Sources and Repercussions of Changing U. S. Farm Real Estate Values

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In recent years, capital gains from farm real estate appreciation provided many farmers with funds for retirement or for investment in a home freezer, tractor, fertilizer, or more land. In the 1930's, real estate depreciation wiped out an equity base and caused mortgage foreclosures for numerous farmers. Changing land prices obviously have had an important impact on real income and resource returns in agriculture. This study was made to determine the magnitude and selected effects of changes in land prices. Certain hypotheses explaining land price changes are enumerated and statistically tested.

Rising land values in recent years have prompted several questions. What is the role of the nonfarmer in the real estate market; is he gaining control of farm land resources? Are government administered allotment and land retirement programs the principal source of land price increments? Is the U.S. in danger of exhausting its land supply to provide food and living space for an expanding population? To what extent is the recent land price spiral based on pure speculation, unfounded in prospective earnings—hence in danger of "overheating" and collapse with consequent heavy capital losses to farmers and others? This study attempts to answer these and other questions.

Magnitude of Capital Gains From Farm Real Estate

The average per acre value of U.S. farm land and buildings increased 337 percent from 1940 to 1964 (Figure 1). This is a substantial rise in relation to other prices in the farm and nonfarm sectors. The implicit price deflator of the Gross National Product, a measure of the general trend (inflation) in all prices in the economy, increased only 147 percent since 1940. In agriculture, the index of prices paid by farmers for items used in production (excluding land but including

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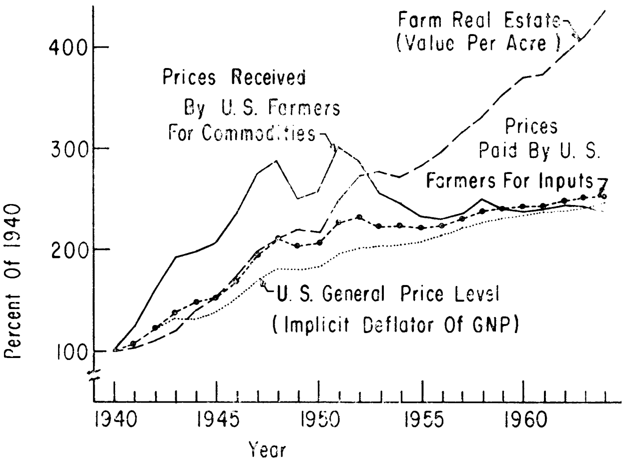

Figure 1. Trends in prices of farm real estate, farm commodities, farm inputs and the general U. S. price level.

Source: *Economic Report of the President*. January, 1965 and previous issues.

interest, taxes and wage rates) rose 152 percent from 1940 to 1964. The index of prices received by farmers for all commodities was up 136 percent from the 1940 level. It is apparent that by several standards, farm real estate prices display a substantial advance since 1940. Meanwhile, land by some measures has declined in importance as a factor of production. Cropland used for crops decreased nine percent and land in farms increased only five percent since 1940. Net capital improvements totaling 11.4 billion 1964 dollars since 1940 justify no more than a one-third increment in land values.[1] Clearly, capital gains are an important element in the farm real estate price trend.

Changes in farm real estate prices are especially important because of the attendant capital gains (losses) and redistribution of income. Measures of capital gains in Table 1 are defined as the consumption items[2] that the hypothetical owner of all U. S. farm real estate could purchase at the end of the year with funds remaining from the beginning

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[1]The *net* investment (capital purchases less depreciation and damage) since 1940 in farm buildings, windmills, wells and fences was 11.4 billion 1964 dollars. This estimate underestimates both (a) land *capital improvements* for conservation and drainage and (b) *depreciation* due to buildings outmoded by farm consolidation, and land attrition through cropping and erosion. Capital data are from (27). Capital data are deflated by the index of prices paid by farmers for buildings and fencing materials from (28).

[2]The capital gains are deflated by the index of prices paid by farmers for items used in family living, 1957-59 = 100. Thus, capital gains measure the magnitude of potential consumption purchases at the 1957-59 price level. Because price indices for production items purchased by farmers and also the general price level display trends similar to the deflator used, the purchasing power inferences can be broadened somewhat beyond consumption items purchased by farmers. For other measures of farm capital gains and their implications see (3), (6), (8), (12) and (24)

year real estate investment—after repaying the purchase price and capital improvements. The annual gains are accounting or "paper" profits never fully realized. Gains are not applicable to any specific farm situation, nor can they be accumulated in Table 1 to show period gains. The estimates are a general measure of changes in U. S. farm financial conditions stemming from annual farm real estate price fluctuations. An attempt by all owners simultaneously to sell farmland and realize the large capital gains for any year in Table 1 would depress land values and cause capital losses.

Three periods of major capital gains and losses are shown in Table 1. An apparent association existed between capital gains and net farm income in the first two periods. The first period, 1910-20, was one of

Table 1. Total Value and Estimated Annual Capital Gains from U. S. Farm Land and Buildings, 1910-1963.

Year	Value of Farm Real Estate[1]	Value of Annual Capital Gains[2]	Year	Value of Farm Real Estate[1]	Value of Annual Capital Gains[2]
	(Bil. Current Dollars)	(Bil. 1957-59 Dollars)		(Bil. Current Dollars)	(Bil. 1957-59 Dollars)
1910	34.8	2.8	1937	35.2	.0
1911	36.0	2.8	1938	35.2	−2.5
1912	37.3	2.5	1939	34.1	−1.0
1913	38.5	2.4	1940	33.6	1.5
1914	39.6	−.7	1941	34.4	6.7
1915	39.6	6.6	1942	37.5	7.6
1916	42.3	7.3	1943	41.6	11.2
1917	45.5	8.2	1944	48.2	9.2
1918	50.0	6.8	1945	53.9	10.8
1919	54.5	15.8	1946	61.0	9.5
1920	66.3	5.6	1947	68.5	5.1
1921	61.5	−12.5	1948	73.7	2.1
1922	54.0	−1.9	1949	76.6	−2.9
1923	52.7	−3.6	1950	75.3	12.4
1924	50.5	−1.3	1951	86.6	8.3
1925	49.5	−1.5	1952	95.1	.6
1926	49.0	2.9	1953	96.5	−2.4
1927	47.7	.9	1954	95.0	2.7
1928	47.6	.0	1955	98.2	4.5
1929	48.0	.8	1956	102.9	7.2
1930	47.9	8.2	1957	110.4	5.1
1931	43.7	15.2	1958	115.9	8.0
1932	37.2	17.2	1959	124.4	5.0
1933	30.8	3.7	1960	129.9	1.0
1934	32.2	2.5	1961	131.4	5.5
1935	33.3	2.4	1962	137.4	5.5
1936	34.3	2.3	1963	143.6	

[1]As of March 1 of the year indicated. From U. S. Department of Agriculture, *Farm Real Estate Market Developments*, CD-64, August, 1963, p. 41.

[2]Capital gains in year t are computed as the increment in real estate value from March 1, year t to March 1, year t+1; less capital improvements; and deflated by the index of prices paid by farmers for items used in family living, 1957-59 = 100. Annual capital gains are *not* cumulative. Corrections for capital improvements are made from unpublished work sheets of the U. S. Department of Agriculture, Farm Production Economics Division.

substantial capital gains and increasing net farm income. Net farm income rose from a $11.2 billion 1910-14 average to $16.4 billion in 1917, then began to decline (1957-59 dollars).[3] The sharp income break from $9.7 billion in 1920 to $5.8 billion in 1921 marked the beginning of a protracted period of capital losses through 1932. The year 1932 was significant not only for the lowest net farm income of the 1910-63 period, $5.5 billion, but also for the largest capital loss, $17 billion.

Then began a period of capital gains that has persisted to the present except for small losses in 1938, 1939, 1949 and 1953. Gains were nominal from 1933 until the war involvement in 1941. The period since 1941 has been one of generally substantial capital gains. Real net farm income reached an all time peak of $21.5 billion in 1946, then gradually declined to about $12.5 billion in 1955. Income has fluctuated near that level since 1955. Yet capital gains continue to be sizeable, reflecting a tendency to depart from the past association between income and capital gains. In subsequent sections we examine the causes and effects of this real estate capital gains phenomenon of recent years.

Effects of Capital Gains

Tables 2, 3 and 4 illustrate effects of rising land values on the economic structure of farms. In 1950, the average residual income was $1,300 (current dollars) per farm family worker after paying all real and opportunity costs except family labor out of gross income (Table 2).[4] This estimate is based on 1950 costs with land and other assets valued at 1950 prices. With a land cost reduced to the 1940 value, the income residual is $1,512. The implication is that if land prices were fixed (bought and sold) at the 1940 instead of the 1950 price, income per farm family worker would have averaged $212 higher in 1950. In 1962, if land were bought and sold at the 1940 rather than the 1962 price, residual labor income would have been nearly double. Stated in other terms, the beginning farmer who purchased an "average" farm in 1962 must pay $1,369 more annual interest because of land appreciation since 1940.[5] The hypothetical former owner who purchased the farm in 1940 receives the gains.

It is possible that the new owner will experience similar capital gains of course. The factor share can give some insight into future

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[3]Purchasing power in 1957-59 dollars. All net income data in this and the following paragraph are deflated by the index of prices paid by farmers for family living items 1957-59 = 100.

[4]Family workers include the operator and his family but excludes hired workers. The cost of land is the interest on the total value of farmland, not just the actual interest paid on farm debt.

[5]Assuming 1.3 family workers per farm, the incremental interest is ($2,118 − $1,065) 1.3 = $1,369.

Table 2. **Estimated Average Residual Income Per Family Worker After Deducting All Real and Opportunity Costs Except Family Labor from Gross Farm Receipts.**[1]

Year	Number of Family Workers	Residual Income Per Worker: Current Land Price	1940 Land Price	1950 Land Price
	(Million)	(Current Dollars)		
1950	7.6	1,300	1,512	1,300
1951	7.3	1,578	1,862	1,642
1952	7.0	1,397	1,759	1,529
1953	6.8	1,146	1,524	1,286
1954	6.6	1,076	1,455	1,210
1955	6.3	986	1,417	1,163
1956	5.9	1,022	1,526	1,253
1957	5.7	1,024	1,609	1,323
1958	5.5	1,282	1,940	1,648
1959	5.4	729	1,492	1,193
1960	5.2	850	1,721	1,409
1961	5.0	1,023	1,958	1,637
1962	4.9	1,065	2,118	1,786

[1]Residual income is all receipts from crops and livestock, government payments and nonmoney income less operating expenses and taxes, depreciation and interest on durable assets. The cost of family labor is excluded. Also, income from off-farm sources and capital expenditures for durables are not included. Basic data from U. S. Department of Agriculture, *The Farm Income Situation*, FIS-191, July, 1963; and U.S. Department of Agriculture, *The Balance Sheet of Agriculture*, Agricultural Information Bulletin 281, 1963, and prior issues.

feasible trends in land values (Figure 2). The factor share is defined as the opportunity interest cost on the total U. S. farm real estate value divided by all U. S. farm receipts. The share declined substantially to the early 1940's, then began a determined rise. The postwar trend cannot be sustained indefinitely, or all farm receipts will not cover land costs. The implication is that the tendency for land prices to rise relative to other prices and income in agriculture will not persist in the long-run. The "long-run" may be very distant, however, and the recent trend could continue for several more years.

Table 3 provides another measure of the economic effects of changing land prices. Real estate capital gains increase the farm commodity price level needed to cover all farm costs. The actual parity price ratio in 1950 was 101.[6] To cover all farm costs at current (1950) prices for land and other inputs, 123 percent of parity prices would have been required.[7]

A parity index of 103 would be required to pay all farm costs at current prices in 1962, despite sharply higher land values. Increased farming efficiency would have permitted a full parity return to all farm

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[6]Land prices are not used by the U.S. Department of Agriculture in computing the parity price ratio. If so, it could be reasoned that higher land prices would cause a lower parity ratio which, in turn, would justify higher support prices which, in turn, would encourage higher land values. Nevertheless, the new farm owner who must pay interest and principal on real estate may find the land price a vital determinant of his economic well-being— his residual income remaining to pay household and operating expenses.

[7]Capital gains are excluded from income. For 1950, the land is assumed to be purchased and sold at the same 1950 price (or rented at a cost equal to the interest on productive real estate).

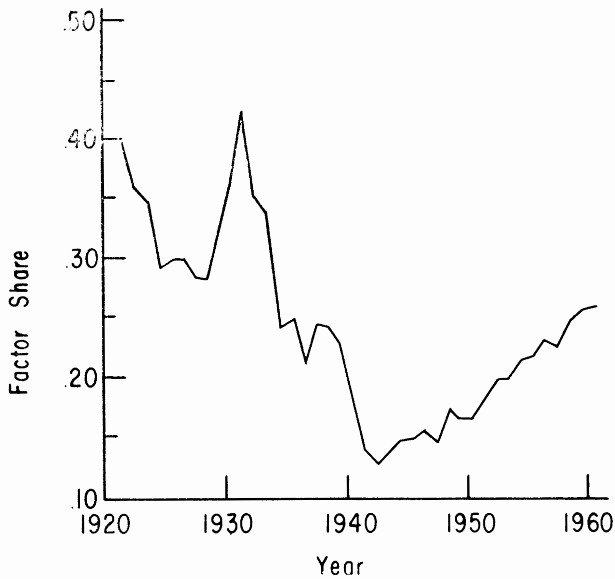

Figure 2. Real estate factor share of total farm products, U. S. 1922-1961[1]

[1]Computed from USDA, *Farm Income Situation* and *Farm Real Estate Market Developments.*

resources with only 93 percent of parity prices in 1962 if land prices were fixed at the 1940 level.[8]

In an environment of rapid capital gains such as near large cities, liquidity problems can stem from land appreciation. In spite of favorable long-run net worth, current earnings may be hard pressed to cover operating and living expenses after paying property taxes expanded by rising real estate values. This problem can be avoided by informed lenders who can use growing real estate equity as security for loans.

Impeding farm land adjustment to recreational, forest or other uses with higher "true" marginal value products and other consequences described above of inflated farm real estate values detract from economic efficiency. Other aspects of high land values contribute to economic efficiency. Land value appreciation can provide incentive for retirement from uneconomic units, an important equity base for purchase of additional land necessary to achieve scale economies, or funds for technologically improved inputs. To illustrate, consider the hypothetical

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[8]This conclusion is based on the assumption that land prices will remain stable at the specific year level and no direct income will accrue from capital gains or losses.

Table 3. Estimated Parity Price Ratio Necessary to Pay Real and Opportunity Costs of All Farm Resources, 1910-14 = 100.[1]

		Parity Required to Pay All Costs at:		
Year	Actual Parity Index	Current Land Price[2]	1940 Land Price	1950 Land Price
		(Percent of 1910-14)		
1950	101	123	118	123
1951	107	125	118	124
1952	100	123	116	120
1953	92	122	115	120
1954	89	119	113	116
1955	84	117	110	114
1956	83	113	105	109
1957	82	111	103	107
1958	85	108	99	103
1959	81	112	103	106
1960	80	107	98	101
1961	79	106	95	98
1962	78	103	93	96

[1]The percent increase in gross farm receipts necessary to cover all farm costs (see footnote 1, Table 2) including family labor (valued at the factory wage rate less farm income from off-farm sources) is multiplied by the current parity index.

[2]The land charge is the interest on the productive farm real estate value in the current year, i.e., 1950, 1951 . . . 1962.

owner of 100 acres valued at $200 per acre who has been extended all possible credit but wants to purchase an additional 20 acres to realize scale economies. Appreciation of land price to $250 per acre increases equity by 100 ($50) =$5,000, or enough to purchase the 20 acres at $250 per acre.

An average U. S. farm had 138 acres and a $5,463 real estate value in 1910 (Table 4). Assuming that this 1910 average farm is sold in 1940 or about one generation later for $4,376 (1940 prices), the capital loss is $1,087. The average 1920 farm of 148 acres, sold in 1950, has a capital loss of $653. Capital gains would be a sizeable $10,669 for an average farm purchased in 1930 and sold in 1960. Gains are an even more impressive $17,065 between 1940 and 1963. The implication is that this capital gain could provide cash or loan equity to purchase land, machinery, fertilizer, household items or a retirement.

Between 1940 and 1963, the value of all U. S. farm real estate rose from $33.6 billion to $143.6 billion, or $110.0 billion. Some of the land price appreciation reflects investment in capital improvements through irrigation, buildings, drainage and conservation. The cost of these improvements tends to be offset by land losses through leaching, erosion and cropping attrition. A correction for capital improvements on real estate (as was done in Table 1 but not in other tables) would reduce this capital gain below $110 billion. But it may be argued that a correction (precluded by lack of data) for land attrition through cropping and erosion would offset the capital improvement correction. Much of this

Table 4. Estimated Capital Gains for Average Size Farms Sold 30 Years (Except 1940) After Purchase.[1]

Purchase				Sale				
Year	Farm Size	Real Estate Value		Year	Farm Size	Real Estate Value		Appreciation
	(Acres/Farm)	($/Acre)	($/Farm)		(Acres/Farm)	($/Acre)	($/Farm)	(Dollars)
1910	138	39.59	5,463	1940	138[2]	31.71	4,376	—1,087
1920	148	69.37	10,267	1950	148	64.96	9,614	—653
1930	157	48.52	7,618	1960	157	116.48	18,287	10,669
1940	174	31.71	5,518	1963	174	129.79	22,583	17,065

[1]U.S. Department of Agriculture, *Agricultural Statistics*, 1963; and U.S. Department of Agriculture, *Farm Real Estate Market Developments*, CD-64, August, 1963, p. 41.
[2]The 1910 average size. The farm size shown for 1950 was the 1920 average, etc.

capital gain remains as paper profit, has been realized and spent for consumption items, or has been invested in the nonfarm sector. However, some capital gains have been directly invested in farm machinery, fertilizers, etc., or have provided the credit base for such purchases by initial landowners. Land price increments have been a form of saving for many owner-operators who realized that capital gains were providing security for emergency use or retirement, and hence current income could be used to purchase operating inputs which raise farming efficiency.

High land values have become an important barrier to entry in farming. Average real estate investment per farm, only $5,518 in 1940, rose to $37,266 in 1963. After allowing for depreciation and interest plus all other costs except family labor, the residual income per family worker in 1940 was $509; in 1962 was $1,065. Arbitrarily assuming that one-half of this residual is applied to the real estate investment, then 22 years are required to repay the 1940 investment, but 70 years are required to repay the 1963 investment out of farm receipts alone. The 1963 duration is longer not only because land prices are higher, but also because farms are larger. If capital gains occur in the future as in the 1940-63 period, the 1963 principal will be easier to repay than indicated. Many young farmers have been "encouraged" to learn new skills and obtain non-farm jobs because of high "entrance" requirements in farming—a decision they may not have regretted and would have eventually made even at lower land prices but only after an unsuccessful tenure on an inadequate farming unit.

The incidence of capital gains from farm real estate and other fixed assets depends on who are the debtors and creditors. Periods of capital gains redistribute real wealth from creditors to debtor-owners. Some would consider this redistribution of real income—often from the older, financially adequate, nonfarm creditor to the younger, less prosperous farmer debtor—consistent with increased welfare of society. Boyne (3, p. 62) found that farm operators were net debtors at the beginning and end of the 1940-60 period but were net creditors from 1943 to 1958. Capital gains during that period represented real wealth losses to operators as net creditors. Estimated net real wealth losses to farm operators were $4.42 billion 1960 dollars ($175 for each member of the farm population) during the 1940-60 period.

Possible Sources of Recent U. S. Land Price Trends

Knowledge of the sources of the recent trends in farm land values is important. For example, if the land price increments are generated by competition for future *speculative* gains without any basis in land earnings—then the foundation for current land prices would be indeed weak. The speculative price trend would need to be arrested by informing investors of risks involved in a market held up by unwarranted expectations.

Should it be found that current prices are justified by productive earnings gained from control of the land factor, the conclusion and recommendation might be to encourage rather than restrain the market mechanism—a system prized for allocating factors toward a Pareto optimum and for rewarding factors according to their contribution to value of output.

If capitalization associated with farm commodity programs is found to be the major source of recent price increments, then a reappraisal of farm commodity programs may be in order. An emphasis on programs minimizing inflation of land values could mean more income for the beginning farmer or new owner to spend on household and operating items rather than on real estate interest and principal.

On the other hand, if it is found that farm consolidation, urban expansion, etc. rather than commodity programs have contributed to land price increments, policy inferences might be quite different. The inference that the land price inflation would have occurred in the absence of commodity programs leads to the conclusion that income to pay household and operating expenses then would have been very low indeed for the beginning owner-operator in the absence of government supports. This conclusion might support the continuation of price and income programs.

These above inferences would not necessarily be those of policy-makers, but are intended to illustrate some of the potential value of knowing the sources of land price trends. The remainder of this study is focused on sources of recent land price trends. Hypotheses potentially explaining the formation of land prices are presented below.

Net Farm Income

Theory suggests that land price would be closely tied to net farm income (cf. 9, 15). Land prices reflect expected future earning power of land, and such expectations would likely be formulated from past or present earnings.

The relationship between net farm income and land prices is apparent from cross sectional data. Scofield (16) used state data to estimate the elasticity of land price with respect to net farm income per acre for three time periods. A one percent increase in net income per acre resulted in an .84 percent increase in land price in the 1936-40 period, an .82 percent increase in land price in the 1951-53 period and a .75 percent increase in land price in the 1961-63 period. These coefficients statistically were highly significant. While net farm income does have an impact on land prices according to these data, the effect appears to be declining secularly. Scofield's analysis using cross sectional income data explained 86 percent of the variation in land prices among states in the 1961-63 period.

But farm income data are less effective in explaining historical land price variation over an extended period. Income effects are confounded with many other factors (discussed subsequently) through time. Also it is not current net income, but expected earnings from ownership of land that motivates buyers.[9] Many considerations are involved in formulating these expected earnings, and not all can adequately be quantified or otherwise included in a statistical model.

Whether the trend in land values is speculative or is tied to production earnings can be judged at least partially from rents. Rents can be expected to reflect earnings or value added by control of the land resource. Rents would not be expected to contain the speculative element built into land prices.

[9] The value V of a perpetual income flow I discounted to the present at rate r is $V = I/r$, where V is called the present, discounted or capitalized value. If annual income *increments* i are anticipated, the formula becomes:

$$V = \frac{I}{r} + \frac{i}{r^2}$$

V is highly sensitive to i since the denominator r^2 is very small. For example if r is .05 the value of i/r^2 is \$400 if $i = \$1$. Thus even an anticipation of small annual income increments such as \$1 per acre can have a very significant impact on land price. The value of i may be based on expected gains from productivity, inflation or supply-demand conditions.

The ratio of net rents to the market value of U. S. rented land decreased from 4.4 percent in 1955 to 3.6 percent in 1962, according to USDA data (29, Aug. 63, p. 22). Another measure of land return, the ratio of cash rent per acre to land value on Midwest farms, has trended upward since 1940.[10] However, in the last decade the rent-to-value ratios have remained nearly stable. The conclusion is that recent land price trends appear to have some economic foundation stemming from improved technology, scale economies through consolidation and other earnings factors which are reflected in rents. The presence of some purely speculative element cannot be ruled out, however.

Farm Programs

Control of the land resource has been used in recent years as a public instrument to raise farm prices and incomes. Output restrictions, coupled with an inelastic demand for farm commodities, effectively raised farm income (cf. 21). Economic theory and observed behavior suggest that the monetary benefits of federal programs controlling land would be capitalized into land values over time. This tendency has been cited as one hypothesis explaining the rise of land values in recent periods of falling or nearly stable farm commodity prices and net income.

Regression analyses of individual farm sales reveal significant values for allotments: estimated to be $1,139 per acre for tobacco, $669 for peanuts and $463 for cotton in northeastern North Carolina (11, p. 1751) and up to $2,500 per acre of tobacco allotment in east central North Carolina (14, p. 39). Analysis of Virginia (2, p. 22) data from 1956 to 1960 showed that an additional acre of peanut allotment added $565 to the sale value of a farm. The same study (2, p. 26) revealed that one additional acre of flue-cured tobacco allotment in Pittsylvania County, Virginia, contributed $2,040 on the average to the farm sales price. Even sizeable per acre values for peanut and tobacco allotments would not make a substantial contribution to total U. S. land values because relatively few acres are involved.

Linear programming studies have also indicated sizeable marginal income potentials from the acquisition of allotments. Hall (7) found the marginal value product (MVP) of one acre of wheat allotment to be more than one-half of the MVP of the best class of land without an allotment, and greater than the land MVP's on the two poorest land classes considered in the Oklahoma Panhandle.

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[10]See (29, October, 1964, p. 45). Cash rent, as a proportion of land value, has averaged approximately seven percent since 1961 in 12 Midwest states.

The annual value of one additional acre of corn allotment on 15 southern Iowa farms averaged $10 and on four northern Iowa farms averaged $20 (10). An additional acre of cotton allotment in southwest Oklahoma averaged $17 on six representative farms under 1961 conditions (19). If capitalized in perpetuity at five percent, the value of these allotment acres would be 20 times as large.

These above estimates may distort the marginal contribution of allotments to total land values, however, because the allotment system depreciates the value of nonallotment land, assuming farm income would be held at the same level by other nonallotment type programs. Restricting the crop alternatives on land not covered by allotments reduces the value of this land. With other systems of price supports, the reduction in value of allotment acres would be offset partially by an increase in value of nonallotment acres.

From Table 5 it is apparent that farms characterized by allotments have experienced greater land price appreciation since 1950 than have ranches which are not directly involved with allotments. Appreciation from 1950 to 1963 ranged from 20 to 44 percent on five typical ranches and from 60 to 147 percent on typical farms. The data support the hypothesis that the allotment system has tended to inflate land prices, although the differential impact of technology may also be a factor.

Table 5. Trends in Land Values for Selected Farms, by Type and Location, 1930-1963.[1]

Type of Farm	1930	1940	1950	1963	Increase 1950-63
	(Current Dollars/Acre)				(Percent)
Central northeast dairy	37	30	60	100	67
Southeastern Minnesota dairy-hog	96	62	107	210	96
Corn Belt hog-beef fattening	133	79	173	286	65
Corn Belt cash grain	149	125	236	431	83
Southern Piedmont cotton	26	23	57	116	104
Texas black prairie cotton	84	51	97	167	72
So. Coastal Plain peanut-cotton	[2]	[2]	38	94	147
No. Carolina Coastal Plain tobacco-cotton	[2]	55	140	234	67
Kentucky tobacco-livestock	[2]	[2]	260	422	62
No. Plains wheat-small grain-livestock	27	14	29	55	90
So. Plains wheat	42	27	68	109	60
Pacific northwest wheat-fallow	24	20	52	88	69
No. Plains cattle ranch	6	3	9	12	33
Intermountain cattle ranch	12	9	16	23	44
Southwest cattle ranch	[2]	3	10	12	20
Northern Plains sheep ranch	6	3	7	10	43
Southwest sheep ranch	[2]	5	11	14	27

[1]Wylie Goodsell and Isabel Jenkins, *Costs and Returns on Commercial Farms*, U. S. Department of Agriculture, Statistical Bulletin No. 297, Washington, D.C., 1963 and subsequent annual issues.
[2]Not available.

If farm benefits of commodity programs are soon lost through land value appreciation, then inflated land values are indirectly maintained through lower farm income, higher consumer food bills, or public taxes—from funds that farmers, consumers and taxpayers might prefer to use elsewhere.

The redistribution of income stemming from capitalization of commodity program benefits into land prices may not be consistent with the goals of society. The owner of farmland at the time a government income support program tied to land is initiated tends to receive the entire expected monetary benefits of the program. The benefits are received in two parts: (a) annual income from price supports or provisions to grow crops while the initial owner retains title, and (b) the discounted value of all expected future earnings that will accrue from the support program through land ownership. Sale of the land brings benefits (b) to the initial owner since the new owner will receive the same net income whether he pays the discounted value of future earnings from allotments or buys a similar farm without allotments.

If annual benefits from allotments are A and the interest rate is r, the discounted value of allotment acres in perpetuity is A/r. The interest on this value is r (A/r), or the annual allotment benefit A per year. It follows that the buyer can pay the seller as much as the discounted value of future benefits and still have as high a return as purchase of similar land without an allotment. The seller receives a substantial "reward." But, since the buyer pays real or opportunity interest equal to annual benefits, the intended income benefits are lost to him. In a perfect market with complete knowledge, this type of income redistribution occurs. With future land price appreciation, the new owner discussed above can later sell and also reap rewards. But this process cannot continue indefinitely, at least not without accelerating transfer payments to farmers at public expense to maintain artificially high land prices.

The capitalization of program benefits into land prices redistributes income in at least two directions. First, the *seller* who realizes the benefits of the support program often is the older farmer with adequate assets and income. The *buyer* who must pay the interest on inflated land prices often is young and possesses limited assets. The young farmer's income is needed to purchase operating inputs and pay living expenses. Second, the seller very often either is moving off the farm or is already living in town. The income redistribution of government support program lost through real estate appreciation is likely to be regressive in both of the above instances. Of course in many instances expectations are incorrect or the initial owner bequests the land (or sells at very low prices) to his heirs so that the income benefits of the support program are not lost to farmers after the first generation.

Farm Consolidation

The proportion of all farm purchases made for farm enlargement varies among regions, but has consistently increased in all regions of the U. S. in recent years. This proportion has nearly doubled in a decade, rising from 26 percent in 1950-54 to 48 percent in 1963 for the 48 contiguous states (29, Apl. 64, p, 12). In the wheat areas, the increase was from 48 to 74 percent in the same period, indicating above average pressures for consolidation.

Farm consolidation has been especially pronounced during the recent period of real estate price increases, suggesting a relationship between the two phenomena. The farmer investing in labor-saving equipment usually buys a larger or more efficient machine than owned previously and eventually finds that he owns excess machine capacity for the land he operates and the labor supply provided by the family. Already owning the machinery and controlling the labor, he budgets the buying price he can afford to pay for additional land at a higher rate than the "whole-farm" buyer who does not have an existing unit to absorb the fixed costs of equipment and labor (cf. 13, 19, 22).

The tendency for individual farm demand for land to stimulate prices can be illustrated with a simple example. Suppose a farmer operates 200 acres at average operating costs of $30 per acre and non-land overhead (machinery, other inventories, operator and family labor) of $10 per acre. Assuming gross returns of $55 per acre, the $15 remaining residual to land capitalized at five percent suggests a 15/.05 = $300 land price per acre. Suppose the farmer has the opportunity to purchase a contiguous 40 acre unit. He can farm it with little increase in family labor, machinery and buildings, hence his overhead on the new unit is reduced to $5 per acre. Land residual on the marginal unit is $20. Capitalized at five percent, the land is worth $400 per acre—one-third more than the "home" unit per acre.

Average costs per acre decline as more land is farmed. These scale economies not only justify a higher land price on a consolidated unit, but also mean that farmers who currently have adequate size units may be making sizeable profits to be used for land investment despite low average returns for the farming industry. (This is apparent in Table 9 to be discussed later). The home farm also is a useful credit base, giving the consolidating farmer even more impetus in the land market.

Excess Labor in Agriculture

Excess labor in agriculture provides another explanation of rising land values. This theory is based on land scarcity relative to the number of people who want to farm. Accumulation of excess labor and consequent competition for available farming units forces those who remain to pay more and more for control of land and therefore to accept lower residual returns to their labor and management. Excess labor constitutes up to 50 percent of the farm work force (25). If all males born on farms "demanded" a farming unit upon reaching age 20, these youths would not find sufficient farming opportunities (Table 6). Table 6 shows that the ratio of total farm transfers to potential farm operators has decreased in recent years, accelerating competition for available units.

Transfers for consolidation do not represent opportunities for new starts in farming. Approximately half of all farm transfers are single farm units not for consolidation. This rate implies that about 20 percent of potential farmers can acquire single units currently. Considering the fact that many of these acquired units are uneconomic, and that the trend is to fewer transfers for single units; only about 10 to 15 percent of farm youths can be expected to find adequate farm opportunities in the future (cf. 18). The result will be continued competition for available units.

Capital Gains

Capital gains can be a self generating mechanism underlying land price appreciation. A negative residual income to real estate from farm production need not *necessarily* concern the speculative buyer—not if

Table 6. Farm Transfers and Potential Requirements for Farms, 1955-63.

Year	Farm Transfers: All	Farm Transfers: Excluding Consolidation (A)	Potential Requirements for Farms[1] (B)	Transfers/ Requirement Ratio A/B
	(Thousands)		(Thousands)	
1955	201.0	136.7	354	.39
1956	205.6	137.8	352	.39
1957	188.9	117.1	352	.33
1958	180.9	108.5	355	.31
1959	172.5	100.0	355	.28
1960	163.3	89.8	331	.27
1961	148.9	80.4	338	.24
1962	148.5	80.2	350	.23
1963	140.2	72.9	322	.23

[1]Estimated demand for farms based on all farm males born on farms "demanding" a farm at 20 years of age.

Data from U. S. Department of Agriculture, *Farm Real Estate Market Developments*, CD-64, August, 1963, p. 17; and *Farm Population*, ERS-130, October, 1963, p. 23.

the sale price will be sufficient to cover the purchase price plus operating losses, and leave a satisfactory return for risk and capital. Current capital gains can establish speculative expectations of future gains irrespective of earnings from production.

The estimated average residual return to farm real estate was 2.45 percent between 1958 and 1962 (Table 7). This is well below opportunity cost investment returns until capital gains are included. The average combined income plus appreciation return is 7.3 percent for the same period. Investors conceivably might compete in the market for such favorable returns.

Speculative investment of this type is hazardous since a change in farm programs or other shock could reverse land price trend expectations. The result could be further regressive income redistributions as the equity of beginning farmers and other vulnerable groups is eroded and assets are acquired by more financially adequate survivors.

Table 7. Estimated Rate of Return on Farm Real Estate from (1) the Income Residual from Farm Production, and (2) Appreciation in Value.

		Returns to Productive Real Estate Assets		
Year	U.S. Real Estate Value Excluding Dwelling	Income Residual to Land[1]	Appreciation	Total
	(Bil. Current Dols.)	(Percent of Current Land Value)		
1940	28.1	3.7	2.5	6.2
1941	28.8	26.5	9.4	35.9
1942	31.5	14.7	11.1	25.8
1943	35.0	13.3	16.3	29.6
1944	40.7	8.1	12.0	20.1
1945	45.6	6.7	13.8	20.5
1946	51.9	10.0	12.9	22.9
1947	58.6	8.1	7.8	15.9
1948	63.2	10.0	4.1	14.1
1949	65.8	2.7	—1.8	.9
1950	64.6	6.3	16.1	22.4
1951	75.0	7.7	10.7	18.4
1952	83.0	5.4	1.1	6.5
1953	83.9	3.1	—2.0	1.1
1954	82.2	2.8	4.4	7.2
1955	85.8	2.0	5.9	7.9
1956	90.9	2.2	7.8	10.0
1957	98.0	2.3	4.7	7.0
1958	102.6	3.8	7.5	11.3
1959	110.3	1.1	5.2	6.3
1960	116.0	1.8	1.3	3.1
1961	117.5	2.6	5.1	7.7
1962	123.5	2.9	5.1	8.0

[1]Expenses include all operating costs, depreciation and interest charges on all capital, plus family labor valued at the hired labor wage rate. The return indicated in *Farm Real Estate Market Developments,* August, 1963, p. 21 is lower because family labor charges are based on *man hours,* not on *employment* as in this study and because of differing interest rates, etc.

One point of view holds that farm land (and other durable capital assets) are attractive investments as a tax haven and as a "store of value" against the effects of inflation. Long-term capital gains are taxed at one-half the rate on ordinary income but numerous other investments including common stocks receive similar tax treatment.

Since 1950, appreciation of land values has not kept pace with appreciation of common stocks in at least three major industries: (a) manufacturing. (b) trade, finance and services and, (c) mining (Figure 3). The trend was similar for the four investment alternatives from 1940 to 1950. By 1964, however, even mining (like agriculture sometimes labeled a "depressed" industry) showed considerably more opportunity than farm real estate for capital gain through stock appreciation. The compound annual rate of growth in the index of stock prices between 1950 and 1964 was as follows: 11 percent for manufacturing; 9 percent for trade, finance and services; 9 percent for mining, and 5 percent for farm real estate. Considering the fact that since 1950 common stock dividends have average 4.3 percent (5) versus 3.4 percent income residual to land (Table 7) farm real estate has not been a profitable alternative either using a direct income or capital gains comparison.

Rates of returns (excluding capital gains) were higher for industry than for farmland investment but the gap closed slightly between 1953

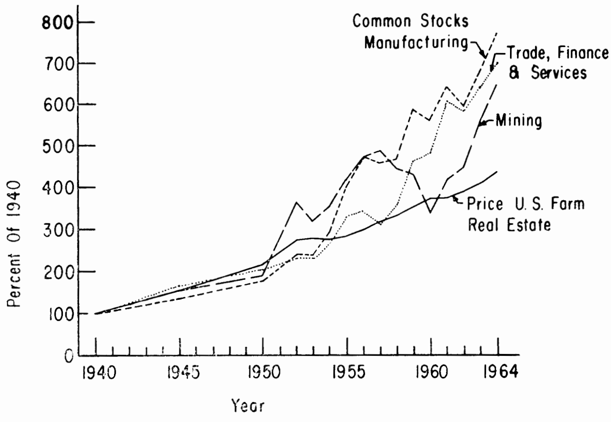

Figure 3. Trends in the index of stock prices in three industries and farm real estate.

Source: *Statistical Abstracts of the U.S.* 1955 and subsequent issues, SEC data. Also, *Farm Real Estate Market Developments,* March 1964.

to 1962. The narrowing gap may have redirected some capital from industry to farmland and stimulated land values. The variation in common stock capital gains among firms is perhaps greater than variation in real estate appreciation among farms, enhancing the attraction for farm real estate investment. Nevertheless comparing the outlook for long time earnings in agriculture with other industries and consequent implications for capital gains, investment in farm real estate that will depend on earnings only from agricultural use would appear to be unattractive economically to the nonfarmer.[11]

Population Pressure

A growing population expands demand for land indirectly through increased food requirements and directly through conversion of farmland to urban housing, airports, roads, etc. Population growth at the rate of 1.6 percent annually can be expected to increase food requirements at least by a similar rate. Other things equal, greater food requirements would be expected to increase land demand and farm real estate values.

A comprehensive study (30) of land resources and anticipated needs has predicted that 15.8 million acres will be shifted to urban and built-up uses between 1958 and 1975. This is equal to more than the combined area of Rhode Island, Delaware, Hawaii, Maryland, and New Jersey.[12]

A comparison of percentage changes in population (31, p. 11) in the states between 1950 and 1960 with the percentage changes in land price (29, Aug. 63, p. 38) between 1950 and 1963 indicates that where population is expanding rapidly, real estate prices have shown a marked advance. This cause-effect relationship does not hold completely. Nevada exhibits a 79 percent increase in population (U. S. average 19 percent) with an 84 percent increase in land price (U.S. average 90 percent), while Arkansas experienced a 128 percent land price increase with a 6.5 percent net loss in population. Mushrooming population in a limited area has a pronounced effect on farm real estate prices, but other important factors are at work in the farmland market.

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[11]Many nonfarmers invest for noneconomic reasons, of course.

[12]The long-run urban requirements are impressive. Assuming a 1.6 percent annual growth rate, the U.S. population would multiply 1,000 times to 190 billion people in 432 years (approximately the same time span since the first Spanish white settlement in the U.S.). Assuming .1 acres per person (a reasonable current standard for urban housing, working space, recreation, etc.), land in the U.S. including Alaska and Hawaii totaling 2.3 billion acres is enough to support direct urban land requirements of 23 billion people. Agricultural needs must be added to this urban requirement, of course. Assuming an annual growth rate of 1.6 percent, and direct urban land requirements of .1 acres per person, all U.S. land would be utilized in 300 years.

Changing Farm Technology

Farm technologies have opposing effects on land prices. Mechanical innovations such as specialized, expensive machines often require large farming units to achieve scale economies. Efforts to secure sufficient acreages to achieve size economies tend to raise land prices.

Biological innovations on the other hand probably cause a secular decline in land prices, *ceteris paribus.* Direct and indirect population pressures for more farm land and higher land prices are offset by substitution of fertilizer, irrigation and other capital inputs for land. Assuming each ton of the 9.5 million tons of fertilizer nutrients applied in 1963 added production equivalent to that on 15 unimproved cropland acres, then fertilizer broadly "added" 142 million cropland acres.[13]

The tendency for capital inputs to substitute for land is one factor responsible for a projection that by 1975 cropland will be reduced by about 2.5 percent, pasture-range will increase by about 2.5 percent, forest-woodland will decrease 2.25 percent and urban built-up area will increase by 31.2 percent (30). Total agricultural and forestry use is predicted to change less than one percent. The use of fertilizer, irrigation, improved varieties, pesticides, etc., can increase the effective land supply, and can more than compensate for rising land demand—thus lowering land price.

The effect on land prices of decreasing production costs through scale or innovation can be quite different at the micro (firm) and macro (national) level. The land buyer, likely to visualize only the short-run micro impact of increased farming efficiency, can easily be mislead into overpricing land.

A one percent increase in output (due to improved production inputs, better farming practices, increased scale or specialization) causes a percentage change in net farm income as specified by the following equation from Tweeten and Plaxico (23):

$$(1)\quad E_N = \frac{TR}{NR}\left(1 + \frac{1}{E}\right) - \frac{TC}{NR} E_c$$

TR = Total gross farm revenue

TC = Total farm production cost

NR = TR — TC

E_N = Elasticity of NR with respect to output

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[13]The U.S. Department of Agriculture (cf. 4, p. 23) estimated that each ton of fertilizer substituted for about 19 acres of cropland in the 1951-55 period. Currently about 330 million acres is classified as cropland used for crops.

E = Elasticity of demand for farm output with respect to farm product price

E_c = Elasticity of farm costs with respect to farm output

If land price P is proportional K to net farm income, as in equation (2),[14] then

$$(2) \quad P = K \bullet NR$$

and the elasticity E_p of land price with respect to output in equation (3) is equal to E_N, providing that K (which may be the inverse discount rate or inverse interest rate) is independent of changes in output q resulting from technology. Equation (3) then becomes equation (4). Many changes in farm technology leave total costs unchanged as output expands so that $E_c = 0$. Capital often is not reduced, only shifted among uses.

$$(3) \quad E_p = \frac{dP}{dq}\frac{q}{P} = \frac{d(K \bullet NR)}{dq}\frac{q}{K \bullet NR} = \frac{dNR}{dq}\frac{q}{NR} = E_N$$

$$(4) \quad E_p = \frac{TR}{NR}\left(1 + \frac{1}{E}\right) - \frac{TC}{NR}E_c$$

In recent years, farm productivity has advanced so that output has increased between one and three percent annually with total costs quite stable. Assume for Mr. Average Farmer the low end of this productivity advance, one percent per year. Further assume that like average U. S. farmers in recent years, his ratio of total revenue to net revenue is three. Then if $E_c = 0$, equation (4) becomes equation (5). What Mr. Average

$$(5) \quad E_p = 3\left(1 + \frac{1}{E}\right)$$

Farmer markets has an imperceptible influence on market prices so his elasticity of demand is infinite ($E = \infty$). Hence $E_p = 3$ (Micro response of land price to technology) and annual increments in his farm productivity justify annual *increments* of three percent in land price.

But with the same types of changes in technology repeated over the nation, the macro effect is important. At the industry level E is no longer

[14]This would be true for example if land price is the capitalized value of net farm revenue. With net earnings, capitalized in perpetuity at the discount rate r, the land price is:

$$P = \frac{NR}{r}, \text{ and } K = \frac{1}{r}.$$

infinite. A one percent increase in aggregate output depresses prices received by farmers four percent if the price elasticity of demand for U.S. food and fiber E = —.25. Assuming the same ratio of total revenue to net revenue as above, then $E_p = 3\left(1 + \frac{1}{-.25}\right) = -9$ (Macro response of land price to technology). When all farmers have made the adjustments and increased productivity one percent as did Mr. Average Farmer, the result is depressed gross and net income that justify a nine percent *decrease* in farm land prices.

These macro effects become increasingly important as technology becomes generally adopted. The implication is that farmers acting individually view increasing productivity as justification for considerably higher land prices. But as many farmers follow this pattern, improved technology results in lower rather than higher prices, other things equal. Farmers who do not recognize this macro relationship, and especially late adopters who are unable to reap their income gains before the macro effects become important, may endanger their equity by paying too much for farmland. Farm income support programs have cushioned this macro effect of technology to a sizeable extent.

Nonfarm Investors

The nonfarm investor is a possible factor in the rising farm real estate price structure. Nonfarmers become owners of farm real estate through inheritance, gift, or mortgage default so that a change in the nonfarm ownership of farmland does not necessarily reflect competition for farmland or profitability of farm real estate to nonfarmers. When farm migration is high, and especially when it accelerates, a substantial amount of farm property is passed to nonfarmers who are: (a) sons and daughters of farmers, and (b) retired farmers or other owner-operators who leave the farm for a nonfarm job. During periods of farm depopulation, nonfarm ownership is likely to rise, other things equal.

Real estate dealer reports on the farmland market have indicated reduced activity in farm real estate by nonfarm investors. Between 1955 and 1963, acquisitions by nonfarmers dropped from 38.2 to 31.0 percent of the farms transferred (Table 8), and their participation in sales increased from 14.6 to 24.9 percent of all sales made, as estimated by the U. S. Department of Agriculture (29, Dec. 62, p. 12). The *Census of Agriculture* (26, p. 1042) reports an increase in owner-operated acreage from the depression low of 49.0 percent to 59.7 percent in 1954 and only a

Table 8. Percentage Distribution of Farm Real Estate Buyers in U. S. Transactions, 1955-63.[1]

Buyer	1955	1956	1957	1958	1959	1960	1961	1962	1963
					Year (Percent)				
Tenant	24.1	21.7	19.9	20.0	18.4	16.2	16.6	17.0	14.9
Owner-Operator	38.7	37.9	39.9	39.8	41.4	46.9	48.1	47.9	51.0
Retired Farmer	4.4	4.9	4.3	5.2	4.0	3.1	3.2	2.9	3.1
Nonfarmer	38.2	35.5	35.9	35.0	36.2	33.8	32.1	32.2	31.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1]*Farm Real Estate Market Developments*, 1957 and subsequent issues.

slight decline to 59.5 percent in 1959. Average annual net investment by nonfarmers in farm real estate fell from $312 million in 1950-54 to $232 million in the 1955-61 period. (17, Table 4). It is apparent from Table 8 that the owner-operator is becoming the dominant force in the land market at the expense of the tenant farmer and nonfarmer.

Two reasons for reduced participation of nonfarm investors in the farm real estate market are: (a) rates of returns from crops and livestock or rents on farmland have not been lucrative in relation to returns in other investments, and (b) uncertainty about farm programs and the duration of inflationary trends in land values. Average returns from 1958-62 on farm real estate excluding appreciation was only 2.45 percent (Table 7).

Changing Financial Structure

The equity position of farmers places restraints on ability to finance land purchases. Farm real estate debt as a percent of farm proprietor's equities was high in the 1930's and stood at 15 percent in 1940 (5). It declined sharply with favorable terms of trade for agriculture in the 1940's and reached a low of 4.3 percent in 1949.

This favorable debt position could be expected to reduce credit restraints and promote competition for farming opportunities through land purchase. Land prices increased and farm real estate debt as a percent of proprietor's equity increased to 10 percent by 1965. This equity position is considerably more favorable than in 1940, but undoubtedly puts some restraint on land purchases and prices.

Farm real estate debt as a proportion of total farm debt dropped from 66 percent in 1940 to a low of 45 percent in 1950. The proportion remained nearly stable for several years. It is notable that in 1965, real estate had increased to 49 percent of all farm debt despite the substantial growth of non real estate capital and a nearly stable physical volume of farm real estate.

Changes in finance structure to broaden asset ownership per unit of income or equity include an increasing proportion of land sales for credit. Less than half of all transfers were credit financed in the early 1940's. From March 1, 1955 to March 1, 1961, a stable two-thirds of all land transfers were credit financed. The balance, one-third, were cash transactions. In the year ending March 1, 1962, 71 percent of all transactions involved credit. The following year ending March, 1963, 73 percent were credit financed (29, Apl. 64, p. 17).

Major adjustments have been made in the form of credit financed transfers—notably the shift to land contracts. In 1956, 37 percent of all credit transfers were financed by sellers. This percentage increased to 43 in 1958 and 1959; then declined to 38 percent in 1963. Seller financing was principally under land contract. The use of land contracts rose in all regions. The percentage of farm sales made under installment land contracts has increased almost every year since USDA estimates of the variable were started in 1946 (29, Aug. 64, p. 28). It was the instrument of transfer in 25 percent of all sales in the year ending March 1, 1962, 30 percent in March, 1963, and 29 percent in March, 1964.

Reasons from the sellers' standpoint for expanded use of land contracts as opposed to conventional mortgages include (a) tax savings, (b) more security in the event the buyer cannot meet obligations, (c) higher land prices, and (d) higher interest rates. Results of a USDA survey tend to be consistent with (c) and (d). Respondents indicated that land prices may average 10 percent higher when sold under land contract (29, Aug. 64, pp. 19-22). Lower down payment requirements increase the potential number of buyers and attendant competition for land.

The advantage to the buyer is low down payment, thereby extending his opportunity to control large holdings of land to achieve scale economies with less equity. Down payments in the year ending March 1, 1963 averaged 23 percent under land contract, and 32 percent under mortgage transfers. The above changes in the structure of real estate finance undoubtedly have contributed to higher land prices.

Income Distribution

One hypothesis cites a widening distribution of income and equity in agriculture as an important source of demand for land. The argument is that early innovators and farmers in a position to obtain windfall gains from commodity programs and capital gains have prospered and improved their financial condition despite falling *average* income for farmers as a group. These relatively few farmers with a favorable financial position have maintained a strong demand for land and pushed real estate values to levels that do not appear justified based on expected future earnings on the average farm.

Sizeable scale economies in agriculture are apparent from Table 9. In 1960, average residual farm income on Class I farms to family and operator labor, management and risk was a substantial $17 thousand (gross income less all nonlabor costs, including hired labor wages, operating expenses, interest and depreciation on all capital in land, machinery, etc).

Farmers in Class I and II comprised only 10 percent of all operators, but sold 53 percent of farm products and had 40 percent of productive farm real estate. In a land market where two percent of the land is sold each year, these few farmers with a positive economic rent can be an important force (1, p. 1253).

Other Factors Determining Land Price

The extent to which farmers impute income to their own labor and nonland resources and how much they attribute to land cannot be directly determined. Income data usually reported do not account for the cost of family labor and owned real estate except for taxes and interest on farm mortgages. Imputing a cost to all farm real estate is a somewhat arbitrary process. Only by making certain assumptions can we separate returns to farmland and other resources. In a period of falling gross farm income,

Table 9. Selected Characteristics of U. S. Farms by Economic Class in 1960.[1]

	Economic Class of Commercial Farms						Noncommercial
	I	II	III	IV	V	VI	Farms
			(Dollars Per Operator)				
Sales	40,000 and over	20,000 to 39,999	10,000 to 19,999	5,000 to 9,999	2,500 to 4,999	50 to 2,499	[2]
Labor income[3]	17,384	8,373	4,702	2,861	2,389	537	2,496
			(Percent of U. S. Total)				
Share of:							
Value of farm products sold	33.3	19.6	22.1	13.9	6.3	1.4	3.3
Real estate[4]	21.7	17.9	21.6	16.1	8.6	2.2	11.8
Farm operators	3.2	7.0	15.1	18.2	16.7	9.4	30.4

[1]From Luther Tweeten, "The Income Structure of Farms by Economic Class," *Journal of Farm Economics*, 47:207-221, May, 1965.

[2]Includes part time, part retirement and abnormal farms.

[3]The return to family and operator labor, risk and management. All real and opportunity costs for operating inputs, durables, land plus hired labor deducted from value of farm products sold, nonmoney income plus off-farm income.

[4]Does not include farm dwelling.

the farm income imputed to land and the level of land prices may be rising because of structural changes affecting efficiency of farm production and marketing, and the marginal product of land. Our tools are not sufficiently precise to test all these hypotheses in later sections as factors explaining recent land price changes. However, structural changes that might influence indirectly the earning power of land are introduced through land retirement, farm size (numbers) and other variables.

An Economic Model of the Land Market

Factors potentially explaining land price movements were discussed above, partially to provide background for the following econometric model, but also to bring out relationships that cannot be adequately qualified and included in the following model. Before presenting the equations in the land price model, the variables are defined below.

The Variables

The variables are for the U. S. and are as follows:[15]

A = Number of farms, in thousands,

C = Cropland used for crops, million acres,

C^*_g = Capital gains on farm real estate, $C^*_{gt-1} = .5C'_{gt-1} + .33C'_{gt-2} + .17C'_{gt-3}$ where C'_g is capital gain taken from Table 1,

E = Employment, national nonfarm, in millions,

F = Net farm income, in billion dollars (Gross farm income less production expenses),

JX = Ratio of average earnings per employed factory worker Y_n to the average income per farm worker Y_w modified by the nonfarm unemployment rate U; $JX_{t-1} = \dfrac{Y_{nt-1}}{Y_{wt-1}}(1 - 5U_{t-1})$,

L_r = Land retired from production by government programs, million acres,

L = Land in farms, in million acres,

P = Price of U. S. farm real estate (land and buildings) per acre, index 1957-59 = 100, deflated by the wholesale price index, 1957-59 = 100. The average per acre value of real estate was $104 in the 1957-59 period, hence one index point in P is equal to $1.04 (1957-59 dollars),

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[15]For sources and additional description of data see (15).

r = Rate of return on nonfarm investment. Standard and Poor's data on common stock dividend divided by market value of stock, in percent,

S = Stock of machinery, beginning year, in million 1957-59 dollars,

T = Transfers of farm real estate per 1,000 farms, and

T_2 = Dummy variable equal to 1 from 1942 to 1948, zeros elsewhere.

The ten foregoing hypotheses (subheads in the previous section) and the variables used above to represent them, albeit imperfectly, are as follows: (1) Net farm income: F, (2) Farm programs: Lr, and an income component due to farm programs through F, (3) Farm consolidation: farm numbers A and the effect of machinery through S, (4) Excess labor: no explicit variable, but reflected partially through JX, and S, (5) Capital gains: C^*_g, (6) Population pressure: indirectly through E, and through F which reflects increased demand for food on farm prices and farm income, (7) Changing farm technology: through productivity per acre and time trend variables, which were included but not retained in the following model, (8) Nonfarm investors: r and indirectly, E, (9) Changing financial structure: the interest rate on farm mortgages, the ratio of real estate debt to equity, the quantity of liquid assets, and the proportion of real estate debt held by various lenders (all found insignificant and dropped from the following model), and (10) Income distribution: not quantified explicitly, only reflected indirectly in variables such as the time trend.

The following model is a composite hypothesis explaining the process through which land prices materialize. The term "hypothesis" is used because no single specification of the land market economic model is widely accepted by economists. The model below is designed more nearly to aproach reality than some earlier specifications of a single land price equation (cf. 9). However, limitation of the specification suggest the model and estimates therefrom be regarded as methodological. The model basically is predictive, but is intended also to have some structural validity.

The 5-Equation Model

The land price or land demand equation is specified as equation (6),

(6) Land price $P_t = f(L_t, T_t, A_t; X_i, P_{t-1})$

where variables to the left of the semicolon are endogenous. X_i refers to predetermined variables affecting land price in the current year. The lagged land price variable represents past effects on land price in a distributed lag model.[16]

The land price equation (6) is the first specified in the 5-equation recursive model for agriculture. Current values of land price P, land quantity L, number of transactions T, and number of farms A appear in the equation. It is expected that land quantity and number of transactions influence P in the current year. But we do not anticipate that *current* land price has a significant influence on current land volume, farm numbers, or number of transactions. If the latter variables are exogenous and land price is the only endogenous (dependent) variable in the equation, then single equation simple least squares is appropriate.

But even if current land price, land volume, farm numbers and transactions are determined interdependently, the statistical properties necessary for minimum least squares bias can be satisfied by the recursive approach. It is necessary that current land quantity and number of transactions are determined only by past land values, financial position and other exogenous or lagged endogenous variables. Then it is possible to first predict current values of L, A and T from predetermnied variables. These predicted values of L, A and T are next used to estimate P in the land price equation. L, A and T are made linear combinations of predetermined variables; hence, the predicted values of the variables essentially are predetermined. Thus, the land price is estimated as a funcion only of predetermined variables. T, A and L are independent of the disturbance (error) in the land price equation, and least square bias is minimized. The empirical equations are estimated both singly and recursively in this study.

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[16]Given that market participants have formed expectations and are subjectively certain of prices and incomes, the adjustment to the desired or equilibrium sales may go slowly. Briefly, the logic of the adjustment model is that the equilibrium position of the dependent variable is approached with a distributed lag following a change in an independent variable. With adjustment only possible between discrete production (time) periods, the adjustment process can be characterized by:

$$(1) \quad Q_t - Q_{t-1} = g(Q^*_t - Q_{t-1})$$

where Q^*_t represents the desired or equilibrium quantity.

The model states that the actual adjustment $Q_t - Q_{t-1}$ of the quantity during a period t is some proportion g of the full desired or equilibirium adjustment $Q^*_t - Q_{t-1}$. The long-run equilibrium Q^*_t results with the full adjustment of Q to current values of explanatory variables X and Z. The long-run equation is expressed as a linear function in equation (2), with u the error. Substitution for Q^* from equation (1) into equation (2) gives equation (3) after rearrangement:

$$(2) \quad Q^*_t = a + bX + cZ + u_t$$

$$(3) \quad Q_t = (1-g)Q_{t-1} + ga + gbX + gcZ + gu_t$$

Estimation by ordinary least squares of equation (3) using untransformed data gives the short-run coefficients (1–g), ga, gb, and gc directly. Long-run coefficients may then be obtained by dividing each direct coefficient by the adjustment rate g which is one minus the least squares coefficient obtained on the lagged dependent variable. The relevant equation for length of run can be formed by the procedure given in Nelson, op. cit., Appendix C.

The equation (6) is similar to other recursive models for agriculture where the current demand quantity is predetermined by lagged endogenous and exogenous variables in the supply equation. The "quantity" in this model is the land-in-farms L, farm number A and transfers T. That is, the effective current supply of land is not only the total land available, but also is the amount of land offered for sale in the current year—measured by farm numbers and transfers in this model. Other measures of quantity would also include capital improvements on the land and buildings.

The assumption of the recursive land equation is that the decisions regarding the *current* land supply are made prior to or exogenously of land price. Land-in-farms or land "supply" in equation (7) is determined

(7) Land-in-farms $L_t = f(C_t; P_{t-1}, P_{t-2}, X_j, L_{t-1})$

interdependently with cropland used for crops C. L also is a function of predetermined variables indicated by X_j. To satisfy the statistical assumption for avoiding least square bias, equation (7) is estimated with the predicted current value of C.

The predicted value C_t in equation (7) is predetermined from an equation (8) for the cropland supply. The current supply quantity of

(8) Cropland $C_t = f(P_{t-1}, P_{t-2}, X_k, C_{t-1})$

cropland is assumed to be a function of past land prices and other predetermined variables summarized in X_k. The supply equation for cropland is identified by the assumption that current land prices do not influence cropland used for crops in year t. Given the demand equation (6), the presence of P_t in the supply equation (7) would imply a joint causal relationship, with current land-in-farms or cropland influencing the current land price, and with current land price affecting land-in-farms and cropland. This joint causal relationship would call for estimating techniques such as Limited Information or Theil-Basmann. If L and C are not influenced by current price as assuming in this model, the recursive form is appropriate. The exclusion of current price from equations (7) and (8) appears justified since decisions regarding acreage C_t and L_t generally are made early in the year, before P_t is determined. Second, since real estate volume and expenses are fixed in the short-run and land is not a variable production cost, P_t is not closely tied to current decisions on land use. In the long-run, as discussed earlier, land prices do have an important role in determining farm income available for family living. Land prices also potentially affect production decisions and land use in the long-run, thus, lagged values of land prices are included in equations (7) and (8).

(9) Transfers $T_t = f(JX_{t-1}, C^*_{gt-1}, X_m, T_{t-1})$

The number of transactions per 1,000 farms T in equation (9) is assumed to be a function of variables JX and C^*_g (reflecting agriculture's financial health) and other undefined variables represented by X_m. The number of farms placed on the market is considered a function of the adjusted nonfarm-farm income ratio JX and capital gains C^*_g. A negative relationship between JX (or C_g) and T would be anticipated if an unfavorable financial status either forced or encouraged farmers to leave farming and if capital gains encouraged farmers to sell and reap their gain. A positive relationship would be anticipated if an improved financial status encouraged farmers to stay in farming to gain additional appreciation of property values.

The number of farms A_t in equation (10) is related to the national beginning-year stock of farm machinery S, the financial advantage and

(10) Farm Numbers $A_t = f(S_t, JX_{t-1}, C^*_{gt-1}, X_p, A_{t-1})$

availability of off-farm employment JX, and capital gains C^*_g in equation (10). With the family farm as the basic unit of farm organization, factors that determine the farm population also influence farm numbers. Since machinery adopted in the time period under consideration tends to substitute for operator and family labor, a negative coefficient for S is anticipated. Machinery S and the number of farms A underly the farm consolidation hypothesis explaining recent land price trends. Hence knowing the magnitude and significance of the A and S coefficients in the land model would help gage the contribution to land prices of forces pressing for larger farms. The machinery purchase decision is assumed to be made prior to farm size decision in equation (10), but it is recognized that in many instances the two decisions are made simultaneously.

The empirical land market model does not lend itself to a rigorous supply-demand dichotomy because certain variables are associated with more than one function, raising questions about identification of an exact demand or supply equation. While retaining the basic model discussed above, we prefer to give the equations a less strict interpretation. In subsequent sections, the land demand equation (6) is called a "land price" equation; supply equation (7) is called the "land-in-farms" equation; and equation (8) is the "cropland" equation.

In addition to variables representing hypotheses discussed earlier that might explain recent price changes, several additional variables enter the system. Researchers in an earlier study (9) were confronted with more explanatory variables than could be simultaneously included in a single least squares equation explaining land price. A hierarchal system of choosing variables was used to select a subset of variables with structural validity. In this study use of the recursive model increases the number of variables that can be included in the system, since each equation in the recursive chain is estimated separately by single equation least squares. If desired, the effects on land price of variables not included directly in equation (6) but linked to land price through the recursive chain, can be ascertained by substituting estimated equations such as equation (7) for L in equation (6). The resulting equation for land price formed by substituting equations (7) through (10) into (6) is called the reduced form. This procedure, showing the effects of several variables on land price, is considered to be more reliable than direct estimation of the reduced form with the hierarchal system. Still, not all variables conceivably relevant from an economic standpoint can be included in the system, and previous studies have aided in eliminating variables.

Statistical Estimates of the Land Model

Table 10 includes alternate specifications of the land price equation, estimated statistically by ordinary and recursive least squares from annual U. S. observations for the 1923-63 period. With 35 degrees of freedom,

Table 10. Estimated Land Price Equations, with Coefficients, t-Values (in Parentheses) and R^2.[1]

			Variables					
			L	T	A	F	r	P
Equation	R^2	Constant	t	t	t	t-1	t-1	t-1
(11) OLS[2]	.94	108.85	—.049	—.20	—.0046	.56		.74
			(2.423)	(2.06)	(1.9475)	(2.73)		(6.94)
(12) RLS[3]	.95	111.95	—.047	—.36	—.0034	.52		.71
			(2.585)	(3.31)	(1.5640)	(2.80)		(7.62)
					t-1			
(13) OLS	.94	116.34	—.050	—.21	—.0052	.56		.71
			(2.521)	(2.21)	(2.0646)	(2.73)		(6.30)
					t-1			
(14) RLS	.95	105.55	—.042	—.39	—.0030	.52		.72
			(2.409)	(3.72)	(1.3255)	(2.79)		(7.45)
					t			
(15) OLS	.95	89.25	—.037	—.23	—.0027	.58	—1.52	.77
			(1.892)	(2.49)	(1.1642)	(3.04)	(2.38)	(7.09)
					t			
(16) RLS	.96	88.58	—.033	—.41	—.0011	.58	—1.63	.77
			(1.906)	(4.06)	(.5138)	(3.23)	(2.90)	(8.83)

[1]Estimated with annual data from 1923 to 1963. Variables are defined in the text.
[2]Ordinary least squares.
[3]Recursive least squares.

coefficients with t values (in parentheses below the coefficients) of 2.03 or greater differ significantly from zero at the 95 percent probability level. The coefficient of farm numbers (A) is on the borderline, but all other coefficients in equation (11) are significant at the 95 percent level or greater.

All equations are estimated in untransformed observations, but the relative effect of the variables on land price can better be judged by converting coefficients to elasticities. Computed at the 1963 values, the elasticities derived from equation (11) are as follows: —.46 for land-in-farms L, —.073 for transfers T, —.134 for farm numbers A, and .086 for net farm income F.

Other things equal, a one percent increase in farmland decreases land prices .46 percent in the short-run. Although the farmland variable has the greatest relative impact on land price, the annual changes in L are in fact small, and the variable does not explain a large amount of the annual variation in land price.

A 10 percent increase in transfers decreases land price .7 percent, ceteris paribus. A 10 percent decrease in farm numbers is associated with a 1.3 percent increment in land price. The three variables L, T and A are broadly interpreted as "quantity" in a demand equation, hence a negative relationship would be expected with price. The farm numbers variable is very closely indicative of farm consolidations and the attendant association of fewer, larger farms with higher land prices. A 10 percent increase in lagged net farm income increases land price just under one percent in the short-run according to equation (11).

The coefficient of P_{t-1} indicates that $1 - .74 = .26$ (approximately one-fourth) of the adjustment of land price to the independent variables is made in one year. The long-run impact of a change in farm income (or other variables) is found by dividing the short-run coefficients by .26. Thus the long-run coefficients in equation (11) are approximately four times the short-run coefficients. For example, a 10 percent increase in net farm income increases land price $.86/.26 = 3.3$ percent in the long run. An adjustment coefficient of .26 implies that 90 percent of the total long-run adjustment is made in 7.65 years.

The five independent variables in equation (11) explain 94 percent of the variation in the deflated land price over the 1923-63 period. Corrected for degrees of freedom the adjusted coefficient of determination $\overline{R}^2 = .93$

Equation (12) contains the same specification as equation (11) except that the recursive equation is estimated from observations of L, T, and A that were predicted from subsequent equations. The coefficient (absolute value) of transfers is larger, of farm numbers smaller, in the recursive equation (12).

Equations (13) to (16) contain alternative specifications of the land price function. Equation (13) results from replacing current observations of farm numbers A in equation (1)) with observations lagged one year. The magnitude and sigificance of the A coefficient is increased in (13). But when predicted observations for L and T are used to estimate the same equation recursively in equation (14), the results are quite different.

Alternative investment opportunities to farmland are introduced in equation (15) with a variable r, the rate of return on common stock. The variable is statistically significant and indicates that a 10 percent increase in the yield of common stock reduces the price of farmland per acre by .4 percent in the short-run and 1.6 percent in the long-run. More lucrative returns in the nonfarm sector would shift capital from farm real estate to nonfarm alternatives, thereby reducing P. Again in equation (16), the recursive counterpart to the ordinary least squares equation (15), the significance of the farm numbers coefficient is reduced. The reduction perhaps may be attributed to an inadequate specification of the farm numbers equation presented later.

Addition of variables such as the farm mortgage interest rate, land retirement, lagged farm liquid assets, the ratio of farm mortgage debt to total debt, the percent of debt held by individuals versus others, a time trend, T_2 or other variables did not improve the specifications in Table 10.

The land-in-farms equation (17) is estimated by ordinary least

$$(17) \quad L_t = -134.37 + \underset{(2.37)}{.80F_{t-1}} + \underset{(1.96)}{.36L_{rt}} + \underset{(2.20)}{.41C_t} - \underset{(2.75)}{.67E_t} + \underset{(38.31)}{1.00L_{t-1}} \qquad R^2 = .99$$

squares. The five independent variables explain 99 percent of the variation in the dependent variable. All coefficients have the expected sign and, except land retirement L_{rt}, are significant at the 95 percent probability level. The variable L displays a quite stable trend through time, hence the lagged dependent variable is highly correlated with the current value and the t value (in parenthesis) on the L_{t-1} coefficient is large. The adjustment rate is nearly zero, indicating that the long-run coefficients are very large. However, the "long-run" is so far distant for (17) that the short-run coefficients also can be taken as the "long-run" coefficients for all practical purposes.

One billion dollars added to net farm income F adds .8 million acres of farmland according to (17). The tendency for higher farm income to "build" more land and increase the supply quantity L indirectly reduces land price through the negative coefficient on L in the land price equation. This effect on P through the L equation (17) tends to offset the direct effect of F on land price in Table 10 equations.

Ten million acres of land retired by government programs adds 3.6 million acres to farmland L according to equation (17). The result suggests that farmers bring in about one acre for each 3.6 acres taken out of production by farm programs. These acres (often newly drained, cleared or irrigated) substitute for land removed by government programs, thereby offsetting some of the intended benefits of land withdrawal.

The nonfarm employment variable E is included in equation (17) to measure the growing nonfarm land demand for housing, parks, golf courses, shopping centers, etc. Demand for these items would be associated with economic conditions in the nonfarm sector, as well as the number of persons involved. Interpreting E as a proxy variable for these effects, equation (17) indicates that each worker added to the nonfarm work force takes two-thirds acres of land away from farming.

A positive association exists between cropland C and farmland L as anticipated. Equation (17) also was estimated recursively with predicted value of C from the cropland equation shown later. The magnitude of the C coefficient was reduced to .28 and the t value was reduced accordingly (the standard error remained nearly stable). Other coefficients and t-values remained essentially unchanged from equation (17), hence the recursive least squares equation is not shown. Inclusion of lagged land prices and other variables in equation (17) did not improve the equation.

Cropland used for crops C is specified to be a function of farm income F, land retired by government programs L_r, a dummy variable to allow for changes in the equation structure in the period 1942-1948, and the lagged dependent variable (equation 18). The coefficient of F

$$(18)\quad C_t = 180.73 + \underset{(1.73)}{.38F_{t-1}} - \underset{(5.92)}{.44L_{rt}} - \underset{(1.22)}{3.13T_2} + \underset{(5.13)}{.51C_{t-1}} \qquad R^2 = .91$$

differs significantly from zero at the 90 percent probability level. Other coefficients except on T_2 are highly significant.

Each 10 million acres removed by government programs reduced cropland by 4.4 million acres—again suggesting slippage with government programs not fully effective in cutting crop acreage. Land retired by government programs is included in farmland L but is excluded from cropland C, thus the alternate signs on the L_r coefficients in the respective equations are expected.

Since the family farm is the characteristic economic unit in agriculture, the number of farms A is closely tied to the number of farm families and workers. The positive coefficient of JX, the ratio of factory to

$$(19)\quad A_t = 418.46 + \underset{(1.05)}{.11JX_{t-1}} - \underset{(4.86)}{9.72C^*_{gt-1}} - \underset{(3.72)}{.017S_t} + \underset{(1.96)}{49.92T_2} + \underset{(38.75)}{.94A_{t-1}} \qquad R^2 = .998$$

farm earnings adjusted for unemployment, in equation (19) is consistent with the hypothesis that lower relative farm earnings increase outmigration and reduce farm population and farm numbers. The coefficient is only slightly larger than the standard error, however. The presence of past capital gains reduces farm numbers and population based on the coefficient of C^*_g in the equation.

Pressures for farm consolidation are measured by beginning year machinery stocks S in equation (19). A 10 million dollar increment in machinery stock reduces farm numbers .17 thousand in the short-run and $.17/(1-.94) = 2.8$ thousand in the long-run. Approximately six percent of the adjustment to the desired or equilibrium number of farms is made in one year after a change in the explanatory variables according to equation (19). This adjustment rate is slow, as might be expected, where migration and farm reorganization are involved.

The specification of the farm transfer equation (20) is similar to the previous farm numbers equation (19). The coefficient of the nonfarm-farm earnings ratio JX possesses a dubious sign, and is not significant

$$(20)\quad T_t = 51.16 - \underset{(1.897)}{.028JX_{t-1}} - \underset{(3.16)}{.67C^*_{gt-1}} - \underset{(2.31240)}{.00068S_t} + \underset{(4.08)}{11.58T_2} + \underset{(2.14)}{.32T_{t-1}} \qquad R^2 = .87$$

at the 95 percent probability level. All other coefficients are statistically significant. If transfers are a simple linear function only of farm numbers, the coefficients in equation (20) would be a fixed proportion of the coefficients in equation (19). The coefficients on the two equations suggest that this is not so, and that year-to-year economic factors affect T in ways different than A. The adjustment coefficient is $1 - .32 = .68$; thus transfers adjust much more rapidly to changes in the independent variables than do farm numbers.

The above 5-equation model estimated by ordinary and recursive least squares embodies several of the hypotheses underlying land price trends discussed in the early sections. Efforts were unsuccessful to expain additional variation in the endogenous variables with more explanatory variables including alternative general deflators, output-input measures, lagged land prices, the ratio of real estate debt to equity, the quantity of liquid assets, the interest rate on farm mortgages, the proporion of real estate debt held by various lenders, and additional trend (time) variables. The model was estimated only in untransformed data, although a logarithm or other nonlinear form might have been more realistic. The residuals were not tested for autocorrelation partly because the tests are known to be especially unreliable when the equations contain lagged dependent variables. Time and research resources preclude refinements at this time, but estimation of the model using an autoregressive error scheme at a later date would be desirable.

Sources of Land Price Variation

Variation in land price depends not only on the magnitudes of the coefficients in the land price equations of Table 10, but also on the indirect effects through the other four equations in the land market model. Movements in explanatory data are important in analyzing the source of variation in P, for land price can vary more from a small effect (coefficient) coupled with major variation in the explanatory data than from a relatively large coefficient coupled with a nearly stable time series.

To determine the extent of disequilibrium in the land market and the contribution of each explanatory variable to land price, a 10-year reduced form land price equation is constructed. The 10-year equations rather than full long-run equations are used because in some instances (e.g., for land-in-farms) the long-run is unrealistically far off. Use of 10-year coefficients increases comparability among equations. These equations show the magnitude of the dependent variables if the explanatory variables are held constant for 10 years and the adjustments are allowed to be made accordingly in the dependent variables. The choice of a 10-year adjustment period is arbitrary. While not all adjustments to the equilibrium after a change in explanatory variables are made in 10 years, it may be reasoned that a longer period would introduce unmanageable distortions. But it must also be cautioned that large errors in prediction may also occur in the 10-year equations. With an adjustment rate even as low as .26 in equation (11), 95 percent of the equilibrium adjustment has been completed in 10 years.

The 10-year equation (21) found by adjustment of coefficients in (11) predicts the magnitude of land price in 10 years if the current

$$(21) \quad P_{t+10} = 393.18 - .18L_t - .73T_t - .017A_t + 2.02F_{t-1} + .047P_{t-1}$$

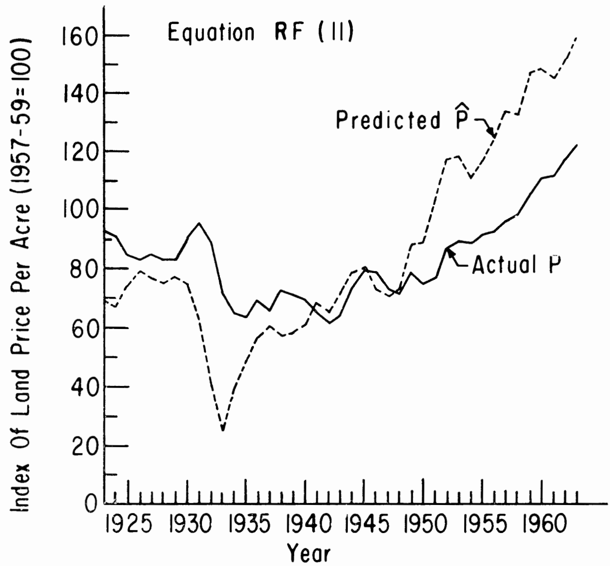
values of L_t, etc. are sustained the entire period. The reduced form land price equation is formed by first substituting the 10-year form of equation (18) for C into the 10 years form of the L equation (17), then substituting the resulting equation for L into equation (21). Ten-year equations for transfers and farm numbers also are substituted for the respective variables in equation (21). The resulting 10-year reduced form of equation (11), specified as RF (11), is intended to reflect both the direct and indirect effects of key variables on land price in 10 years.

$$\begin{aligned} \text{RF (11)} \quad P_{t+10} = {} & 251.78 + .04F_{t-1} + .013L_{rt} + 1.19E_t - .015JX_{t-1} \\ & + 2.01\ C^*_{gt-1} + .0029S_t - 14.46T_2 - .00082C_{t-1} \\ & - .18L_{t-1} - .0095A_{t-1} - 000009T_{t-1} + .047P_{t-1} \end{aligned}$$

Measures of Disequilibrium in the Land Market

Figures 4 and 5 graphically illustrate the disequilibrium in the land market as measured by the 10-year reduced form equations found by substituting the 10-year form of equations (17) through (20) into the respective 10-year land price equations—the same procedure used to form RF (11). The reduced form of equation (11) indicates disequilibrium prior to World War II, with actual land prices below predicted equilibrium levels. During the war years, actual land values were slightly below equilibrium levels justified by earnings and other explanatory variables. The prewar pattern again emerged for two years in 1946 and 1947. Then began an extended period of disequilibrium that has continued to the present with actual land prices below equilibrium levels predicted by RF (11). The 10-year reduced form of recursive equation (12) predicts much the same disequilibrium pattern, but generally indicates a smaller degree of disequilibrium in the land market. While there is no substantial basis to choose between the two equation forms, the recursive model theoretically provides certain advantages of minimized least squares bias discussed earlier. However, the recursively estimated equations are more sensitive to specification errors.

The 10-year reduced form of equation (15) predicts a near equilibrium in 1929, another between 1936 and 1950. After equilibrium in 1948, disequilibrium began to grow. The equation suggests that there remains considerable "catching up" to do with even higher land values than actual 1963 values predicted by variables in the model. Thus, if the 1963 magnitude of forces underlying land prices are undisturbed and



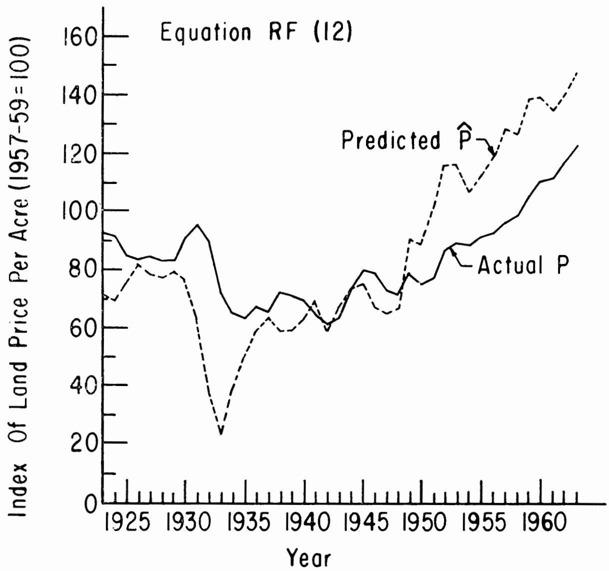
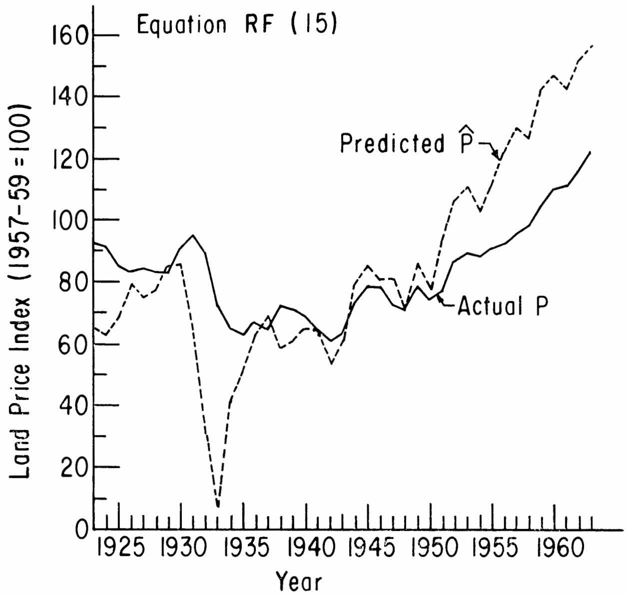


Figure 4. Actual land price (deflated) and predicted land price from the 10 years reduced form of equations (11) and (12).



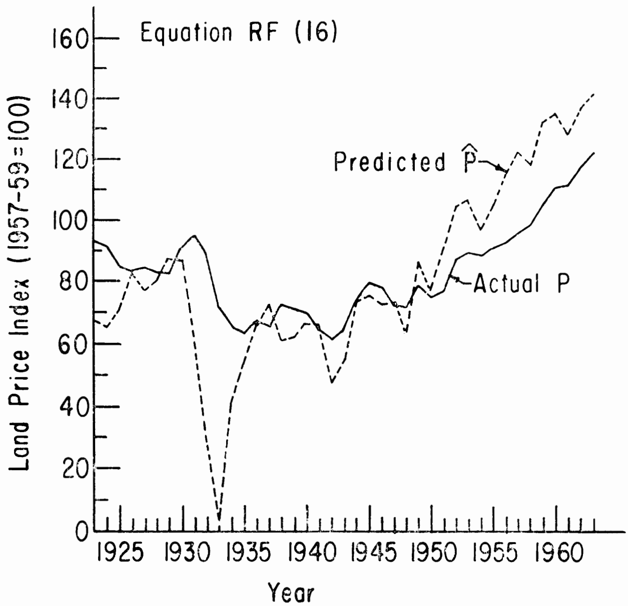


Figure 5. Actual land price (deflated) and predicted land price from the 10 year reduced form of equation (15) and (16).

allowed to work themselves out, the land price is predicted to be 29 percent higher in 1973 than in 1963. The prediction error becomes large for extended extrapolations, however.

The 10-year reduced form of the recursive equation (16) predicts disequilibriums in the early 1920's, early 1930's and after 1950. Near-equilibrium was sustained from 1935 through 1950. Disequilibrium then widened, and the equation predicts a land price index of 142 (148 1957-59 dollars per acre) in 10 years if the 1963 values of explanatory variables were to be sustained. The actual land price index was 123 in 1963, hence price was 16 percent below equilibrium. The predicted long-term land price index in 1957 was 123, hence the actual 1963 price index represents an equilibrium for 1957 conditions according to the model.

Empirically Estimated Sources of Disequilibrium

Tables 11 and 12 show contributions of the predetermined variables to land price as computed from the 10-year reduced form equations. The estimates from the reduced form RF (11) are shown in the top half of Table 11. The reduced form counterpart formed by substituting the 10-year forms of the *recursively* estimated land-in-farms equation and equations (18) to (20) into equation (12) also is used to predict land price (lower part of Table 11). Only selected years are shown to reduce the table size.

Contributions to rising land prices since 1925 have come mainly from nonfarm land requirements measured by E, and farm consolidation and other factors represented by farm numbers A and machinery S according to Table 11. Land retirement programs L_r and capital gains have contributed smaller magnitudes to higher farmland prices. Changing farm income F_{t-1} has had little net long-term effect on land values based on results in Table 11.

Higher farm income contributes in a direct, significant way to land values according to the land price equations (11) to (16) in Table 10. But as stated earlier, the equation (17) indicates that higher farm income sets in motion forces to expland land volume through clearing, irrigation, etc. In 10 years, the additional income generates larger land volume which tends to restrain land prices, and offsets the direct, positive effect of farm income in equation (11). Ceteris paribus, greater land in farms is associated with lower land values. The secular trend in farmland is partly reflected in other variables such as income. The "residual" influence of L_{t-1} has been to increase land prices. The recursively estimated 10 year reduced form of equation (12) predicts a slightly greater contribution of farm income to land prices in Table 11.

Table 11. Estimated Contributions of Specified Variables to 10-year "Equilibrium" Land Prices from RF(11) and RF(12).[1]

Year	F_{t-1}	L_{rt}	E_t	JX_{t-1}	C^*g_{t-1}	S_t	r_{t-1}	T_2	C_{t-1}	L_{t-1}	A_{t-1}	T_{t-1}	P_{t-1}	P^2_{t+10}	P^3_t
Predictions from the 10-year Reduced Form of Ordinary Least Squares Equation (11).															
1925	.36	0	40.13	2.62	—4.41	15.35		0	—.30	—184.69	—61.50	0	4.27	74.11	84.8
1930	.47	0	41.82	1.80	—1.20	20.52		0	—.31	—182.58	—61.80	0	3.85	74.35	90.9
1935	.29	0	38.26	.29	—.80	14.88		0	—.31	—194.59	—64.30	0	3.08	48.58	63.9
1940	.43	0	45.20	1.66	—2.61	20.92		0	—.30	—198.00	—61.13	0	3.32	61.27	69.8
1945	.83	0	52.62	1.83	19.25	31.94		—14.46	—.31	—209.66	—56.97	0	3.45	80.33	79.4
1950	.62	0	62.18	2.48	.20	38.32		0	—.32	—215.04	—54.30	0	3.69	89.01	74.9
1955	.55	0	66.91	3.23	1.20	50.99		0	—.31	—216.30	—45.53	0	4.12	116.64	91.2
1960	.45	.38	72.54	2.37	12.03	54.34		0	—.29	—211.45	—38.88	0	4.92	148.19	110.2
1963	.53	.70	76.00	2.43	9.63	57.15		0	—.27	—208.94	—35.00	0	5.48	159.49	122.6
Predictions from the 10-year Reduced Form of Recursive Least Squares Equation (12).															
1925	1.44	0	34.48	6.85	—4.56	14.20		0	.18	154.15	41.99	0	2.99	75.85	84.8
1930	1.89	0	35.49	5.55	—1.24	18.99		0	—.19	161.11	42.20	0	2.70	76.65	90.9
1935	1.15	0	32.47	.16	—.83	13.77		0	.18	171.71	—43.91	0	2.15	49.84	63.9
1940	1.70	0	38.36	3.24	—2.69	19.36		0	.18	—174.72	—41.74	0	2.32	62.42	69.8
1945	3.32	0	44.68	5.24	19.88	29.55		—22.38	—.19	185.01	—38.90	0	2.41	75.37	79.4
1950	2.48	0	52.77	5.75	.21	35.45		0	—.19	—189.75	—37.08	0	2.58	88.99	74.9
1955	2.19	0	56.79	7.49	1.24	48.17		0	—.19	—190.86	—31.09	0	2.89	112.38	91.2
1960	1.81	—.10	61.57	6.33	12.42	50.28		0	—.18	—186.59	—26.55	0	3.45	139.21	110.2
1963	2.10	—.18	64.50	6.18	9.94	52.87		0	—.16	—184.37	—23.90	0	3.83	147.58	122.6

[1]RF refers to reduced form equations. Variables are defined in the text.
[2]The summation of all variables to the left.
[3]The actual current U. S. land price per acre, deflated by the wholesale price index.

Table 12 predicts land values in 10 years from the reduced form of equation (15) estimated by ordinary least squares and equation (16) estimated by recursive least squares. Changes in returns r on investment alternatives outside agriculture have contributed to higher land prices since 1925 based on results in Table 12. The more direct sources of land demand in the nonfarm sector as measured by employment E, also contributed to the secular trend in land prices. The equation indicates that the years 1942-48, indicated by T_2, had a net depressing effect on land price equal to 27.35 units in RF (16).

The reduced form, whether derived from the ordinary least squares or recursive least squares equations, predict similar sources of land price trends in Table 12. The earlier discussion suggests that the nonfarm investor is a declining force in the land market. Hence the major emphasis given to declining returns r in the nonfarm sector as a source of recent land price trends is doubtful. Estimates in Table 12, therefore, appear less plausible than those in Table 11.

Predicting the Forces Underlying Recent Land Price Trends

Reduced form equation (12) predicts a 58.6 unit increase in the predicted equilibrium land price index between 1950 and 1963, whereas the actual increase was 47.7 units.[17] Approximately half of the predicted rise in land values is explained by pressures for farm enlargement according to Table 13. Growing nonfarm purchasing power, capital, and land use represented by the nonfarm employment variable E accounted for 20 percent of the predicted land price increase based on RF (12). Expectations of future capital gains that created competition for land contributed 9.7 points to equilibrium land price index estimates. Of the variables included in the model, only farm income had a depressing effect on land values during the 1950-63 period. The effect was small, however.

All monetary variables, including land price were deflated by the wholesale price index, a measure of the general price level. The implicit assumption is that land prices adjust with a 1:1 relationship to any inflationary trend in the general price level. This assumption is not fully met, and an alternative procedure would have been to leave land price undeflated and include the general price level as an explanatory variable in the model. This latter procedure was rejected to reduce the number of variables and the attendant multicollinearity in the model. The wholesale price index was 16 percent higher in 1963 than 1950. Thus, land

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[17] These actual and predicted prices need not necessarily coincide even with perfect prediction because latent adjustments are always present in the market.

Table 12. Estimated Contributions of Specified Variables to 10-year "Equilibrium" Land Prices from RF(15) and RF(16).[1]

Year	F_{t-1}	L_{rt}	E_t	JX_{t-1}	C^*g_{t-1}	S_t	T_2	C_{t-1}	L_{t-1}	A_{t-1}	T_{t-1}	P_{t-1}	P^2_{t+10}	P^3_t
					Predictions from the 10-year Reduced form of Ordinary Least Squares Equation (15).									
1925	6.38	0	35.85	5.15	−4.07	13.05	−37.94	0	.27	−154.12	−42.57	0	8.09	68.43	84.8
1930	8.37	0	36.90	4.10	1.11	17.45	−22.50	0	.28	−161.08	−42.78	0	7.30	85.25	90.9
1935	5.09	0	33.76	.18	.74	12.65	−27.12	0	−.27	−171.68	−44.52	0	5.83	52.06	63.9
1940	7.55	0	39.88	2.54	2.41	17.79	−27.39	0	.26	−174.69	−42.32	0	6.29	65.86	69.8
1945	14.73	0	46.45	3.90	17.76	27.16	−31.74	−17.09	−.28	−184.97	−39.44	0	6.53	85.11	79.4
1950	10.99	0	54.86	4.40	.19	32.59	−43.75	0	−.28	−189.72	−37.59	0	6.99	77.56	74.9
1955	9.70	0	59.04	5.71	1.11	43.36	−31.54	0	−.28	−190.85	−31.52	0	7.82	111.45	91.2
1960	8.03	.34	64.01	4.75	11.10	46.21	−21.84	0	−.26	−186.55	−26.92	0	9.33	147.08	110.2
1963	9.32	.63	67.06	4.67	8.88	48.60	−22.04	0	−.24	−184.34	−24.23	0	10.38	157.37	122.6
					Predictions form the 10-year Reduced form of Recursive Least Squares Equation (16).									
1925	7.55	0	28.68	11.01	−4.30	11.54	−37.38	0	−.15	−128.84	−16.14	0	6.47	70.71	84.8
1930	9.90	0	29.52	9.28	−1.17	15.43	−22.17	0	−.16	−134.66	−16.21	0	5.84	87.87	90.9
1935	6.03	0	27.01	.01	−.78	11.19	−26.72	0	−.15	−143.52	−16.87	0	4.66	53.13	63.9
1940	8.94	0	31.90	4.74	−2.54	15.73	−26.98	0	.15	−146.04	−16.04	0	5.03	66.86	69.8
1945	17.43	0	37.16	8.64	18.77	24.01	−31.27	−27.35	−.16	−154.64	−14.95	0	5.22	75.13	79.4
1950	13.00	0	43.89	8.94	.20	28.81	−43.10	0	−.16	−158.60	−14.25	0	5.59	76.59	74.9
1955	11.48	0	47.23	11.59	1.17	38.33	−31.07	0	.16	−159.53	−11.95	0	6.25	105.61	91.2
1960	9.49	.08	51.20	10.24	11.73	40.85	−21.52	0	.15	−155.96	−10.20	0	7.46	135.33	110.2
1963	11.03	.15	53.64	9.88	9.38	42.96	−21.91	0	.14	−154.11	9.18	0	8.30	141.97	122.6

[1]RF refers to reduced form equations. Variables are defined in the text.
[2]The summation of all variables to the left.
[3]The actual current U. S. land price per acre, deflated by the wholesale price index.

Table 13. Estimated Sources of the Increase in Equilibrium Land Price from 1950 to 1963.[1]

Item	Land Price Index Points (1957-59 = 100)[2]	Portion of Total (Percent)
Capital gains (C^*_g)	9.7	17
Farm income (F)	.4	—1
Farm consolidation, enlargement (A, S)	30.6	52
Farmland adjustment (L)	5.4	9
Nonfarm variables		
Nonfarm employment (land requirements, etc.) (E)	11.7	20
Labor earnings in farm and nonfarm sector (JX)	.8	1.5
Miscellaneous (latent adjustments of endogenous variables, etc.)	.8	1.5
Total	58.6	100.0

[1]From the 10 year reduced form of equation (12).
[2]Each land price index point is approximately 1.04 1957-59 dollars. With approximately 1.1 billion acres of land in farms, each index unit contributes 1.1 ($1.04) = 1.14 billion 1957-59 dollars to total U. S. farm real estate values.

prices are implicitly assumed to increase approximately that percentage in response to inflationary trends characteristic of the general economy.

The basic equations and predicted sources of the land price rise between 1950 and 1961 from an earlier prototype model are contained in Table 14 (15). Land retirement through government programs is cited as the major source of land price increments in recent years in that model. The earlier text discussion included several references to studies showing positive contributions of land retirement (including crop allotment) programs to land values. Results in Table 14 support the hypothesis that government programs restricting land use have been an important source of the land price rise since 1950. Nevertheless, the statistical properties including low t-values on crucial coefficients in the Table 14 model, give little basis for confidence in the results. From a statistical standpoint, the results in Table 13 are superior. We conclude from the descriptive analysis presented earlier and the econometric models that factors associated both with (a) farm consolidation (e.g., scale economies, machinery investment and labor inputs), and (b) government restrictions on use of the land resource are likely the major contributors to the land price rise since 1950. The exact contribution of each factor cannot be pinpointed, however.

It is cautioned that the above econometric model is only a subset of many possible specifications of the land market, and prediction errors can be large. Because more than one set of variables predicts almost equally well and can be justified from an economic standpoint, the pro-

Table 14. Estimates Sources of the Increase in Equilibrium Land Price from 1950 to 1961.[1]

Item	Land Price Index Points	Portion of Total
	1957-59 = 100)	(Percent)
Capital gains (C_g)	4.8	9
Farm income (F)	.1	—
Farm consolidation, enlargement (A, S)	2.5	5
Farmland adjustment (L)	2.1	4
Nonfarm variables		
Nonfarm employment (land requirements, etc.) (E)	2.6	5
Labor earnings in farm and nonfarm sector (JX)	2.0	4
Land retirement	30.4	59
Miscellaneous (latent adjustments of endogenous variables, etc.)	6.7	13
Total	51.2	100[2]

[1]The above results were from a 10 year reduced form equation computed in a manner similar to that described in the text from the following prototype model:

$$P_t = 73.5 - .03L_t - .25T_t - .0007A_t + .65F_{t-1} + .17L_{rt} + .68P_{t-1}$$
(1.5) (2.0) (.21) (1.7) (1.4) (5.8) $R^2 = .90$

$$L_t = -292 - .049F_{t-1} + .46L_{rt} + 3.3C_t - .29E_t + 98L_{t-1}$$
(.1) (3.2) (5.4) (1.2) (41.5) $R^2 = .997$

$$C_t = 37.8 + .26F_{t-1} - .059L_{rt} - .046H_{t-1} + .015P_{t-1} + .62C_{t-1}$$
(2.0) (1.7) (1.3) (0.6) (5.1) $R^2 = .84$

$$A_t = 594.4 + 1.91JX_t - 2.69C_{gt} - .0036S_t + .92A_{t-1}$$
(2.6) (3.4) (4.6) (36.2) $R^2 = .998$

$$T_t = 40.1 + .122JX_t - .366C_{gt} + .31T_{t-1}$$
(1.9) (5.7) (3.1) $R^2 = .88$

Equations were estimated by ordinary least squares from annual data for 1922 to 1961, excluding the 1942-47 period. Variables are defined as previously in this study, except the above data are indices for cropland used for crops C (1947-49 = 100), and machinery S (1957-59 = 100). Also capital gains C_g are defined to include a longer period than in C^*_g defined earlier; and the index of output per unit of cropland H (1947-49 = 100) is included. For other details see Ted Nelson, "An Econometric Model of the Land Market Stressing Effects of Government Programs on Land Values," (unpub. Ph.D. thesis, Library, Oklahoma State University) May, 1964.

[2]Not exact due to rounding.

cess of selecting the appropriate single model is necessarily somewhat subjective. While we judge the specification in this study (Table 13) to be superior statistically and in other ways to previous models, similar results from independent studies and methodologies will be needed to build substantial confidence in the results.

A need exists for additional research to explore the effect on the results of alternative model specifications, intercorrelations and errors in the independent variables, and autocorrelated disturbances. The results are general and do not apply to specific situations. An attempt at model disaggregation to the regional level is found in Nelson (15). A further disaggregation to at least the state level would be desirable.

Summary and Conclusions

Changing land prices in agriculture historically have been a major source of capital gains and losses to land owners. Through land appreciation and depreciation, significant redistribution of income has occurred within agriculture and between agriculture and the remainder of the economy.

Several possible contributing factors to the recent land price increase were discussed, including government programs, changes in the structure of financing land sales, farm consolidation and attendant scale economies, nonfarm investment in land, etc. A econometric model to test several of these hypotheses placed major emphasis on competition among farmers for farm enlargement as a principal contributor to higher farmland prices since 1950. Use of farmland for nonfarm purposes and other variables associated with changing farm-nonfarm economic relationships contributed one-fifth of the price gains according to the econometric model. Government acreage allotments and changes in financing structure (e.g., conditional sales contracts) also are known to contribute to higher land prices based on other studies and alternative model formulations.

For 1963, the model (RF 12) predicts equilibrium farm land prices 20 percent above actual 1963 levels. The implication is that the current upward price trend will continue. Until pressures for farm consolidation are reduced and the excess labor problem is lessened, land prices will continue to be at levels greater than justified by average rates of return.

The econometric model indicates that an element of speculation is present in the current price spiral. This element contributed an estimated one-sixth of the price gain since 1950; hence is small in relation to other elements. But the speculative element is particularly important because it is highly volatile and could collapse causing a sudden and cummulative land price drop. Should speculators lose confidence and expectations of future capital gains become neutral, the predicted equilibrium land price for 1963 would be 10 percent rather than 20 percent above the actual 1963 price (RF 12). And should capital gain expectations (C^*_g) become negative as in the 1930's, the equilibrium 1963 price could very quickly fall to the actual 1963 price. For this reason potential investors in farmland are cautioned against purchase of land oblivious of earning potential from crops and livestock, since capital gains through future price appreciation are by no means assured. The model does suggest that current land prices have a reasonably adequate foundation in stable factors, and land purchases are not subject to undue risk at the present time.

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