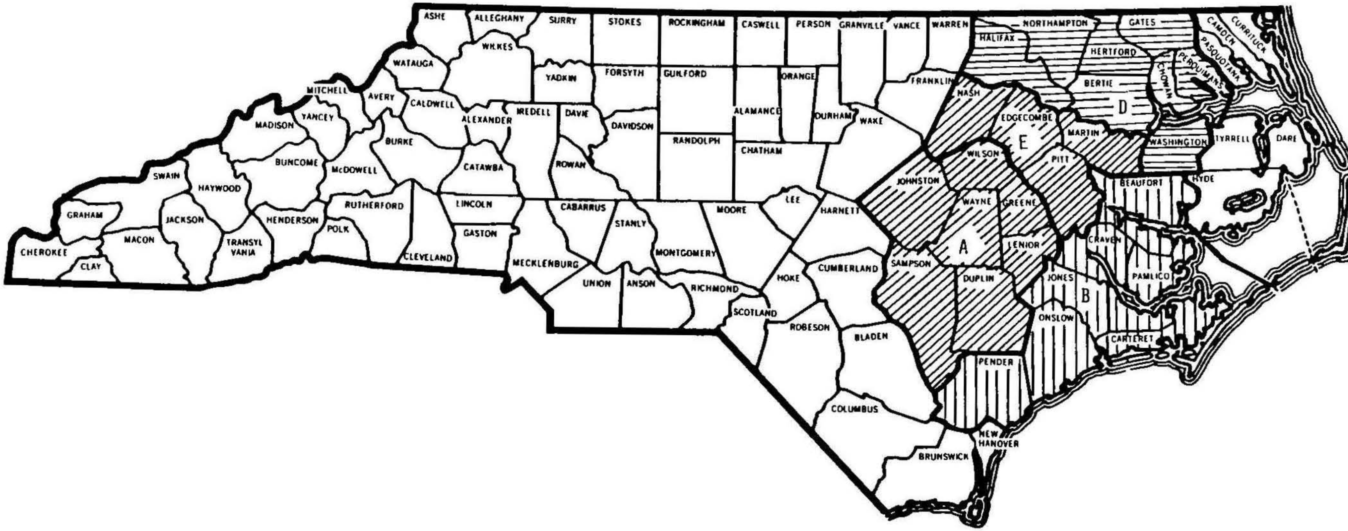


Figure 2. North Carolina tobacco and peanut producing counties used in this study

A = seven central counties

B = seven coastal counties

C = twelve northern counties = D + E

D = eight northern peanut counties

E = four north-central counties

F = eleven central counties = A + E

than did North Carolina and the nation. The annual compound rates were 8.5, 7.9, and 7.4, respectively. Flue-cured tobacco counties had relatively large increases in land values from 1945-54 and again from 1969-78. These were favorable years for the tobacco program. Similarly, relative declines in land values in these tobacco counties from 1959-69 were associated with years when the tobacco program was in trouble. Acreage allotments had caused high production of poor quality tobacco in the early 1960's. In 1965 the quotas were changed to a poundage basis. This gave farmers an incentive to produce higher quality tobacco. The 60's were years of uncertainty and adjustment for tobacco producers.

The Federal Land Bank has compiled data on individual farm sales since 1974. Average values per acre for 26 eastern North Carolina counties for the period 1974-80 are presented in Table 4. Again, the rates of growth in land values for these counties are compared with those for the United States and for North Carolina as a whole. Land values increased at 13.3 percent per year in nominal dollars for the 11 central tobacco counties, while the same compound annual rates of change were 8.2 percent per year for North Carolina as a whole, and 13.7 percent for the nation. These tobacco counties had especially high rates of increase in land values from 1975-77.

Note that there are large differences in the annual rates of change of land values for the different groups of counties listed in Table 4. In the eight northern peanut and tobacco counties, land values did not keep up with inflation, and there was considerable variation in capital gains within those identified as "coastal." Actually the number of recorded sales was too small in some cases to have much confidence in some of these averages.

Table 3. A comparison of the annual rates of change in the Consumer Price Index and the value of farmland and buildings for the U.S. as a whole, for all of North Carolina, and for 11 flue-cured tobacco producing counties of central eastern North Carolina, 1940-1978

		Values of land and buildings in nominal dollars/acre and percentages increases from one period to the next		
			North Carolina	
Census years	Consumer Price Index (1967 = 100)	U.S. as a whole[a]	NC as a whole[a]	Eleven eastern flue-cured tobacco counties[b]
1940	42.0	32	39	57
	>28%	>47%	>64%	>32%
1945	53.9	47	64	75
	>32	>40	>53	>96*
1949	71.4	66	98	147
	>13	>24	>28	>48*
1954	80.5	82	125	217
	> 8	>35	>41	>43
1959	87.3	111	177	311
	> 6	>24	>38	>21*
1964	92.9	138	245	378
	>18	>36	>37	>10*
1969	109.8	188	337	416
	>35	>61	>64	>63
1974	147.7	302	551	680
	>47	>62	>26	>88*
1978	217.4	488	694	1,279
Average annual rate of change 1940-78	4.4	7.4	7.9	8.5

Sources:

[a] Farm Real Estate Market Developments, USDA.

[b] U.S. Censi of Agriculture, 1940-78.

* Large or small increases in reported values compared to those for the United States could have been caused by changes in the tobacco program.

Table 4. A comparison of annual rates of change of the CPI, the U.S. Farm Real Estate Index, the value of land and buildings in North Carolina, and the average value of land from farm sales data for 26 counties in eastern North Carolina, 1974-80

Year	U.S. Consumer Price Index (1967 = 100)	% change	USDA's Farm Real Estate Index[a] (1967 = 100)	% change	All of NC values of land and buildings[a] USDA, $/ac	% change	Eastern North Carolina, farm sales data, averages (prices in nominal dollars per acre)[b]: All 26 counties	% change	8 northern counties	7 coastal counties	11 central tobacco counties	% change
1974	147.7	> 9.1%	187	>14%	551	> 7%	610	>15%	575	408	662	> 9%
1975	161.2	> 5.8	213	>14	590	> 8	702	>11	558	663	720	>28
1976	170.5	> 6.4	242	>17	637	> 6	781	>30	651	697	920	>20
1977	181.5	> 7.7	283	> 9	675	> 3	1,016	> 5	634	889	1,103	> 0
1978	195.4	>11.3	308	>14	694	>18	1,064	>23	743	894	1,097	>13
1979	217.4	>13.9	351	>15	819	> 8	1,311	>-5	877	1,108	1,240	>13
1980	247.6		404		885		1,239		837	885	1,404	

Annual percentage compound rates of increase from first to last year:

	U.S. CPI	Farm Real Estate Index	All of NC	All 26 counties	8 northern counties	7 coastal counties	11 central tobacco counties
Nominal	9.0%	13.7%	8.2%	12.5%	6.4%	13.8%	13.3%
Real, deflating with CPI:		4.3%	-0.7%	3.2%	-2.4%	4.4%	3.9%

[a] Source: Farm Real Estate Market Developments, 1967-80. Index includes farm improvements. Percentages are changes from one year to the next.

[b] Based on 1060 bona fide sales for the 26 counties recorded by the Federal Land Bank. The eight northern counties are: Bertie, Chowan, Gates, Halifax, Hertford, Northhampton, Perquimans, and Washington.

The seven coastal counties are: Beaufort, Cartaret, Craven, Jones, Onslow, Pamlico, and Pender.

The 11 central tobacco counties are: Nash, Edgecombe, Martin, Pitt, Wilson, Green, Lenoir, Johnston, Wayne, Duplin, and Sampson.

III. DATA AND REGRESSION RESULTS

The data that are used in this study need to be understood before explaining the regression results. Average real values per acre are presented in Table 5. Sale prices were standardized to 1980 using the United States Farm Real Estate Index. This is a way of removing the effect of changing inflation rates on all farm real estate. Farm land values in these 11 counties increased in "real" terms (relative to those for United States as a whole) from 1975 to 1977. Since then they have fallen back to where they were in 1974-75. The trend from 1975 on could be described with a quadratic or square-root function. Table 5 also reveals the gradual decline in total tobacco allotments during this period. Actually, flue-cured tobacco allotments for the United States were reduced a total of 21.5 percent from the average level of 1974 and 1975 to the 1980 level.

Table 6 presents the average values per acre for counties. Generally speaking the counties with more tobacco allotments per acre had higher land values. The 192 farm sales in Region 2 had average land values of $1,923; nearly $700 per acre higher than those in the other two regions. Part of the difference is due to higher quality cropland, part to the higher tobacco allotments, and part to nonfarm development of these counties.

Another way to become familiar with the data is to examine the standard deviations and correlation coefficients. Table 7 shows that the average farm in this sample had 84 acres, 41 of which were cropland, and a flue-cured tobacco allotment of 8,299 pounds. Also, the average sale price was $121,346 in 1980 dollars. Standard deviations were about as large as the means suggesting that a wide range of farm sizes is included in this sample of 737 sales.

Table 5. Averages for years: "real" value of land and tobacco quotas per acre of all land, for 11 central flue-cured tobacco counties of eastern North Carolina, 1974-80

Year	Number of observations, sales	"Real" value of land in 1980 dollars per acre[a]	Tobacco quota, pounds per acre of all land
1974	64	1,430	114
1975	119	1,366	106
1976	104	1,535	120
1977	85	1,576	99
1978	101	1,438	85
1979	152	1,428	81
1980	112	1,404	98

[a] The United States Index of Farm Real Estate was used to inflate values from final column of Table 4 ahead to 1980.

Table 6. Averages for counties and regions: "real" values of land per acre, tobacco quota and acres of cropland per acre of all land, 11 central counties of eastern North Carolina, 1974-79

Region and County	Number of observations	"Real" value of land in 1980 dollars per acre	Tobacco quota, pounds per acre of all land	Acres of cropland per acre of all land
Region 1:				
Edgecombe	50	1,051	58	.510
Martin	52	1,664	113	.489
Nash	47	1,202	93	.431
Pitt	68	1,837	174	.540
Regional averages	217	1,363	102	.496
Region 2:				
Green	51	1,910	154	.539
Lenoir	89	2,002	135	.533
Wayne	14	1,567	87	.496
Wilson	38	1,861	147	.557
Regional averages	192	1,923	139	.536
Region 3:				
Duplin	108	1,099	61	.459
Johnston	103	1,443	101	.499
Sampson	117	1,325	70	.444
Regional averages	328	1,256	74	.464
Overall averages	737	1,446	99	.492

Table 7. Means, standard deviations and correlation coefficients for 737 farm sales observations used in the regression analysis

Items	"Real" value of land per farm, RVLF	Acres of all land per farm, ALF	Acres of cropland per farm, ACL	Acres of other land per farm, AOL	Pounds of tobacco quota per farm, PTQ
Means	121,346	84	41	43	8,299
Standard deviations	117,131	102	47	63	8,906
Correlation coefficients, r values:					
RVLF	1	.82	.85	.70	.81
ALF		1	.90	.95	.57
ACL			1	.72	.67
AOL				1	.43

The correlation coefficients indicate the extent to which the variables move together. For example, $r = .81$ between RVLF and PTQ means that $r^2 = .66$, or that 66 percent of the variation in real land values per farm could be explained by the pounds of tobacco allotment alone. Acres of cropland, ACL, is the variable with the highest single association with RVLF, $r = .85$, but, unfortunately, it also has the highest correlation with PTQ, $r = .67$. This high correlation among the independ variables means that multiple regression results will be highly sensitive to changes in the data set and the model. Different models and data sets that were tried are descirbed in Appendix A.

Multiple regression results provide estimated values of each component: the value per acre of cropland, VCL; the value of other land, VOL; and the value of per pound of tobacco quota, VTQ. Table 8 presents estimates from regression model 30, the one which was chosen. The equation itself is given toward the end of Appendix A. One can use the "real" values from the first row of Table 8 plus a constant term of $2,000 per farm to form this equation for estimating the "real" value of any Pitt County farm in 1975: RVLF = 2,000 + 918(ACL) + 177(AOL) + 6.64(PTQ) where ACL and AOL stand for acres of cropland and other land per farm and PTQ represents the pounds of tobacco quota assigned to that land. A typical Pitt County farm with 45 acres of cropland, 28 acres of other land, and 15,000 pounds of tobacco would then have had an estimated value of $147,866 in these "real" dollars.[2] In 1975 dollars this would be $77,983. (The Farm Real Estate Index factor for 1980/1975 was 1.896.) One might be more interested in what $77,988 would be worth in 1980 when it is

---

[2] This "typical" farm is simply the average from the sales data. It is not a good estimate of the average sized farm in the county.

Table 8. Estimated values of different components that make up a farm from model 30 in "real" and nominal values, for Pitt County, North Carolina, 1975-80[a]

Year	"Real" 1980 values			Nominal values		
	VCL	VOL	VTQ	VCL	VOL	VTQ
	(dollars per acre)		($/lb.)	(dollars per acre)		($/lb.)
1975	918	177	6.64	485	93	3.50
1976	1,216	240	5.55	729	144	3.33
1977	1,368	303	6.59	958	212	4.61
1978	1,428	366	5.64	1,089	279	4.30
1979	1,421	429	4.56	1,235	372	3.96
1980	1,365	491	3.24	1,365	491	3.24
Annual rate of growth 1975-80				23%	39%	-1.6%

[a] "Real" values are based on the prices paid for farms in earlier years having been inflated forward using the U.S. Farm Real Estate Index. The index ratios for 1975-79 were: 1.896, 1.669, 1.428, 1.311 and 1.515. Nominal values are "real" values divided by those same ratios. The constant terms is nominal dollars for each year.

inflated forward using the Consumer Price Index. The CPI increased 1.544 from 1975 to 1980 meaning that a farm that was worth $77,988 in 1975 dollars should be thought of as being worth $120,413 in 1980 purchasing power. The reason two indicies and definitions of "real" are needed is that we used the Index of Farm Real Estate to "purge" our data of the general effects of inflation on farm real estate. This is quite different from standardizing money to the same real purchasing power.

Every estimate has a confidence interval. For example, the tobacco allotment value of $3.24 per pound for 1980 has a confidence interval of plus and minus two standard errors extending from $2.05 to $4.44. We are about 80 percent certain that the true value would fall within that range. The reasons why we don't call this a 95 percent confidence interval are explained in footnote one of Appendix A. Appendix A, Table 6 presents estimated values from a slightly different data set and three other regression models. This is followed by a discussion of confidence intervals. Estimates for 1974 have been omitted from Table 8 because we have little confidence in them. Estimates for 1975-80 will now be used to analyze the returns to an investor.

IV. IMPLICATIONS OF THE MODEL CHOSEN

What are the implications of the estimated values of land and allotments for returns on investment? Table 8 shows a small decline in tobacco allotment values from 1975 to 1980 in nominal dollars. But, this only tells part of the story because the number of allotted pounds were cut on all farms about 21.5 percent or 4.7 percent per year during the period 1974-75 to 1980. In order to illustrate the combined effect of these two reductions and the offsetting large increase in land values, estimates based on model 30 for a typical Pitt County farm purchased in 1975 and sold in 1980 are presented in Table 9. This typical farm has 45 acres of cropland, 28 acres of other land, and 15,000 pounds of tobacco allotment in 1975. Using the Consumer Price Index to inflate 1975 values forward to 1980, a farm that sold for $77,983 in 1975 would have an equivalent value of $120,346 in 1980 dollars (see last row of Table 9). The same farm was estimated to sell for $115,259 in 1980 which represents a loss in real terms of about one percent per year. The tobacco allotment component shows an annual loss of 14.01 percent while the value of the land increased 14.42 percent per year. Part of the reduction in the tobacco allotment component was due to the 21.5 percent reduction in allotted pounds from 15,000 to 11,755.

Table 10 provides a summary of data on tobacco rental rates (from Appendix B) and allotment values from model 30. Rental rates over the five years averaged 48 cents per pound in 1980 dollars. Allotment values fell from $4.95 per pound in 1976 (1980 dollars) to $3.24 in 1980. Rent as a percent of allotment values increased from 8.7 percent to 14.2 percent, which could indicate an increase in the uncertainty with which investors view the tobacco programs. Even greater investor uncertainty in 1981 and 1982 could stem from budget-cutting measures

Table 9. Implications of model 30 for capital gains from a typical flue-cured tobacco farm in Pitt County, North Carolina, purchased in 1975 and sold in 1980

Item	1975 values in 1975 dollars	1975 values in 1980 dollars[a]	1980 values in 1980 dollars	Annual percentage increases in real terms[b]
Value of cropland: $/acre	485	749	1,365	12.75
45 acres, $/farm	21,825	33,698	61,425	12.75
Value of other land: $/acre	93	144	491	27.80
28 acres, $/farm	2,604	4,020	13,748	27.80
Constant term $/farm	1,054	1,629	2,000	4.18
Value of land alone, 73 acres, $/farm	25,483	39,346	77,173	14.42
$/acre	349	539	1,057	
Value of tobacco allotment: $/lb.	3.50	5.40	3.24	-9.71
Number of pounds per farm	15,000	15,000	11,755	-4.76
Product, $/farm	52,500	81,000	38,086	-14.01
Value of land and tobacco allotments, $/farm	77,983	120,346	115,259	-0.87

[a] Inflating 1975 values ahead to 1980 using the ratio of their CPI's, 1.544.

[b] Percentage changes from the preceeding two columns compounding over 5 years.

Table 10. Gross cash rents and estimates of rates of return to investors in tobacco allotments and land for eleven central tobacco counties in eastern N.C. assuming land and allotments were purchased in 1975 and sold in 1980

Year	Gross cash rental rates for tobacco allotments[a] $/lb. in		Estimated value of allotments from model 30 $/lb. in		Gross rents as a percentage of estimated values
	Nominal dollars	1980 dollars	Nominal dollars	1980 dollars	
1975	--	--	3.50	5.40	--
1976	.29	.42	3.33	4.95	8.7
1977	.36	.50	4.61	6.34	7.8
1978	.40	.51	4.30	5.45	9.3
1979	.46	.51	3.96	4.40	11.6
1980	.46	.46	3.25	3.24	14.2
Simple average of gross rents as a percentage					10.3

Real annual percentage returns:

Asset	Capital gains from Table 9	Gross rent %	Combined annual return 1975-80[b]
Land alone	+14.42	+4.7	+19.8
Tobacco allotments alone	-14.01	+10.3	-5.2
Combined	-0.87	+7.6[c]	+6.7

[a] Estimates for individual counties are given in Appendix B, Table 1.

[b] Combined returns are based on the preceeding two columns and the compounding principle defined in Table 1.

[c] Based on the values for 1975 and 1980 given in Table 9 and rental incomes of 4.7 percent for land, 8.7 percent for tobacco allotments in 1975, and 14.2 percent in 1980. A simple average of percentage returns in the two years, 7.4 percent and 7.8 percent, is used.

which have reduced the subsidization of interest rates on stabilization loans and tobacco grading. Also, some members of Congress have criticized the supply control program and there has been some decline in the domestic demand for U.S.-grown flue-cured tobacco. Uncertainty in 1979 and 80 could have been related to smaller than expected increases in price, given the allotment reductions, and to larger than expected imports of "scrap" flue-cured tobacco.

The lower portion of Table 10 provides a summary of annual percentage returns. We conclude that during these years the real returns to an investor in a typical eastern North Carolina tobacco farm were about 6.7 percent per year. He lost a little on his tobacco allotments, -5.2 percent, but did very well, +19.8 percent per year, on his investment in land. These returns also can be partitioned into rent and capital gains as shown in Table 10.

Our main objective was to estimate the capitalization rate for tobacco allotments. We conclude that cash rents are now about 14-15 percent of the capitalized value of a tobacco allotment. If a farm appraiser wants to estimate the value of a tobacco allotment in 1982, he could divide the rent by an expected rate of return, 15 percent. If uncertainty about the future of the program increases, then this percentage should be increased. It is not valid to conclude from high annual cash rents that investors are well off. We estimate that capital losses have more than offset rental income since 1977.

Our analysis can also be used to compare returns to renters of tobacco allotments as opposed to owners, even though this was not the purpose. Renters compete with one another for allotments and their returns for labor and management are expected to be merely competitive. A crop budget for 1981, presented in Appendix B, Tables 2 and 3, allows $3.75/hour for the renter's own labor and 15 percent ($299/acre) for management. These are essentially the only returns to an efficient renter who paid 48 cents per pound for allotment in 1981. Even so, in percentage terms, these returns to renters as managers (15 percent of total costs) are much greater than those of owners who rented out allotments in recent years.

V. SUMMARY AND CONCLUSIONS

Real returns to owners of farmland in the United States have averaged about 8 percent per year in recent years with sizable variations depending on the location and time period chosen. A USDA study (Gertel and Lewis, 1980) of four regions for the period 1940-79 found real returns (real capital gains plus net rent) of 5.1, 6.3, 9.1, and 12.7 percent. The simple average was 8.3 percent. For the period 1967-80, capital gains of farm real estate in constant dollars were: 1.9 percent for North Carolina, 5.9 percent for Iowa, and 3.6 percent for the United States as a whole. Rental incomes of about 4½ percent should be added to these capital gains to estimate total returns. This study finds returns on a typical eastern North Carolina tobacco farm of about 6.7 percent for the period 1975-80. However, this average conceals large differences in real capital gains for farmland (+14 percent per year) and for tobacco allotments (-14 percent per year).

Farm sales data can be used to gain insight into changing components of land values. Since 1974 the Federal Land Bank has compiled data on a large number of bona fide sales, which they make available for research. Among other things, they record the sale price, the value of buildings and timber, the acres of cropland, and the pounds of tobacco allotment per farm. The main purpose of this study was to develop regression procedures for the analysis of such data so as to obtain separate estimates of the value per acre of cropland and other land, and the value per pound of tobacco allotments. Such estimates should be useful to farmers, lending institutions, real estate agents, and farm appraisers.

For 11 counties in the central coastal plain of eastern North Carolina, the counties which had the highest net incomes per pound of tobacco, the value of a typical tobacco farm decreased slightly in real terms over the period 1975-80 (-0.87 percent per year for the farm given in Table 9). That part of the value of a farm attributable to its flue-cured tobacco allotment fell an estimated 14 percent per year. This can be broken down into a 4.8 percent per year decline in basic allotments and 9.7 percent per year decline in the estimated value per pound. Meanwhile that part of farm values attributable to land increased in value 14.4 percent per year. These results come from the preferred regression equation which is identified as model 30. Estimates from other models and sets of data differed somewhat from these (see Appendix A, Tables 6 and 9). Given these diverse estimates and the wide statistical confidence intervals that should be assigned to such estimates, the authors conclude that the real annual rate of decline in the value of flue-cured tobacco allotments on a typical farm in eastern North Carolina between 1975 and 1980 was between 5 and 15 percent per year. Most of the decline actually came after 1977.

Overall returns on an investment in a typical tobacco farm from 1975-80 were probably about +6.7 percent per year before taxes. Cash rents for tobacco allotments (average lease and transfer rates for these same 11 counties) were estimated to be 46 cents per pound in 1980. Rental rates changed very little in real terms while allotment values have fallen. The average rental income for the period was 10.3 percent per year. Adding to this our estimated capital gain of -14 percent per year, we end up with returns on investments in tobacco allotments alone of -5 percent per year. Offsetting these losses would have been capital gains plus rent on land amounting to about 20 percent per year. Combining these expected returns for a typical Pitt County farm which had 73 acres, with 45 acres of cropland, and 15,000 pounds of tobacco allotment in

1975, we obtained an estimated return on investment of about +6.7 percent per year before taxes for the period 1975-80. Farms with relatively smaller amounts of tobacco would have had higher returns.

Two myths related to allotment values should be mentioned. One myth is that allotment values make it difficult for a young person to get started in tobacco farming. First, consider a young farmer who is renting and growing flue-cured tobacco versus another renter who is growing other crops not protected by government price supports; lending institutions should be more willing to loan money to a farmer who is producing a crop with a stable price. Then the only risk is the production risk. Therefore, a young farmer in eastern North Carolina who produces tobacco should be able to borrow more money than one who does not produce tobacco. Second, consider renting versus owning land. Farming is capital intensive and most young farmers with little capital begin as renters. They can get a much higher rate of return on money invested in fertilizer and machinery than in land or allotments. Third, consider a farmer who has accumulated some wealth and wants to buy a farm--would he be better off buying a tobacco farm or a farm without tobacco allotments? His annual net revenue (expected rent) as a percent of purchase prices would be about 4 percent for cropland and 14 percent for allotments. His annual net income would be greater if he bought a farm with a tobacco allotment than if he bought a farm with no tobacco. However, his risk would also be greater if he buys allotments, because the value of the allotments could continue to fall. The high return and the high risk go together.

Another possible myth or half-truth is that the tobacco program has contributed to uncertainty by creating capitalized values. The program has had two main effects: to stabilize and to support the income of farm owners. Incomes of flue-cured tobacco producers (both renters and owners) have been remarkably stable during the 48 years of tobacco programs. The high support level has made it easy to stabilize income in the short run. To the extent that income supports are expected to continue, there always will be a capitalized value of these rents, and the value of the allotments will be greater the greater the certainty that the program will continue. Capitalized values per farm will decline whenever there are declines in: the level of support, the number of pounds that can be produced, or the level of certainty with which investors view the future of the program. What is true is that support levels probably will have to be reduced in order to maintain current levels of production. In a long-run sense the program has contributed to the production of flue-cured tobacco in other countries and substitutes at home. This is a gradual process which probably was anticipated.

Contrary to popular belief, renters of allotments have had more favorable returns than owners in recent years. Even so, it is reasonable to ask if renters of allotments would be better off without the tobacco program. The program has stabilized prices and this has been beneficial to young farmers who are beginning mostly as renters. However, they must borrow large amounts of money in order to rent allotments. It is possible that renters would be better off if support levels could be reduced gradually while the price stabilization feature is retained. A severe conflict between renters and owners regarding the program is not likely because most producers are both owners and renters.

REFERENCES

Fisher, Lawrence, and James H. Lorie. 1977. A Half Century of Returns on Common Stocks and Bonds, 1926-76. University of Chicago Press, Chicago.

Gertel, Karl, and James A. Lewis. 1980. "Returns from Absentee-Owned Farmland and Common Stock 1940-79." Agricultural Finance Review, 40:1-11, April.

Maier, F. H., J. L. Hedrick, and W. L. Gibson, Jr. 1960. The Sale of Flue-Cured Tobacco Allotments. Virginia Polytechnic Institute Agr. Exp. Sta. Tech. Bul. 148, Blacksburg.

Manning, R. D. 1965. An Econometric Estimation of the Distributional Impact of the Tobacco Support Program. Unpublished Ph.D. thesis, North Carolina State University. University Microfilms, Ann Arbor, Michigan.

Seagraves, J. A. 1969. "Capitalized Values of Tobacco Allotments and the Rate of Return to Allotment Owners." American Journal of Agricultural Economics, 51 (2):320-334.

Seagraves, J. A., and R. D. Manning. 1967. Flue-Cured Tobacco Allotment Values and Uncertainty, 1934-62. ERR No. 2, Department of Economics and Business, NCSU, Raleigh.

U.S. Department of Agriculture. 1967-1980. Farm Real Estate Market Developments. Washington, D.C.

U.S. Department of Commerce. 1940-1978. Censi of Agriculture. U.S. Government Printing Office, Washington, D.C.

Wallace, T. Dudley. 1977. "Pretest Estimation in Regression: A Survey." American Journal of Agricultural Economics, 59:431-443, August.

Williams, Fred Eugene. 1980. Capitalized Allotment Values as Indices of the Uncertainty with which Farmers Perceive Future Tobacco Programs. Unpublished Ph.D. thesis, North Carolina State University. University Microfilms, Ann Arbor, Michigan.

APPENDIX A. REGRESSION MODELS USED TO ANALYZE FARM SALES DATA

The objectives of the analysis are to estimate the capitalized values of tobacco allotments for recent years and to develop a useful way of summarizing sales data for purposes of farm appraisal. Many different functional forms logically could be used to account for the combined value of farmland and allotments. This Appendix describes the steps that were followed in arriving at what we think is a satisfactory approach. We would not recommend that anyone repeat these steps. Very few readers will want to read the whole story. The preferred models are briefly described in the final section.

Seagraves and Manning (1967) and Williams (1980) found that models which allowed both farmland and allotments to each take on separate values for each year gave unbelievably large fluctuations in estimates from one year to the next even though the coefficients were highly significant. When the estimated value of land was "high," the estimated value of tobacco pounds would be "low" and vice versa. In order to cope with these problems (multicolinearity and an insufficient number of observations), the models were constrained. The value of farmland was forced to have a trend and only allotments were allowed to have individually estimated values for each year. This procedure assumes that changes in the value of farmland are likely to follow a simpler trend than would be true for allotment values. Manning (1965) used linear trends for the value of cropland and peanut allotments. Williams selected a linear trend for all land in farms and let both tobacco and peanut quotas take on individual values for each year.

The procedure which is followed here may be described as "pretest estimation" (Wallace, 1977) in which a good deal of trial-and-error and little theory is used in the selection of a model. A number of models use nominal sales values for the period 1975-80. These are listed here as models 1-15. Model 16 uses real values per acre as the dependent variable and the Consumer Price Index to convert values to 1980 dollars. Models 17-30 use the U.S. Farm Real Estate Index to standardize all sales data to 1980 or to "purge" the data of trends in real estate values. In the models defined below, the parentheses represent trends for the value of land, cropland, and tobacco allotments. Criteria for selection are statistical (F tests on restrictions), graphical (do the trends make sense?), and evaluation of the estimated values. Models are listed here and discussed in the chronological order in which they were fitted:

1. $VLF_{ij} = (\beta_0 + \beta_1 T_j)ALF_{ij} + \sum_j \beta_j d_j PTQ_{ij} + e_{ij}$.

2. $VLF_{ij} = (\beta_0 + \beta_1 T_j + \beta_2 T_j^2)ALF_{ij} + \sum_j \beta_j d_j PTQ_{ij} + e_{ij}$.

3. $VLF_{ij} = (\beta_0 + \beta_1 T_j + \beta_2 T_j^2)ACL_{ij} + (\beta_3 + \beta_4 T_j + \beta_5 T_j^2)AOL_{ij}$

   $+ \sum_j \beta_j d_j PTQ_{ij} + e_{ij}$.

4. $VLF_{ij} = (e^{\beta_0 + \beta_1 T_j})ACL_{ij} + (e^{\beta_2 + \beta_3 T_j})AOL_{ij} + \sum_j \beta_j d_j PTQ_{ij} + e_{ij}$.

5. $VLF_{ij} = (e^{\beta_0 + \beta_1 T_j})ACL_{ij} + (e^{\beta_2 + \beta_3 T_j})AOL_{ij}$

   $+ (e^{\beta_4 + \beta_5 T_j + \beta_6 T_j^2})PTQ_{ij} + e_{ij}$.

6. $VLF_{ij} = (\beta_0 + \beta_1 T_j)ACL_{ij} + (\beta_2 + \beta_3 T_j)AOL_{ij} + \sum_j b_j d_j PTQ_{ij} + e_{ij}$.

7. $VLF_{ij} = (\beta_0 + \beta_1 T_j + \beta_2 T_j^2 + \beta_3 T^3)ACL_{ij}$

   $+ (\beta_4 + \beta_5 T_j + \beta_6 T_j^2 + \beta_7 T_j^3)AOL_{ij} + \sum_j b_j d_j PTQ_{ij} + e_{ij}$.

8. $VLF_{ij} = (\beta_0 + \beta_1 T_j + \beta_2 T_j^2 + \beta_3 T_j^3)ACL_{ij} + (\beta_4 + \beta_5 T_j + \beta_6 T_j^2 + \beta_7 T_j^3)AOL_{ij}$

$+ (\beta_8 + \beta_9 T + \beta_{10} T_j^2 + \beta_{11} T_j^3)PTQ_{ij} + e_{ij}$.

9. $VLF_{ij} = (e^{\beta_0 + \beta_1 T_j + \beta_2 T_j^2})ACL_{ij} + (e^{\beta_3 + \beta_4 T_j + \beta_5 T_j^2}) AOL_{ij}$

$+ (e^{\beta_6 + \beta_7 T_j + \beta_8 T_j^2})PTQ_j + e_{ij}$.

10. Model 4 with 7 coefficients for peanut allotments for each year, $\sum_j \beta_j d_j PQ_{ij}$, added.

11. Model 4 with non-zero peanut allotment values only allowed for 1974 and 1975 and tobacco allotment values constrained to be equal in 1974 and 1975.

12. Model 4 with non-zero peanut allotment values only allowed in 1974 and 1975.

13. Model 4 with β_1 constrained to equal β_3.

14. $VLF_{ij} = (e^{\beta_0 + \beta_1 T + \beta_2 T^2})ACL_{ij}$

$+ (e^{\beta_3 + \beta_1 T + \beta_2 T^2})AOL_{ij}$

$+ \sum_j \beta_j d_j PTQ_{ij} + e_{ij}$.

15. $VLF_{ij} = (e^{\beta_0 + \beta_1 T + \beta_2 T^2 + \beta_3 T^3})ACL_{ij}$

$+ (e^{\beta_4 + \beta_1 T + \beta_2 T^2 + \beta_3 T^3})AOL_{ij}$

$+ \sum_j \beta_j d_j PTQ_{ij} + e_{ij}$.

16. $RVPA_{ij} = (\beta_0 + \beta_1 T_j) + \beta_2 \left(\frac{ACL}{ALF}\right)_{ij}$

$+ \beta_3 T_j \left(\frac{ACL}{ALF}\right)_{ij} + \beta_4 \left(\frac{1}{ALF}\right)_{ij}$

$+ \sum_j \beta_j d_j \left(\frac{PTQ}{ALF}\right)_{ij} + e_{ij}$.

$ALF \equiv AOL + ACL$. The first parentheses will provide an estimate of the value of all land.

17. $SVLF_{ij} = \beta_1 T_j ALF_{ijk}$

$+ (\beta_2 + \beta_3 T_j + \beta_4 T_j^2) ACL_{ijk}$

$+ \sum_j \beta_j d_j PTQ_{ijk}$

$+ \sum_k \beta_k c_k ALF_{ijk} + e_{ijk}$

allows separate basic land values for each county, k.

18. Model 17 with every variable including the intercept vector of 1's multiplied by ALF^{-1}_{ijk}.

19. Model 17 with every variable multiplied by $ALF^{-.8}_{ijk}$. Models 18 and 19 were run to observe the effects of using this method of correcting for heteroskedasticity upon the coefficients.

20. $SVLF_{ij} = \beta_0 + \sum_j \beta_j d_j ACL_{ij}$

$+ \sum_j \beta_j d_j PTQ_{ij}$

$+ \sum_k \beta_k c_k ALF_{ijk} + e_{ij}$.

21. $SVLF_{ij} = \sum_r (\beta_{1r} + \beta_{2r}T_j)g_r AOL_{ijr} + \sum_j \sum_r \beta_{jr} d_j g_r ACL_{ijr}$

$$+ \sum_j \sum_r \beta_{jr} d_j g_r PTQ_{ijr} + e_{ij} .$$

22. Same as model 21 except the 21 coefficients for tobacco were reduced to 7, one for each year ($\sum_{j=1}^{7} \beta_j d_j PTQ_{ij}$) .

23. $SVLF_{ij} = \sum_r (\beta_{ir} + \beta_{2r}T_j)g_r AOL_{ijr} + \sum_{r=1}^{3} \beta_{3r} g_r ACL_{ijr} + \beta_4 T_j ACL_{ij}$

$$+ \beta_5 T^2 ACL_{ij} + \sum_j \beta_j d_j PTQ_{ij} + e_{ij} .$$

24. Same as model 23 without the quadratic term for ACL.

25. $SVLF_{ij} = \sum_r (\beta_{ir} + \beta_{2r}T_j)g_r AOL_{ijr} + \sum_r (\beta_{3r} + \beta_{4r}T_j)g_r ACL_{ijr}$

$$+ \beta_5 d_{74} ACL_{ij} + \sum_j \beta_j d_j PTQ_{ij} + e_{ij} .$$

26. $SVLF_{ij} = \sum_r \beta_{1r} g_r AOL_{ijr} + \beta_2 T_j AOL_{ij} + \sum_r (\beta_{3r} + \beta_{4r}T_j)g_r ACL_{ijr}$

$$+ \beta_5 d_{74} ACL_{ij} + \sum_{j=1}^{7} \beta_j d_j PTQ_{ij} + e_{ij} .$$

27. Same as model 26 with additional dummies for the value of ACL in 1977, 1980.

28. Same as model 26 with a quadratic trend for the value of PTQ instead of individual annual estimates, $(\beta_6 + \beta_7 T_j + \beta_8 T_j^2)PTQ_{ij}$.

29. $$SVLF_{ij} = \sum_r \beta_{1r} g_r AOL_{ijr} + \beta_2 TAOL_{ij} + \sum_j \sum_r \beta_{jr} d_j g_r ACL_{ijr}$$

$$+ (\beta_3 + \beta_4 T_j + \beta_5 T_j^2) PTQ_{ij} + e_{ij} .$$

30. $$SVLF_{ij} = 2{,}000 + \beta_1 T_j AOL_{ij} + \sum_r (\beta_{2r} + \beta_{3r} T_j^{\frac{1}{2}}) g_r ACL_{ijr}$$

$$+ \beta_4 T_j ACL_{ij} + \sum_j j d_j PTQ_{ij} + \sum_k \beta_k \, c_k ALF_{ijk} + e_{ij}.$$

Where VLF_{ij} = the sale price in current dollars of the land in farm i in the year of the sale, j, (VLF = sale price - building value - timber value),

ALF_{ij} = acres of all of the land in that farm,

ACL_{ij} = acres of cropland,

AOL_{ij} = acres of other land,

PTQ_{ij} = pounds of tobacco quota attached to that farm,

PQ_{ij} = acres of peanut allotment on that farm,

T_j = a time trend number for years, T = 1, 2, . . . , 7 for 1974, . . . , 1980,

CPI_j = Consumer Price Index for year j,

$FREI_j$ = U.S. Farm Real Estate Index for year j,

$RVPA_{ij} = \frac{VLF_{ij}}{ALF_{ij}} \cdot \frac{CPI_{1980}}{CPI_j} =$ real value per acre,

$SVLF_{ij} = VLF_{ij} \frac{FREI_{1980}}{FREI_j} =$ value of land in each farm standardized to 1980 using the U.S. Farm Real Estate Index and k identifies the county,

T_j = a trend variable for years, $T_{74} = 1$, $T_{75} = 2$, . . . $T_{80} = 7$,

d_j are dummy variables for each year which equal 1 for each observation that comes from the jth year and zero otherwise,

c_k are dummy variables for each county which equal 1 if the observation comes from the kth county and zero otherwise, and

g_r are dummy variables for each region which equal 1 if the observation comes from the rth region and zero otherwise. The regions are identified in Table 6 of the text.

Models 1-9 for Seven Central Tobacco Counties

Initially, different trends for the value of land were tried using data from seven reasonably homogeneous tobacco counties identified as region A on the map. Results for nine models are summarized in Appendix A, Table 1. The first model, with a linear trend for all land, is a restricted form of the second model which has a quadratic trend. The F-ratio to test the linear restrictions is:

$$F_{df_d,\ df_u} = \frac{(SSE_r - SSE_u)/df_d}{SSE_u}$$

where the SSE's refer to the sums of square of errors, and the df's to the degrees of freedom. Here the subscript r refers to the more restricted model, u to the unrestricted model, and d to the difference, ($df_d = df_r - df_u$). The F ratio for model 1 as a restricted form of model 2 where $\beta_2 = 0$ is

$$F_{1,\ 491} = \frac{(427.29 - 420.47)/1}{420.47/491} = 7.96\ .$$

Appendix A, Table 1. Summary statistics from different regression models fitted to the farm sales data from seven central counties of the eastern North Carolina flue-cured tobacco belt for 1974-80 and estimated tobacco allotment values

Model No.[a] Forms of trends fitted	1 Linear trend for the value of all land, VAL	2 Quadratic trend for VAL	3 Quadratic trends for VCL and VOL	4 Exponential trends for VCL and VOL	5 Exponential trends for VCL, VOL, and VTQ	6 Linear trends for VCL and VOL	7 Cubic trends for VCL and VOL	8 Cubic trends for VCL, VOL, and VTQ	9 Exponential quadratic trends for VCL, VOL and VTQ
Corrected R^2	.8829	.8847	.9084	.9081	.9052	.9073	.9108	.9091	.9061
n	501	501	501	499	499	499	499	499	499
df	492	491	488	488	492	488	484	487	490
SSE in billions	427.29	420.47	334.66	335.04	345.42	338.06	325.13	331.53	342.34
F ratio arrows point toward the more restricted models	F = 7.96** (2 → 1)	F = 41.7** (3 → 2)		F = 4.08** (4 → 5)	F = 4.40** (9 → 5)	F = 4.82** (7 → 6)	F = 3.18** (7 → 8)		
Estimates of coefficients for cropland and other land:									
b_0	147.31*	437.10*	739.62*	6.2290*	6.3570*	354.27*	1865.15*	1889.06*	6.2782*
b_1	79.47*	-93.53	-58.02	0.1667*	0.1400*	172.14*	-1146.11	-1157.24	0.1789
b_2		20.70*	27.31	4.7422*	4.5482*	104.19*	321.56	320.74	-0.0042
b_3			301.20	0.1641*	0.2031*	32.47*	-23.61	-23.37	5.8439*
b_4			84.83				-722.18	-718.78	-0.4541
b_5			14.11				886.43*	865.67*	+0.0711
b_6							-245.03*	-238.76*	
b_7							20.61*	20.15*	

Appendix A, Table 1 (continued)

Model No.	1	2	3	4	5	6	7	8	9
Year	Estimated values of tobacco allotments in nominal dollars per pound								
1974	3.64*	2.61*	1.85*	2.62*	2.04	2.87*	1.81*	2.06	1.86
1975	4.23*	4.10*	3.08*	3.21*	3.02	3.22*	3.19*	3.06	3.61
1976	4.57*	4.92*	3.89*	3.71*	4.07	3.53*	3.85*	4.32	4.15
1977	6.47*	7.14*	5.82*	5.45*	5.03	5.15*	5.77*	5.47	5.24
1978	6.68*	7.37*	5.53*	5.17*	5.63	4.85*	5.50*	6.12	5.86
1979	7.93*	7.96*	6.23*	6.18*	5.75	6.19*	6.22*	5.92	5.84
1980	7.24*	6.39*	4.01*	4.37*	5.35	4.84*	4.18*	4.48	5.15

[a] The model numbers correspond to those listed in the text. VAL, VCL, VOL, and VTQ refer to the parentheses in the models and to the values per acre of all land, cropland, other land, and to the value per pound of tobacco quota.

* Indicates coefficient significantly different from zero at the 5 percent level based on the two-tailed test or the asymptotic 95 percent confidence interval.

** Indicates an F ratio that is significant at the .05 level, or that the less restricted model should be preferred.

The critical F ratio for a probability level of 0.05 with 1 and 500 degrees of freedom is 3.86 ($F(.05, 1, 500) = 3.86$). Hence, one can reject the hypothesis that the restriction is valid and legitimately choose the quadratic trend.

Comparing models 2 and 3, model 2 forces cropland and other land to have the same value per acre each year while model 3 permits each to have a separate quadratic trend. Since $ALF \equiv ACL + AOL$, model 2 can be viewed as a restricted form of model 3. The MSE test revealed that:

$$F_{3,\ 488} = \frac{(420.47 - 334.65)/3}{334.65/488} = 41.7$$

where the critical F ratio (0.05, 3, 500) is 2.61. The null hypothesis that the paired coefficients in model 3 are equal, Ho: $\beta_0 = \beta_3$, $\beta_1 = \beta_4$, and $\beta_2 = \beta_5$, must be rejected,and one should conclude that it is preferable to allow separate trends for cropland and other land.

In the tables of this Appendix, F ratios for constraints are indicated with brackets connecting the respective sums of squares for errors (SSE's). R^2 values, the number of observations, and degrees of freedom are also listed for each model. Most of the models do not have intercepts because it was reasoned that farms without land or allotments would have zero value.

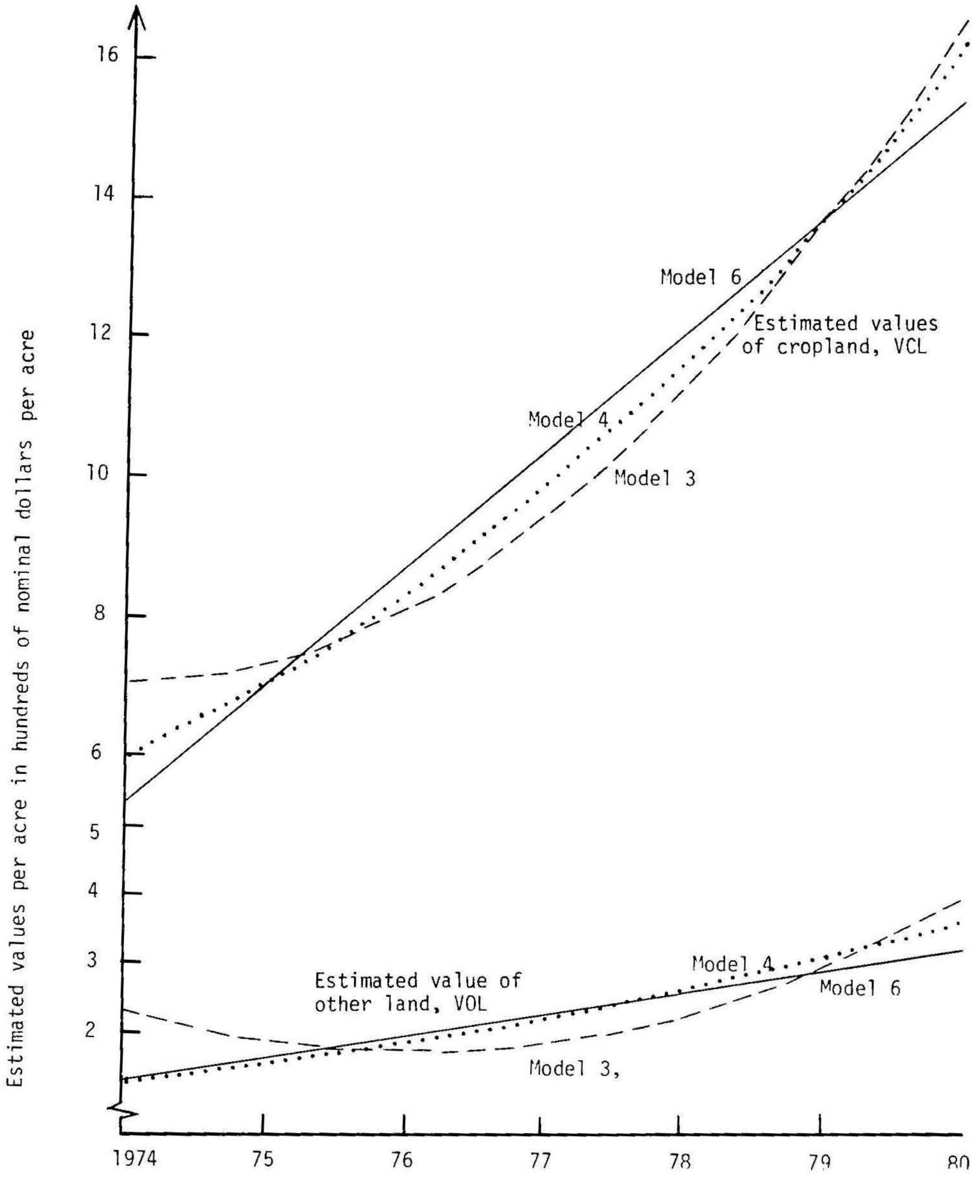
When no intercepts are included, the R^2 values from the computer routine are biased upward. Corrected R^2's are given in the first row of each table. These are the regression sums of squares divided by the corrected sums of squares, $R^2 = RSS/CSS = (CSS - SSE)/CSS$ where CSS is the number of observations minus one times the variance of the dependent variable. Residuals from model 3 were examined and two observations which were thought to contain errors were deleted. This reduced the number of observations from 501 to 499 for model 4.

Models 4, 5, and 9 use polynomial trends in the exponents of e. Their sums of squares for regression cannot be viewed as subsets of those from the other models (regular polynomials). However, model 5 can be viewed as having a regression sums of squares that is a nested subset of those for models 4 and 9. Models 4 and 5 allow the exponents to increase linearly in the expression for the estimated values per acre of cropland and other land. Model 4 allows independent estimates of the value of tobacco allotments for each year while model 5 constrains tobacco allotment values to follow a quadratic exponential trend. The F-ratio for the restriction is 4.08, while the critical F(.05, 4, 500) ratio is 2.38. One can reject the hypothesis that the restriction is valid at the 5 percent level. Model 5 can also be viewed as a constrained version of model 9. Model 9 allows all three components to have quadratic exponential trends for the estimated values. The F value of 4.40 for this restriction is also significant suggesting that the constraints in model 5 are justified.

Models 6, 7, and 8 provide a comparison of linear with cubic trends for the values per acre of cropland and other land (6 versus 7) and for the imposition of a cubic trend on allotment values (7 versus 8). The F-ratio for the linear trend is 4.82 while the critical F(0.05) value is again 2.38. One can reject the hypothesis that the linear restriction is valid. Model 8 is also more restricted than model 7. The F-ratio of 3.18 is small, but still one should reject the imposition of a cubic trend instead of allowing individual annual estimates of tobacco allotment values.

Based on the F tests, models 4 and 7 are preferred. But two additional criteria, besides F ratios, are used in selecting a satisfactory model. These are plots of the estimated values of cropland and other land

and the estimated values of tobacco allotments given in the lower portion of each table. The curve in Appendix A, Figure 1 for the value of other land from model 3 reveals a falling trend to 1976 and a rise thereafter. It does not seem logical that the estimated value per acre of either cropland or other land fell during this period of generally rising land values. The quadratic exponential (model 9) also had estimates of VOL which fell at first. And, the cubic equations (models 7 and 8) gave estimated values of cropland which fell at first. These polynomials were not given further consideration because of these seemingly illogical trends. That leaves models 4 and 6 as serious contenders. The quadratic and cubic models seem to allow too much curvature, and the linear models too little. Note in Appendix A, Figure 1 that the straight lines for model 6 produce "low" estimates of land values for the extreme years (1974 and 1980). When the values of land are "under-estimated," the values of tobacco allotments will be "overestimated" and vice versa. Comparing estimated tobacco allotment values in Table 1 for models 3 and 6, it can be seen that the linear form gives much higher estimates in the extreme years. The same can be seen when comparing models 1 and 2. Given this time period, we conclude that forcing land values to follow linear trends may bias upward the estimated values of tobacco allot-ment for the early and late years and bias downward the estimated values for the middle years. Hence, the models with linear trends for nominal land values are also rejected. Model 4 is tentatively chosen. However, observe that tobacco allotment values from model 4 fall from 1977 to 1978 and then rise sharply in 1979. This unusual pattern also occurs in the estimates from models 3, 6, and 7. It could be a peculiarity of the data. Recall that data from only 7 tobacco counties are used in these regressions. It is concluded that model 4 should be tried on other subsets of the data.



Appendix A, Figure 1. Estimated values of cropland and other land from models 3, 4, and 6.

Results from Model 4 Applied to Six Regions

Model 4 is applied with small modifications to the data from different groupings of counties which are identified on the map in the text. The results are explained here and summarized in Appendix A, Table 2. The first two columns compare results from model 4 applied to the seven central counties and to seven coastal counties. The coastal counties have lower rental rates per pound of tobacco (see Appendix B) and had lower allotment values in each year. There is little reason to consider combining these regions.

The northern counties of the coastal plain have peanut as well as tobacco allotments. Farm sales data from twelve of these counties are used to obtain the results in columns 3 and 4. Model 10 is the same as model 4 except that it also allows for seven annual estimates of peanut allotment values. Only one of these, the one for 1974, was significantly greater than zero using the asymptotic 95 percent confidence interval. Another problem with model 10 is the disconcertingly low and insignificant tobacco allotment value for 1975. Too few observations for 1974 and 1975 is the likely cause. Model 11 constrains model 10 by combining tobacco allotments for 1974 and 1975 into one variable and by constraining peanut allotment values to equal zero for 1976-80. Model 12 is similar to model 11 but has separate tobacco allotment values for 1974 and 1975. The F test for model 11 C versus 12 D plus 12 E suggests that it is not logical to combine the 12 northern counties into one model especially not for tobacco allotment values.

Four of these 12 northern counties with peanuts have considerable tobacco and high net incomes to tobacco. These are Edgecombe, Martin, Nash, and Pitt counties. Based on rental rates given in Appendix B, it would seem logical to combine these four with the seven central counties. Results for these four tobacco counties, model 12 E show highly significant positive tobacco allotment values. In contrast to the relatively low estimated allotment values for 1978 from model 4 A, ($5.15/pound) the results for 12 E provide an unusually high estimate ($6.28/pound). As might be expected, the regression for the combined 11 counties, 12 F, provides a more credible estimate for 1978,($5.75/pound). However, the F ratio, 9.38** does not suggest combining the regressions for the seven central counties, 4 A, and the four north-central counties, 12 E, into one set of coefficients for the 11 counties, 12 F. Hence, the results suggest a subdivision of the data into at least these four regions:

Seven central tobacco counties--A
Four north-central counties--E
Seven coastal tobacco counties--B
Eight northern counties--D

However, there are costs connected with subdivision of the data. It reduces the number of observations available for each regression and increases the standard errors of some of critical coefficients, such as the estimates of the tobacco allotment values. In order to justify the combination of two regions, such as A and E, into one larger region, F, one should improve the specification or find other variables which distinguish the subregions. Before discussing other subdivisions of data and models, we should explain why certain observations were deleted from and added to the analysis.

Changes in the Number of Observations

Before the regressions were run, the data for each sale were examined. If they were thought to be in error, the Federal Land Bank was contacted and those observations were either corrected or deleted. Later, percentage residuals were obtained for models 4 A, 4 B, 12 D, and 12 E and these were used to identify 12 additional observations which were deleted. Whenever the percentage error

Appendix A, Table 2. Summary of regression statistics for model 4 applied to different groups of counties

Model No.[a]	4 A	4 B	10 C	11 C	12 D	12 E	12 F	4 F
Grouping of counties	Seven central counties	Seven coastal counties	Twelve northern counties	Twelve northern counties	Eight northern peanut counties	Four north-central counties	Eleven central and north central	Eleven counties without 1974
Corrected R^2	.9081	.8899	.8756	.8734	.9332	.8741	.8823	.8853
n	499	196	377	376	162	214	713	639
df	488	185	359	364	149	201	700	629
SSE in billions	335.05	76.52	358.80	365.23	65.73	233.20	654.12	614.3

F = 1.07 (10 C vs 11 C)

F = 5.57**, 11 C vs 12 D + 12 E

F = 9.38**, 12 F vs 4 A + 12 E

Estimates of coefficients:

	4 A	4 B	10 C	11 C	12 D	12 E	12 F	4 F
b_0 cropland exp	6.2290*	6.5175*	6.2514*	6.3634*	6.8640*	5.8841*	6.1422*	5.7801*
b_1 rate of growth	0.1667*	0.0769*	0.1549*	0.1142*	0.0340	0.1830*	0.1526*	0.2029*
b_2 otherland exp	4.7422*	4.7395*	5.2319*	5.1997*	5.0462*	5.0089*	4.7597*	4.5197*
b_3 rate of growth	0.1641*	0.1722*	0.0644	0.0828	0.1599*	0.1114	0.1868*	0.2306*

Year Estimated values of tobacco allotments in nominal dollars per pound:

Year	4 A	4 B	10 C	11 C	12 D	12 E	12 F	4 F
1974	2.62*	0.56	1.39	0.75	-4.55	2.37*	2.61*	----
1975	3.21*	1.30*	0.52		-0.17	2.71*	3.30*	3.42*
1976	3.71*	1.58*	2.59*	2.55*	-1.30	3.37*	3.33*	3.88*
1977	5.46*	3.81*	4.56*	4.60*	-3.05	5.88*	5.75*	6.34*
1978	5.15*	3.66*	4.37*	5.03*	1.07	6.28*	5.75*	6.35*
1979	6.18*	3.92*	3.64*	4.04*	2.55*	4.29*	5.25*	5.48*
1980	4.37*	2.84*	3.26*	3.80*	-1.36	3.98*	4.48*	4.78*

Year Estimated value of peanut allotments in nominal dollars per acre:

Year	4 A / 4 B	10 C	11 C	12 D	12 E	12 F	4 F
1974	There are no peanuts in these counties	2403*	2513*	2315*	2502*	2099*	----
1975		115[b]	-215	386	-824	-1909*	----

Appendix A, Table 2 (continued)

[a] Models numbers correspond to those listed in the text. Letters refer to groups of counties identified on the map.

[b]Peanut allotment value estimates for this and subsequent years were mostly negative and not significantly different from zero at the 5 percent level.

*, ** See Appendix A, Table 1.

(actual-predicted) was greater than +100 percent or lower than -50 percent of the predicted value, an observation was considered a candidate for deletion. The most common reasons for deletion were that allotment values seemed to be in error or the land value was thought to be heavily influenced by nonfarm uses.

It was observed in connection with running model 16 (described below) that the average ratio of the number of pounds of tobacco quota per acre of land recorded for 1974 was considerably less than for the other years. It seemed likely that some tobacco farms that were reported as having no allotments in 1974 (the first year the data were collected) actually had allotments. So the data for 1974 were deleted for purposes of running models 4 F and models 17-20.

Subsequently, additional sales records were obtained for 1980, some observations which had been deleted were corrected and reinserted, and some additional information was obtained on tobacco allotments in 1974. Regressions run with this set of 737 observations for the 11 central tobacco counties are numbered 21-30.

Constraining the Values of Land to Have the Same Rates of Growth

Results presented in Appendix A, Table 2 show widely different estimates of annual rates of growth of cropland, b_1, and other land, b_3. There is little reason to think these coefficients should differ from one another within regions. Models 13, 14, and 15 were developed to observe the effects of forcing these rates of growth of land values to be the same. In model 13 time enters the exponent as a linear trend, while models 14 and 15 allow quadratic and cubic trends. Appendix A, Table 3 summarizes regression results for these models using data for 1974-80 from four reasonably homogeneous counties that are heavily committed to flue-cured tobacco. The first derivative of the exponent

Appendix A, Table 3. Summary of regression results for four main tobacco counties when the same annual rates of change are imposed on cropland and other land

Model No.	13	14	15
Grouping of counties	Group G, 4 central tobacco counties: Green, Lenoir, Pitt, and Wilson		
Items			
R^2	.8992	.8996	.9010
n	235	235	235
df	225	224	223
SSE in billions	201.18	200.48	197.67
	F = 0.78 (13 vs. 14)	F = 2.13 (14 vs. 15)	
Estimates of coefficients			
b_0	6.5872*	6.1974*	7.4502*
b_1	0.1299*	0.3208	-0.7523
b_2	5.5201*	-0.0200	0.2434
b_3		5.0988*	-0.0195
b_4			6.3446*
Estimated values of tobacco allotments			
1974	1.40	2.16	0.60
1975	1.32	1.74*	1.69*
1976	2.00*	2.02*	2.39*
1977	4.32*	4.05*	4.50*
1978	4.26*	3.82*	3.62*
1979	3.75*	3.56*	3.12*
1980	3.59*	3.85*	4.28*

* See Appendix A, Table 1.

e equals the proportional change of land values, $\frac{\dot{VLF}}{VLF}$. In model 14, this equals .3208 - .04T, which means a rate of growth is 28 percent when T = 1 (1974) and 6 percent when T = 7 which corresponds to 1980. The cubic trend in model 15 has high initial values for land which fall from 1974-1975 and then rise with a point of inflection at T = 4.16 (1977). It also has an unbelievably high rate of growth of land values of 25 percent per year in 1980. Constraining the cubic trend to be a quadratic in model 14 is not costly (the F ratio is 2.13 while the critical ratio is F(0.05, 1, 200) = 3.89). However, the quadratic trend for land values is quite different from the cubic. The linear trend in model 13 results in a constant average rate of growth of land values of 12.99 percent per year. Meanwhile the value of tobacco allotments grew from $1.40 to $3.59 which is about 14.5 percent per year. This seems high as does the slightly lower rate of growth of tobacco allotment values indicated by equation 14. The extremely high rate of growth of allotment values implied by equation 15 is associated with extremely high initial land values and low estimated land values for 1980.

Regressions Run in Constant 1980 Dollars

Exponential and other trends used above to remove the effect of inflation in land values are not based on theory. They are simple attempts to find a trend which describes the past. One alternative would be to develop the theory for how capital asset values should be affected by changes in the rates of inflation and taxation. At the same time, a theory could be devised which would account for new nonfarm demands for land, say for industry, new highways, and rural homesites. The authors feel that these data are not powerful enough to test such theories. One would need a longer period of time with larger changes in inflation rates and several real assets to test the first, and good indicators of the nonfarm influences on each farm to test the second.

Another alternative would be to remove most of the trend by converting the sales prices of farms to constant 1980 dollars. This was done using the CPI in model 16 and USDA's Index of U.S. Farm Real Estate for models 17-29. The objective was to purge the data of underlying trends caused by inflation. Increases in the expected rate of inflation cause disproportionately large increases in the price of real assets such as gold and land because people feel that increased inflation will result in increased fluctuations in the value of monetary assets. U.S. land values increased faster than the rate of inflation each of the years from 1974 to 1980. Table 4 of the text lists these two indices and average values land in North Carolina. Land values indicated by the sample of sales in eastern North Carolina increased faster than U.S. land values from 1975 to 1977 and less rapidly in subsequent years. The question is, how much of this difference is due to tobacco allotment values, how much is due to changes in the value of cropland, and how much to nonfarm development. Our objective is to estimate the net influence of tobacco allotment values.

Model 16 is a departure from earlier models in three respects: sale values are inflated forward to 1980 using the CPI; all variables are divided by the number of acres of land in each farm so that the dependent variable is value per acre, and the reciprocal of farm size is added as a variable. Danielson (1981) used a similar model and concluded that value per acre was significantly and negatively related to farm size. The coefficients, b_0 and b_1 in Appendix A, Table 4, which correspond to the β's in the models, provide estimates of the basic value of an acre of land on an infinitely large farm, and b_4 1/ALF

Appendix A, Table 4. Summary of regression results for model 16 applied to three groups of the central tobacco counties

The dependent variable is now the real price per acre of the farmland sold inflated to 1980 dollars using the CPI

Grouping of counties	H Ten central counties[a]	G Four main tobacco counties	I Six other central counties[a]	F Eleven counties without 1974
R^2	.6843	.7100	.6039	.6795
n	590	235	355	639
df	578	223	343	628
SSE in millions	136.69	65.19	53.44	145.75
	F = 7.16** (G and I vs. H)			
Estimates of coefficients				
b_0 intercept for VAL, $/ac.	406.13	317.09	447.75*	517.05*
b_1 T, increment in VAL	-13.15	32.80	-22.98	-31.46
b_2 ACL/ALF, $/ac.	473.35	468.76	378.11	346.00
b_3 T ACL/ALF	129.46	97.06	183.23*	154.73
b_4 1/ALF	1,332.55	1,934.56	2,516.56*	1,277.98
Estimated values of tobacco allotments in 1980 dollars				
1974	3.82*	3.90*	3.74*	----
1975	3.56*	4.02*	2.94*	3.72*
1976	4.10*	5.18*	2.53*	4.07*
1977	6.88*	7.19*	4.63*	6.75*
1978	6.43*	7.69*	2.20*	6.07*
1979	5.36*	5.23*	3.83*	5.11*
1980	4.11*	4.10*	2.30	4.06*

[a] Sampson County was inadvertently deleted from these regression runs. Otherwise group H is the same as group F. Group I includes Duplin, Edgecombe, Johnston, Martin, Nash, and Wayne counties.

*, ** See Appendix A, Table 1.

estimates the extra value per acre of smaller farm. Estimated values of b_4 from different subsets of the data vary a great deal, and in only one case is b_4 significantly greater than zero at the 5 percent level. Converting to a per acre basis reduces the amount of variation in the dependent variable and hence the amount to be explained by the model. R^2 values, which are percentages of that variation explained by the model, fall from the high .80's to the high .60's. The F ratio of 7.16 indicates that it is costly to combine the data from the two sub-regions; in this case to combine G and I into H. The negative trends for all land, b_1, and the positive annual increments for cropland, b_3, are generally not significant. That is because most of the trend was removed by inflating all of the sales prices to 1980 dollars. Estimated tobacco allotment values are much lower than those from the earlier models. This is because model 16 gives equal weight to the value of tobacco allotments per acre on each farm (as if each had one acre) and hence gives more weight to small farms as opposed to the earlier models. Smaller farms tend to have more cropland and tobacco per acre of all land than do larger farms, and they have considerably higher average values per acre. But, tobacco allotments are relatively less important (have less value) to people trading the smaller tracts of land as opposed to farmers buying larger blocks. All of the models except 16, 18, and 19 used as observations the totals for each farm (values, acres, and allotments) and hence gave equal weight to each acre sold. That is, a 100-acre farm has five times as much effect on the results as a 20-acre tract.

Models 17-20 use the Index for U.S. Farm Real Estate in a more satisfactory attempt to remove the effect of inflation on asset values. These models also allow a different basic land value (dummy variable) for each county, which in a sense allows different degrees of uniform development to enter the picture. All of the models except 16, 18, and 19 suffer from heteroskedasticity because the variances of their residuals increase with farm size. Models 18 and 19 were run to observe the effect on heteroskedasticity of dividing model 17 by the acres of land in the farm, ALF, and by $ALF^{.8}$. Two effects were anticipated and observed. The variance of the residuals was much more homoskedastic with respect to farm size than in the other models, and the estimated values of tobacco allotments were lower. Model 18 seemed to have a slightly larger variance in the residuals at the smaller sizes while model 19 removed most of this heteroskedasticity. The problem is that these weightings of the data to remove heteroskedasticity also reduce the estimated values of tobacco allotment values for the reasons mentioned in the preceding paragraph (because tobacco allotments on larger farms command higher values).

Models 17 and 20 are considered serious contenders for nomination as "satisfactory approaches" to use in analyzing such data. These models are identical except that 17 uses trends for land values and 20 has individual estimated values of cropland for each year. The problem with trying to estimate two annual effects at the same time (the incremental effects of cropland acres and tobacco pounds) is multicolinearity. It shows up in the estimates for 1978 in model 20, where the share going to cropland falls about $450 per acre (-$20,500 per 73-acre typical farm) compared with nearby years while the tobacco price for the same year increased by about $2.00 per pound (+$23,000 per farm). If it weren't for this problem of multicolinearity, the form-free nature of model 20 would be preferred. Estimated values of cropland from model 20 would be preferred. Estimated values of cropland from model 20 could be on the "low side" for 1975 and 1980 which means that the tobacco allotment estimates for the same years could be "high." Appendix A, Table 6 provides a comparison of the estimated values of cropland, other land, and tobacco allotments from models 4, 17 and 20. The regression coefficients for model 17 are rearranged and expressed here as an equation estimating the value of a Pitt County farm for 1980:

$$\begin{aligned} SVLF &= 5{,}259 + (111.66 + 25.91T)AOL \\ &\quad + (-371.81 + 720.13T - 67.52T^2)ACL \\ &\quad + (4.04)PTQ. \end{aligned}$$

The parentheses represent the values of each component. Substituting T = 7 for 1980 into this equation, one can obtain the land values listed in Appendix A, Table 6 in the row for 1980 and the columns for model 17. The values for earlier years are obtained in a similar fashion and then deflated back to nominal dollars using the U.S. Farm Real Estate Index. Note that models 17 and 20 show higher rates of growth of cropland values than does model 4, while the opposite is true for tobacco allotment values. The high correspondence between the overall trends from models 17 and 20 increases our confidence in model 17 (because model 20 is virtually form free).

Confidence Intervals

A coefficient, such as $4.04/pound for tobacco allotments, from model 17 is simply an expected value, or an estimate of the true value. True values are never known. Estimates have standard errors and confidence intervals. The standard error of $4.04 is $.58. We can say with reasonable confidence (about

Appendix A, Table 5. Regression results from Models 17-20 which were based on sale prices inflated to 1980 using the index of U.S. farm real estate values

Model No.	17	18	19		20
R^2	.9077	.7042	.6452		.9087
n	639	639	639		639
df	617	617	617		615
SSE	889.7b.	148.8m.	671.6m.		880.0b.
	(17 vs. 20) F = 3.39**				
Estimates of coefficients[a]				Individual year $/ac.	
b_0	5,259	1,803	2,690		4,300
b_1	25.91	-29.14	-10.16	(75)	546*
				(76)	992*
b_2	-482.42	1,306	1049	(77)	1,301*
b_3	694.23*	-232.89	-82.84	(78)	926*
				(79)	1,483*
b_4	-67.52*	37.20	19.21	(80)	1,202*
b_5					
Estimated value of tobacco allotments in 1980 "land value" dollars[a]					
1975	6.63*	4.03*	4.49*		6.74*
1976	5.39*	4.51*	4.65*		5.31*
1977	6.29*	6.61*	6.66*		6.08*
1978	5.11*	5.80*	5.94*		7.54*
1979	4.58*	5.13*	5.05*		4.20*
1980	4.04*	3.42*	3.45*		4.24*
Estimated dummies for counties ($/acre of all land)					
Green	314	723	602		406
Lenoir	517	1,040	875		596
Pitt	111	576	441		212
Wilson	216	670	549		299
Johnston	113	618	474		212
Wayne	384	707	611		479
Edgecombe	65	395	285		153
Martin	346	659	583		446
Nash	108	362	268		203
Duplin	178	407	324		302
Sampson	340	632	544		434

[a]Table 4 of the text summarizes values of land and tobacco allotments in nominal dollars and Table 6 provides an estimate for a typical Pitt County farm.

80 percent)[1] that the true value falls within plus and minus two standard errors of the estimate:

$$4.04 - (2)(.58) = \$2.87$$

$$4.04 + (2)(.58) = \$5.21 \;,$$

or that the true value falls in the range $2.87-$5.21 per pound.

In models 1-15, we used nominal sales values and different trends to describe the rate of increase of land values. Model 4 with separate exponential trends for cropland and other land was the preferred model of this type. The estimate of the tobacco allotment value for 1980 was $4.78 per pound with confidence interval of two standard deviations extending from $3.94 to $5.62.

In most cases, the confidence intervals for the estimated values of tobacco allotments from one model overlap the confidence intervals from the other models. For example, the interval for model 4 in 1980, $3.94-$5.62, overlaps that from model 17, $2.87-$5.21/lb. This was not true in the case of 1977 and 1978. For these years, the exponential trend for land values probably underestimated land values per acre which means that the estimates of tobacco allotment values from model 4 for 1977 and 1978, $6.35/lb., may be biased upward. This illustrates the fundamental problem with using any simple trend to describe land values. The

---

[1] There are at least four reasons why this should be considered less than a 95 percent confidence interval. (1) Acres of land (especially cropland) and pounds of tobacco allotment are highly correlated. Uncertainty about the estimated values of land cause some reduction in the confidence we have in estimated tobacco allotments values (the confidence region for the estimates is elipitcal rather than circular). (2) The land value trends are least well estimated for the extreme years of the series, and 1980 is an extreme year. (3) Use of pretest regression procedures, or use of the same data to select a model and obtain a set of estimates, causes an acutal reduction in confidence (see Wallace, 1977). And (4) Average residuals from adjacent years could be slightly autocorrelated even though the model includes individual year estimates for the value of tobacco allotments. Eighty percent certain would be a more reasonable figure than 95 percent.

Appendix A, Table 6. An illustration of differences in estimated values of land and allotments from different regression models fitted to data from farm sales in 11 eastern North Carolina tobacco counties, 1975-80

	Values from model 4 which were fitted to farm sales data in nominal values and used exponential trends for cropland and other land, and individual year estimates for tobacco quotas			Values from models 17 and 20 which were fitted to sales data deflated to nominal dollars using the U.S. Farm Real Estate Index[a]					
				Model 17 has a quadratic trend for cropland, a linear trend for other land, and individual year estimates for tobacco quotas			Model 20 has no trends but provides individual year estimates for both cropland and tobacco quotas		
Year	Crop-land (nominal	Other land = $/ac.)	Tobacco quotas $/lb.	Crop-land (nominal	Other land = $/ac.)	Tobacco quotas $/lb.	Crop-land (nominal	Other land = $/ac.)	Tobacco quotas $/lb.
1975	486	146	3.42	421	86	3.50	400	112	3.55
1976	595	183	3.88	708	113	3.23	721	127	3.18
1977	729	231	6.35	1,000	150	4.40	1,060	148	4.26
1978	893	291	6.35	1,175	183	3.90	868	162	5.75
1979	1,009	366	5.48	1,319	231	3.98	1,473	184	3.66
1980	1,340	461	4.78	1,361	292	4.04	1,413	212	4.24
Growth rates[b]	22	25	7	26	28	3	24	14	4

[a] Models 17 and 20 have dummy variables for base land values in counties and constant terms which apply regardless of the farm size. The constant terms are $5,259 for model 17 and $4,300 for model 20 expressed in 1980 dollars per farm. They are not included here. Base land values for Pitt County are used.

[b] Annualized percentage changes from 1975-80 compounding over 5 years.

type of exponential trend used in model 4 was the most satisfactory of all the different trends that were tried, but it still has this basic flaw. The pattern of land value increases, especially that part caused by changes in the expected inflation rate in the 1970's, doesn't follow a simple trend. For this reason the approach used in models 17 and 30 is preferred.

A Better Approach

A preferable approach to that which was followed up to this point might have been to begin with a general model, such as model 20, and apply it to each geographic subdivision that might subsequently be combined into one regression. Then, selectively try logical restrictions on that model such as the combining of certain geographic subdivisions for some estimates and trends but not for others. Adopt restrictions which have F ratios less than those from the F table for some preassigned level of probability, such as 0.01. A lower level is chosen (.01 instead of .05) because we want to err in favor of more restrictive models. Finally, one must check the logic of the estimates and trends before adopting a particular model.

Earlier analyses revealed that it was reasonable to use the United States Farm Real Estate Index to standardize the values of individual farms or to "purge" them of the irregular effects of changes in expected inflation rates. It also revealed that restrictions which forced cropland and other land to have the same values are not justified. That is, one can reject at the .01 level the hypotheses that such restrictions are valid. Also, the high correlation between acres of cropland and pounds of tobacco allotment means that, if one tries to obtain separate estimates of their values for individual years, the estimates would be unstable and fluctuate irrationally in opposite directions. Hence, it was tentatively decided to restrict one of these (usually cropland values) to follow a trend and let the other (tobacco allotment values) be free. Tobacco allotment values thus represent the net residual part of the value of farms not attributable to cropland, other land, timber, and buildings. These residuals are expressed as dollars per pound of tobacco allotment.

It was also decided to not include a constant term for regressions 21-29. One argument for including a constant term is that smaller farms tend to command higher prices per acre than larger farms and constant terms can be used to reflect this. An argument against constant terms is that we want to estimate the average value of each component regardless of size.

An empirical argument against constant terms is that those from model 17 and 20 were unusually large and those from model 16 were unstable across geographic subdivisions. The instability suggests that they do not really estimate the inherent effect of a farm size, and large constant terms would cause other components of value to be biased downward. Part of the reason that constant terms are often large is that smaller farms tend to be closer to towns and tend to have valuable attributes for purposes other than farming. It was also observed that smaller farms have: a higher proportion cropland and more tobacco allotment per acre of all land, a smaller value per pound for tobacco, and a higher rate of turnover than do larger farms.

The eleven contiguous counties in the central part of eastern North Carolina (area F) are chosen for this analysis. These counties also have the highest tobacco allotment rental rates in the state. We hypothesize that allotment values are homogeneous for these 11 counties and so the data from them can be combined for purposes of estimating allotment values. Land values probably do differ across these counties. For purposes of this regression analysis, the counties are subdivided into three regions which are identified in Table 6 of the text.

This preferred approach then was to start with a general model and check to what extent it was possible to restrict it, thereby reducing the standard errors of the coefficients of interest. Model 21 allows twenty-one individual coefficients (7 years times 3 regions) for estimating both the values of tobacco quotas, VTQ, and the values of cropland, VCL. As expected, these estimates were unstable and fluctuated in opposite directions. Examination of the VTQ's revealed similar average values for the three regions suggesting that they could be combined for purposes of estimating the value of tobacco allotments. The F ratio comparing model 22 (restricted) with 21 was .97. The critical ratio F (01, 14, 700) is 2.10 so one can accept the hypothesis that the restriction is valid. It is reasonable then to seek single annual average estimates of the values of tobacco allotments for these 11 counties. Estimated VTQ's for models 21 and 22 are listed in Appendix A, Table 7. It appears as though multicolinearity is causing unduly large fluctuations in these values. In particular the values for 1975, 77, and 78 appear to be out of line with estimates for nearby years.

Model 23 uses three regional base values and a quadratic trend for estimating VCL. It only uses five degrees of freedom where model 22 used twenty-one. The F ratio was 4.19 for this restriction and the critical ratio was 2.02 so one can reject the hypothesis that the restriction is valid. Model 24, which drops the quadratic term and forces VCL for all three regions to follow a single linear trend, has practically the same sums of squares of errors as model 23, and the F ratio is only .20 for this restriction.

Appendix A, Table 7. Selected regression statistics from models 21-29

Items	Model Numbers 21	22	23	24	25	26	27	28	29
Corrected R^2	.9010	.8970	.8873	.8873	.8901	.8899	.8906	.8881	.8949
n	737	737	737	737	737	737	737	737	737
Degrees of freedom	688	702	718	719	716	718	716	722	708
SSE in billions	977.7	1017.1	1112.7	1113.0	1085.7	1087.7	1080.9	1104.9	1037.6

F ratios for restricted versus less restricted models[a]

- 21 → 22: .97 (2.10)
- 22 → 23: 4.19* (2.02)
- 23 → 24: .20 (6.67)
- 25 → 24: 5.98* (3.81)
- 25 → 26: .63 (4.63)
- 27 → 26: 2.25 (4.63)
- 27 → 28: 2.66 (2.83)
- 29 → 28: 3.28* (2.10)
- 22 → 25: 3.38*(2.10)
- 26 → 28: 2.83(3.35)
- 22 → 26: 3.05*(2.02)
- 22 → 28: 3.03*(2.02)
- 22 → 29: 2.36(2.83)

Estimated values of tobacco allotments in real 1980 land value dollars

	21	22	23	24	25	26	27	28	29
1974	3.85	3.90 (1.463)	7.83 (0.858)	7.58 (0.639)	4.28 (1.429)	4.25 (1.429)	4.22 (1.426)	4.84	5.78
1975	6.58	7.06 (0.540)	6.48 (0.437)	6.41 (0.409)	6.67 (0.431)	6.66 (0.425)	6.80 (0.438)	6.09	6.02
1976	4.79	5.45 (0.413)	6.14 (0.347)	6.20 (0.320)	6.26 (0.324)	6.29 (0.321)	6.37 (0.323)	6.72	6.04
1977	4.84	4.42 (1.190)	7.52 (0.595)	7.66 (0.520)	7.66 (0.524)	7.68 (0.521)	5.69 (1.072)	6.74	5.83

Appendix A, Table 7 (continued)

1978	6.70	7.86 (1.726)	6.63 (0.595)	6.78 (0.491)	6.70 (0.496)	6.68 (0.491)	6.80 (0.511)	6.14	5.39
1979	6.14	5.24 (0.463)	5.19 (0.381)	5.21 (0.378)	4.96 (0.396)	4.91 (0.382)	4.96 (0.412)	4.93	4.71
1980	3.40	2.96 (0.735)	3.49 (0.617)	3.35 (0.533)	2.87 (0.547)	2.88 (0.537)	2.90 (0.711)	3.11	3.90

[a] Numbers in parentheses are 1 percent points for the distribution of F. * indicates that one can reject the hypothesis that the restrictions imposed by the model are valid at the .01 level.

[b] Numbers in parentheses are standard errors. There are no standard errors for model 21 because the allotment values are simple averages of the coefficients from the three regions, and for model 28 because the allotment values are calculated from the quadratic equation.

Another problem with models 23 and 24 are the unbelievably large estimated tobacco allotment values for 1974. In a sense, models 21 and 22 are form-free as far as VCL is concerned, so that their estimates of tobacco allotment values for 1974, \$3.85 and \$3.90, provide a standard against which to judge the results of the more restricted models. The simple trends imposed in models 23 and 24 appear to force an underestimation of VCL in 1974. Table 5 of the text reveals that the average value of all land in farms for the sample of 64 farms in 1974 was higher than the average value in 1975. Perhaps favorable crop prices for corn and soybeans in 1973 and 1974 caused the values of cropland in eastern North Carolina to rise sharply in those years and then fall off in real terms in 1975.

Models 25-29 allow three separate linear trends for VCL and they have a dummy variable for VCL in 1974. These models provide more "reasonable" estimates of tobacco allotment values for the initial year, 1974, when the estimates from models 21 and 22 are used as a standard. Viewing model 24 as a restricted version of model 25, the highly significant F ratio, 5.98, means that one can reject the hypothesis that the restriction is valid and select model 25. High correlation between AOL and ACL caused unreasonably large instability in the estimated linear trends for the three regions from model 25. Model 26 was added to observe the effects of forcing the three regions to have but one linear trend for estimating VOL. It led to much more homogeneous regional trends for VCL in model 26 as opposed to model 25. The F-ratio going from model 25 to restricted model 26 indicates that one cannot reject the hypothesis that the restriction is valid. For these reasons, model 26 is selected over models 23-25. Results from model 26 might be preferred over those from model 22 in spite of the significant F-ratio, 3.05 ($F(.01, 16, 700) = 2.02$). This is because the form-free estimated VCL in model 22 force too many large irrational opposite fluctuations in its estimated values of tobacco allotments.

Disturbing things about the estimated allotment values from models 25 and 26 are that the estimates for 1977 are $1 per pound higher than those for 1976 and 1978, and estimates for 1980 seem low compared with those from the smaller data set (models 4, 17, and 20). Model 27 allows dummies for cropland in 1977 and 1980 as well as 1974. This causes a drop of $2 per pound in the estimated allotment values for 1977. Also, the insignificant F ratio, 2.25, would cause us to prefer the estimates from the less restricted model, number 26. Observe in Appendix A, Table 7 that the standard errors of the estimated allotment values fall as the restrictions are added. Model 26 is definitely preferred over models 22 and 27 when the standard errors are compared.

Allotment values from model 26 appear to follow a simple quadratic trend. So, model 28 is added to impose such a trend on the estimated allotment values. The F-ratio indicates that one cannot reject the hypothesis that the restrictions going from model 26 to 28 are valid at the .01 level. However, one would reject the same hypothesis at the .05 level. Going from model 22 to 28 the restrictions on the estimated values of cropland definitely would be rejected. On statistical grounds model 28 is preferred over model 26 but neither is preferred over model 22. However, if one wants a smooth trend for tobacco allotment values and the other components, one might prefer model 28.

Model 28 has all three components (VOL, VCL and VTQ) constrained with trends. Now, it would seem logical to check the results of constraining tobacco allotment values to follow a quadratic trend but allowing the values of cropland to take on different values in each year and region. This is done in model 29. Model 29 is similar to model 22 except that tobacco allotment values are constrained to follow a quadratic trend. The F ratio, 2.36, is less than the critical value meaning that we cannot reject the hypothesis that the restrictions of model 29 are valid. This is the first time we have found an admissible restriction on model 22. Model 28 can in turn be viewed as a restricted version of model 29 in which the 21 independent coefficients for VCL are constrained to follow three linear trends. The F ratio 3.28* indicates that one can reject the hypothesis that these restrictions are valid. Thus model 29 would seem to be the preferred model--the one that would be selected based on the F ratios.

Problems with model 29 are: (1) the high standard errors for the trend coefficients used to calculate the allotment values, VTQ:

$$\text{Model 28:}\quad VTQ = \underset{(1.0020)}{2.9830} + \underset{(0.4917)}{2.1677T} - \underset{(0.0552)}{0.2071T^2}$$

$$\text{Model 29:}\quad VTQ = \underset{(1.6522)}{5.2993} + \underset{(0.8925)}{0.5947T} - \underset{(0.1154)}{0.1154T^2}$$

The standard errors (given in parentheses) are much larger in the second case because it is a much less restricted model. (2) Another problem is that attributing all of the residual to the value of cropland VCL makes it difficult to recommend this equation to farm appraisers. The residual cropland values fluctuate too much to be credible. Exceptionally low values are marked with an asterisk in Appendix A, Table 8. One worthwhile observation is that the simple average of these regional VCL's reveals a rising and gradually falling pattern which might be described with a square-root function. The same pattern was not as clear in the average values of VCL from models 21 and 22. What this suggests is that the linear form imposed on VCL in models 24-28 is too restrictive and that it forces the estimated VTQ

Appendix A, Table 8. Estimated values of cropland (and standard errors) from model 29

Year	Regions			Simple averages
1974	1,697 (300)	1,369 (351)	1,379 (281)	1,481
1975	851* (109)	1,066* (159)	1,446 (161)	1,121
1976	1,087* (101)	1,656 (214)	1,173 (162)	1,396
1977	1,792 (244)	2,166 (238)	1,490 (170)	1,816
1978	1,705 (185)	2,074 (209)	1,338 (111)	1,705
1979	1,272* (137)	2,087 (153)	1,453 (96)	1,604
1980	1,501 (214)	1,658 (202)	1,394 (158)	1,526

to be too quadratic in shape, or too high in 1976-78 and perhaps too low in 1980 (see Appendix A, Table 7). This suggests examining the average values in Table 5 of the text. If one ignores 1974, then the real land values do seem to follow a curve which rises quickly and declines gradually as would a square-root time trend. This suggests allowing estimated VCL values to follow a square root trend. (3) Another problem with model 29 is that using a trend for estimating VTQ leaves us with little confidence in the estimate for the final year. One of our objectives was to see if we could develop a regression procedure which we could recommend to farm appraisers. Given the uncertainties of the tobacco program, it would be better to have an estimate for the most recent year that is not determined by a trend or heavily influenced by values from earlier years. This model, 29, is the best we have been able to find following what we thought was "A Better Approach." Perhaps the original starting point, model 21 was not broadly enough defined. In any event, the whole effort suggests taking stock and starting over.

A Comparison of the Most Satisfactory Models

The reader could be overwhelmed with model numbers, VCL's and VTQ's. Appendix A, Table 9 is designed to summarize what we have learned and explain the design of model 30. Four different approaches are defined in the first two rows of the table: (1) the annual values of both VCL and VTQ are flexible in models 20 and 22, (2) only VTQ is felxible in models 17 and 30, (3) only VCL is flexible in model 29, and (4) neither is flexible in model 28. Other differences among the models are of minor importance. Considering the estimated VTQ: (1) those for the flexible models, 20 and 22, seem to be too high in 1975 and 1978, (2) those for models 17 and 30 have a sizeable dip in 1976, but perhaps tobacco allotment vàlues fell that year. (There was an increase of

15 percent in allotted pounds going from 1974 to 1975 followed by a 15 percent decrease going from 1975 to 1976. This uncertainty plus accumulated stocks could have depressed values in 1976. There was another 12 percent cut in allotments going from 1976 to 1977. The need for this could have been anticipated.) (3) Model 29, with VCL flexible, yields trend values of VTQ that appear to be reasonable. But we have little confidence in the estimate for 1980. (4) Model 28, which has trends for both VTQ and VCL, would have been more staisfactory if it had used square-root rather than for VCL. Even with that change, we would have had little confidence in the estimate of VTQ for 1980.

These considerations led to the development of model 30 which combines some desirable characteristics of model 17 plus ideas gleaned from running the other models. Model 30 has three regional intercepts and square-root trend terms for estimating VCL. Forcing all three regions to share one linear term, T ACL, has the effect of reducing fluctuations in these trends among regions. Tobacco allotment values, VTQ, are flexible. Each county has a separate base land value (dummy for ALF) which contributes to both VOL and VCL. The intercept is fixed at $2,000 per farm instead of being flexible as in model 17 or fixed at zero. This adds $200 per acre for a 10-acre farm and $20 per acre for a 100-acre farm. This intercept seems more reasonable than the alternatives.

Model 30 achieves a higher R^2 value than model 22 with fewer degrees of freedom lost; so, it would be preferred. The main advantage comes from the use of individual county base land values. The results for model 30 are slightly preferred over those from model 17 because three regional trends are allowed for estimating VCL. Also, the constant term, $2,000/farm, seems more reasonable than the estimate of $5,404 from model 17. The results of model 30 are summarized

Appendix A Table 9. A summary of the most satisfactory models

Items	Numbers of the models					
	22	20[a]	17[a]	28	29	30
	Description of the models:					
VCL	Flexible, 3 regions	Flexible, 1 area	1 Quadratic trend	3 Linear trends	Flexible, 3 regions	3 Square root trends
VTQ	Flexible	Flexible	Flexible	1 Quadratic trend	1 Quadratic trend	Flexible
VOL or VLF	3 intercepts and linear trends for VOL	1 linear trend for VLF		3 intercepts and 1 linear trend for VOL		1 linear trend for VOL
Constant terms	none	yes ($5,216)	yes ($5,404)	none	none	Fixed at $2,000
1974	data for 1974 in	data for 1974 deleted		data for 1974 along with a dummy for VCL in 1974		
Geographic distinctions	3 regions	12 counties for ALF		3 regions	3 regions	12 county base values for ALF
Selected regression statistics:						
Corrected R^2's	.8970	.9024	.9015	.8881	.8949	.8996
Number of obs.	737	673	673	737	737	737
Degrees of freedom	702	647	650	722	708	709
SSE's in billions	1017.1	925.0	944.5	1104.9	1037.6	992.2

Appendix A, Table 9 (continued)

Items	Numbers of the models					
	22	20[a]	17[a]	28	29	30
Estimated tobacco allotment values, $/lb.						
1974	3.90	--	--	4.54	5.78	5.14
1975	7.06	6.82	6.46	6.09	6.02	6.64
1976	5.45	5.35	5.66	6.72	6.04	5.55
1977	4.42	5.84	6.88	6.74	5.83	6.59
1978	7.86	7.10	5.81	6.14	5.39	5.64
1979	5.24	5.02	4.79	4.93	4.71	4.56
1980	2.96	3.09	3.53	3.11	3.90	3.24

[a] These results differ from those in Appendix A, Table 5 because additional observations were added especially for 1980 and a linear trend for ALF was added to model 20.

here as an equation:

$$SVLF = 2{,}000 + \underset{(18.35)}{62.86}\ T_j AOL_{ij}$$

$$+ \text{ for region 1 } \left[\underset{(1414)}{-1991} + \underset{(1450)}{2908}\sqrt{T_j}\right] ACL_{ij}$$

$$+ \text{ for region 2 } \left[\underset{(1461)}{-2680} + \underset{(1475)}{3351}\sqrt{T_j}\right] ACL_{ij}$$

$$+ \text{ for region 3 } \left[\underset{(1487)}{-1858} + \underset{(1481)}{2856}\sqrt{T_j}\right] ACL_{ij} - \underset{(363)}{627}\ T_j ACL_{ij}$$

$$+ \underset{(475)}{1258}\ ACL_{i1974} \text{ (only applies to 1974)}$$

Year	$+PTQ_{ij}$ times these estimated values of tobacco quota	County	$+ALF_{ij}$ times these base values of land for each county
1974	5.13		
	(1.40)	Region 1:	
		Edgecombe	-42.86
1975	6.64	Martin	260.88
	(0.49)	Nash	16.32
		Pitt	51.41
1976	5.55		
	(0.37)	Region 2:	
		Greene	124.91
1977	6.59	Lenoir	308.40
	(0.62)	Wayne	122.83
		Wilson	0.53
1978	5.64		
	(0.59)	Region 3:	
		Duplin	39.37
1979	4.56	Johnston	41.91
	(0.40)	Sampson	224.03
1980	3.24	Standard errors range from $92 to $170/acre	
	(0.60)		

with standard errors given in parentheses under the coefficients. For 1980 (T = 7) and for Pitt County which is in Region 1, this equation reduces to SVLF = 2,000 + 1365ACL + 491AOL + 3.24PTQ. Table 8 of the text provides a summary of these estimates of VCL, VOL and VTQ.

For further analyses of this type, we would suggest examination of the standardized average values per acre, as in Table 5, for any trend that may be there. These might suggest a polynomial, or a combination of an exponential and a power function trend for VOL and VCL. Then one should consider regional subdivisions, especially factors which account for differences in the value of cropland. Basically, however, we recommend a model similar to model 30.

APPENDIX B. RENTAL RATES FOR FLUE-CURED TOBACCO ALLOTMENTS AND COMPARISONS WITH BUDGETED NET REVENUES

Annual rental of tobacco allotments apart from the farmland is permitted within counties. Rental rates provide a market-determined estimate of net income to allotments. Estimates for 23 counties and six years are summarized in Table 1. Weighted average rental rates are practically the same for the seven central counties and the four north-central counties. These eleven counties are heavily committed in flue-cured tobacco production and evidently have similar net incomes. Average rental rates are considerably lower in the five counties in the northern part of the coastal plain--about 20 cents per pound lower in 1981. Production is also much more sparse in these counties, suggesting that it is a "thinner" market. In the seven coastal counties, tobacco allotment rental rates are about 10 cents per pound under those in the heart of the eastern belt. Production of tobacco is very sparse in some of these counties.

Estimated average rental rates for 1981 are practically the same as independently estimated net incomes to allotments based on crop budgets for medium-sized tobacco farms. Table 2 provides an estimated return to land, management, and quota of $1,370 per acre per year. Table 3 shows a subtotal of operating, overhead, and labor costs of $1,990. Adding 15 percent of these costs for management and $70 per acre for rental of tobacco land, we obtain an estimate of total costs of $2,359 or $1.12 per pound. Assuming an expected price of $1.60 per pound, this leaves an estimated net income to quota of $0.48 per pound. If efficient farmers are competing with one another to rent tobacco quotas, then this is exactly the result one would expect. Farmers have to be efficient to be able to pay 50 cents per pound for the allotment, and at that rate they are only making wages plus about 15 percent of their non-land costs for their managerial effort.

Appendix B, Table 1. Rental rates for flue-cured tobacco allotments by counties in the Eastern Belt of North Carolina, 1976-81*

County	Years					
	76	77	78	79	80	81
			(cents per pound)			
Seven central counties of Eastern Belt:						
Duplin	30	32	40	47	40	48
Green	32	40	38	47	50	50
Johnston	25	38	40	45	45	50
Lenoir	25	30	35	42	42	45
Sampson	30	35	40	45	45	50
Wayne	28	35	38	45	47	50
Wilson	32	40	40	50	50	50
Weighted averages[a]	29	36	39	46	46	49
Four north-central tobacco and peanut counties:						
Edgecombe	32	42	43	50	40	45
Martin	30	35	45	49	37	50
Nash	28	32	40	45	41	47
Pitt	30	38	40	45	55	58
Weighted averages[a]	30	37	41	46	46	52
Five northern peanut and tobacco counties:						
Bertie					25	30
Halifax					35	27
Hertford					25	30
Northhampton					35	27
Washington					25	30
Weighted averages[a]					29	29
Seven central coastal counties:						
Beaufort	20	25	35	40	33	38
Carteret	20	28	22	25	28	33
Craven	25	32	30	37	40	45
Jones	25	32	37	42	38	43
Onslow	24	26	32	38	37	42
Pamlico	20	28	22	25	28	33
Pender	15	25	30	35	30	35
Weighted averages[a]	22	28	32	38	36	41

*Source: Lending officials familiar with tobacco leasing in each county were contacted by telephone and asked what they thought the average rental rates had been for each season for simply leasing allotments (lease and move). These are very similar to rates obtained by Pugh (1981) from Agricultural Extension Agents.

[a]Weights used were the proportions of total 1978 production that applied to each county. Source: N. C. Agricultural Statistics, 1979.

Appendix B, Table 2. Estimated revenue, operation expenses, annaul ownership costs, and net revenue per acre for tobacco, flue-cured in North Carolina, medium-sized farm (around 25 acres), 1981.

CATEGORY	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
Total Receipts:					
Tobacco, Flue-Cured	lbs.	$ 1.60	2100.00	$3360.00	____
Operating inputs:					
Tobacco seed	oz.	25.00	0.12	3.00	____
Custom fumigation	sq. yd.	0.25	85.00	21.25	____
12-6-6, p.b.	cwt.	7.10	0.57	4.05	____
16-0-0, p.b.	cwt.	7.57	0.05	0.38	____
Fungicide, p.b.				1.56	____
Insecticide, p.b.				0.49	____
Field Blue Mold Control				28.00	____
Nematicide				49.50	____
Herbicide				12.36	____
8-8-24	cwt.	10.12	5.00	50.60	____
15-0-14	cwt.	9.42	2.00	18.84	____
16-0-0	cwt.	7.57	1.00	7.57	____
Insecticide				14.38	____
Contact, suckers				32.32	____
Systemic, suckers				14.13	____
Cover crop	bu.	6.00	1.25	7.50	____
Tobacco curing	gal.	1.03	220.00	226.60	____
Electricity				30.24	____
Crop insurance				52.80	____
Building insurance				40.00	____
Warehouse charges	dol.	0.03	3360.00	100.80	____
Marketing organization				1.05	____
Leased quota				____	____
Other expenses					____
Tractor fuel & lube				71.74	____
Tractor repair cost				21.39	____
Machine fuel & lube				31.59	____
Machine repair cost				29.11	____
Equipment repair cost				56.25	____
Total operating cost				$ 927.49	____
Returns to land, (quota), labor, capital, machinery, overhead and management				$2432.51	____
Capital cost at 12%				$ 271.82	____
Returns to land, (quota), labor, machinery, overhead and management				$2160.69	____
Ownership cost: (Depreciation, taxes, insurance)				$ 278.58	____
Returns to land, (quota), labor, overhead and management				$1882.11	____
Labor cost	hr.	3.75	136.59	$ 512.20	____
Returns to land, (quota), overhead and management				$1369.92	____

Prepared by C. R. Pugh, Extension Economist and W. K. Collins, Crop Science Extension Specialist (Tobacco).

Appendix B, Table 2. (continued)

Month	Type of operation	Equipment used	Hours per acre Labor	Hours per acre Power
	Plant bed (85 sq. yd.):			
Jan.	Plowing	4-bottom plow	0.05	0.05
Jan.	Disking	12' disk	0.02	0.02
Jan.	Fumigating	Custom hired	--	--
Feb.	Rake and seed	Hand	1.60	--
Feb.	Fertilizer	Spreader	0.30	0.03
Mar.	Pest control, 6 X	Sprayer	0.12	0.11
Mar.	Top-dressing	Pick-up	0.27	0.25
	Land preparation (1 1/4 acres per acre of allotment):			
Mar.	Plowing	4-bottom plow	0.65	0.60
Mar.-Apr.	Disking, 2 X	12' disk	0.51	0.46
Apr.	Harrowing	Section harrow	0.22	0.20
Apr.	Applying nematicide	Applicator	0.38	0.35
Apr.	Disk in nematicide	12' disk	0.26	0.23
Apr.	Applying herbicide	Sprayer or applicator	0.20	0.18
May	Laying off rows and fertilizing	2-row disk-hiller	0.27	0.24
	Transplanting:			
May	Pulling plants	Hand	8.00	--
May	Hauling plants and water	Pick-up	0.80	0.25
May	Transplanting	1-row transplanter	12.96	3.49
	Growing:			
May	Cultivating, 2 X	2-row rolling cultivator	0.30	0.28
June	Cultivating, side dressing	2-row rolling cultivator with fert. attachment	0.40	0.14
June	Lay-by herbicide	4-row sprayer	0.20	0.18
June	Apply insecticides, 2 X	4-row sprayer	0.40	0.36
June-July	Topping, 3 X	Topper, tractor-mounted	1.87	1.70
June-July	Applying sucker control, 2 X	4-row sprayer	0.40	0.36
	Harvesting, curing marketing:			
July-Aug.	Priming and racking on aide		64.00	3.24
July-Aug.	Hauling to barn	Trailer	7.90	7.00
July-Aug.	Loading barn		15.00	--
July-Aug.	Curing supervision		2.00	--
July-Aug.	Removal and sheeting	2-T, truck	10.40	2.10
July-Sept.	Marketing	2-T, truck	5.20	2.80
	Post-harvest:			
Sept.	Cutting stalks	2-row cutter	0.35	0.32
Sept.	Plowing	4-bottom plow	0.65	0.60
Sept.	Disking, 2 X	12' disk	0.51	0.46
Sept.	Seeding cover crop	Grain drill	0.40	0.36
	Total		136.59	

Appendix B, Table 3. Estimated net revenues to flue-cured tobacco quota on a medium-sized eastern North Carolina farm

Costs from Table 2:	1981 $/acre
Operating costs	927
Overhead costs:	
Capital costs 12 percent	272
Depreciation, taxes, and insurance	279
Labor costs	512
Subtotal	$1,990
Management (15 percent of subtotal)	299
Rental of cropland	70
Total cost/acre	$2,359
Number of pounds/acre	2,100 lbs.
Cost per pound	$1.12/lb.
Assumed revenue per pound	$1.60/lb.
Net revenue to tobacco quota	$0.48/lb.

For future analyses of this type, we would begin with an examination of the standardized average values per acre, as in Table 5, to see if there is any particular trend that VOL and VCL should be allowed to follow. That trend may be mainly due to VTQ, but this procedure would give the other components a chance to claim it. Trends in the value of similar cropland in other areas that have no tobacco also should be examined. Then one should consider regional subdivisions, especially factors which account for differences in the value of cropland. We would also continue to include a constant term and county dummies for base land values. Most likely we would end up with a model similar to model 30.

Agricultural Research Service

North Carolina State University
at Raleigh

D. F. Bateman, Director of Research