Long-run Trends in American Farmland Values

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"Long-run Trends in American Farmland Values," by Peter H. Lindert, University of California - Davis, Agricultural History Center, Working Paper no. 45, February 1988.

Abstract

The long history of U.S. farmland prices shows some striking reversals, with the latest being the worst. The boom and bust cycle since 1973 has been as unstable as any earlier era of ten years or more. Its land-value instability matches that of the Civil War disruption, and is far worse than those in either the famous speculative cycle peaking in 1920 or the Great Depression of the 1930s. The interwar movements in fact reveal a single long downward slide in real land farmland values from 1914 to 1942, not the popular alternation of booms and busts. Each of these conclusions is supported by the twentieth-century behavior of rents and the ex-post rate of return on farm land, as well as by the movements in its purchase value.

These movements were "real" in every sense. They showed up in real, not just nominal, values. They were genuine price movements, not movements in the quality of land. And they were shared by all the regions of the United States, despite a few interesting regional variations.

The trends throw new light on two issues in the history of American capital accumulation. Incorporating market-perceived capital gains and losses on farm land into measures of savings starts to re-shape the contours of the famous rise and fall of American savings. The attractions of farm land as an asset may also help explain the lower capital intensity of the American than the British economy in the middle of the last century.

A final section of the paper makes initial progress toward explaining the striking movements in farmland values and rents since the early nineteenth century. It explores the roles of several forces, finding a general pattern: those changes that historically raised the price of farm land were, with only one exception, changes that must have harmed the advance of wages and average national income.

Table of Contents

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by

Peter H. Lindert

The scarcity of agricultural land richly deserves its own history. It is an actor in many of our histories of social structure and economic growth. The rent and price of agricultural land have a twofold social meaning. One is that the return to land is largely a site rent, the controversial "unearned increment" that allows owners to "grow rich in their sleep," in Mill's phrase. The other is that agricultural land is largely owned by one or another special social class. In many countries, especially in England, it has been a rich man's asset, concentrated into the hands of persons having high overall income and wealth, even apart from their agricultural land holdings [Lindert 1986; Lindert 1987]. In others, such as the United States, agricultural land has been owned largely by farm operators, so that social tensions over the position of the farmer are tied to the price of farm land. Periods of farm crisis are ones in which farmers fear that the value of their land will plummet. So it was in the famous U.S. farm protests of the late nineteenth century, the farm crises of the early 1920s and the 1930s, and the severe farm crisis of the 1980s.

Agricultural land scarcity has often had a prominent role in theories of economic growth. Yet when we turn to the task of explaining land price movements across modern history, we find an incomplete story filled with puzzles. Our theoretical tradition is much richer than our empirical history of land values.

Traditional theories about land and growth build a strong presumption that growth of population and the economy should cause the price of land to go on rising, as long as land scarcity does not choke off that growth. In the pessimism of Malthus's essays on population, increasing population pressure entailed a rising price of land as an implicit mirror image of the declining ratios of land and food per person. What Malthus left implicit was made explicit by Ricardo's famous theory of rent. That growth should push up the price of land indefinitely was a proposition on which John Stuart Mill, Henry George and Alfred Marshall agreed, though George and Marshall agreed on little else. Rising land scarcity is also predicted by

postwar mathematical models of the growth process [e.g. Nichols, 1970]. The key to the argument is obvious enough: the supply of land is harder to expand than the supplies of human beings, capital goods and other productive inputs.

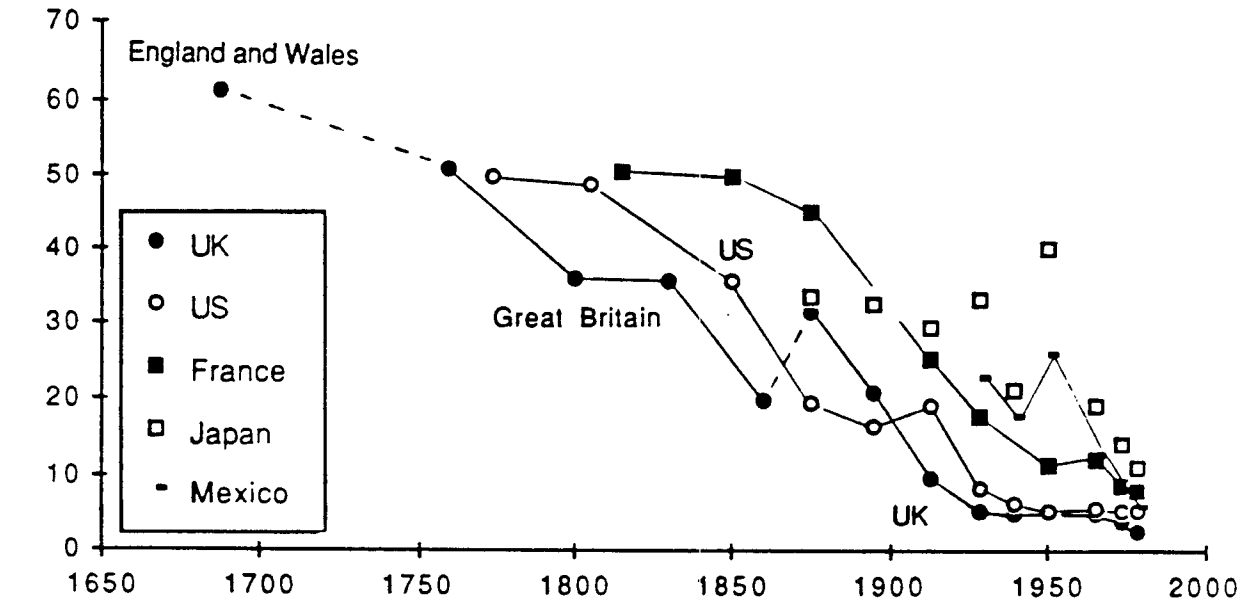
Yet the tradition of predicting a monotonic rise in the price of land, both in and out of agriculture, clashes with some of the facts. The most familiar counter-tendency is the declining share of agricultural land and its rents as shares of wealth and income. We find it only natural that its share should fall, just as agricultural output falls as a share of national income. Figure 1 confirms what we have always assumed about the share of agricultural land values in total national wealth. In every country, as in the five countries shown here, its share falls rapidly in the middle of development, approaching zero asymptotically. Theodore W. Schultz [1951, 1963, 1968] developed this point in a series of anti-Malthusian essays on the declining economic importance of land.

The fall in land's share of national income and wealth can be reconciled with a persistent rise in land's price. Its price can rise while its share of the economy declines as long as other productive forces grow much faster than the supply of land.

More troublesome for the presumption that land values should rise is the fact, confirmed here, that there have been prolonged periods of falling land values in America. There have also been sharp short-run crises in the farm real estate market, and these crises also demand special explanation. The American case also raises special issues relating to the role of the frontier in wealth accumulation and the character of economic growth. The history of the price of land is richer and more varied, and it challenges us to develop a more careful explanation of the movements in this key social barometer.

Three perspectives on the long-run history of American farmland values are offered in the remainder of this paper. Section I gathers the abundant, but still underused, data on farmland values since colonial times. Their curious history is followed for the nation and for nine regions, with adjustments for changes in land quality. The implied capital gains on farm land are compared with other types of asset return and with wage rates. Section II points out two important implications of the capital gains on farm land: implications for our perspectives on the rise of US

Figure 1. The Share of Agricultural Land in Tangible National Wealth, Five Countries, 1688-1978.



Source: Goldsmith [1985, pp. 123, 300].

"saving" rates in the nineteenth century, and implications for the long-standing debate over the effects of land abundance for American industrial development. Section III takes some tentative steps toward the goal of weighing the determinants of movements of farmland values.

I. Movements in American Farmland Prices and Rents.

The official United States statistics offer a fairly accurate view of the average price of farm land by state and county since 1850, at first in decennial censuses and then, since 1910, in annual surveys. Before 1850, we have only a few scraps of local data, as we shall see. One peculiarity of the American data is that the purchase price of land is much more available than the annual rental price, perhaps because American land abundance and land policy made it easier than in most countries for a farmer to buy his own land instead of renting from a landlord.

Land Price vs. Land Quality. Any attempt to measure movements in the "price" of land must grapple with its varied quality. Each parcel of land is a unique asset. Agricultural land values vary greatly with climate, soil conditions and other dimensions of nature. They also vary because of human investment of money and effort into the land itself, such as clearing forest, fencing, fertilizing, and laying drains. And they depend on the whole economic environment -- the macroeconomy, transport costs, taxes, liens, and such property entitlements as water rights, local schooling and farm income support programs. Yet we know that the values of millions of separate and immobile acres respond to common influences over time, because they are linked by farm-product markets, asset markets, other input markets and common government policies.

The social and economic meaning of a change in farmland values depends critically on whether or not it is a change in price, affecting the net wealth of the landowner without any change in the owner's investments into the land. In this paper all changes in land value caused by changes in the economic environment (macroeconomic swings, transport improvements, etc.) are viewed as changes in price. Price changes are distinguished from quality changes, which result from those

direct investments in the land by farm owners and farm operators.[1] The crucial price-quality separation is performed by removing known sources of quality change from the historical measures of land value, to distill as pure as possible a measure of those price changes, those capital gains and losses that owners experienced on their farm lands. In particular, the data allow removal of three quality-change components: changes in the value of farm buildings, changes in aggregate land value caused by geographic drift of America's farms between states with differeing land quality, and farmers' conversion of land between the "unimproved" and "improved" categories.

It so happens that in American experience, the movements of farmland values are dominated by price movements. Removing all the quality changes does not greatly alter the view of price trends one would have gained from the raw per-acre values themselves. In fact, the long pre-1915 rise in true farmland prices was even greater than the raw value figures imply, while the price movements since 1915 were very close to those suggested by the unrefined figures. Since similar trends emerge from unrefined value-change figures or from refined price-change figures, we can economize on tables and figures here by looking only at unrefined national values (Table 1 and Figure 2), including annual values since 1900, and at refined regional and national prices for 17 benchmark dates since 1850 (Table 2 and Figure 3).[2]

Average U.S. Farmland Values since 1850. To survey the long movements, it is best to begin the main chronology in 1850, with the start of the census/USDA series, and to defer discussion of trends before 1850 to the next section, when the trends and the deficiencies of the early data can be weighed together.

Between 1850 and 1915, real[3] farmland values advanced 2.08 percent a year, nearly quadrupling over the whole 65 years (Table 1 and Figure 2). What share of the value gain was a true price gain, a capital gain on farm land? More than one hundred percent. The real price of fixed-quality farm land (Table 2 and Figure 3) more than quadrupled, rising 2.18 percent a year. The price gain exceeded the overall value gain because of the westward drift of America's farm land into lands that have always been less productive. The westward drift dragged down the average quality of

American farm land faster than the 0.29 percent annual quality gain from improvements on fixed sites.

The overall price increase occurred despite a 29-percent national drop in farmland prices in the Civil War decade. The era famous for farm protest, 1870-1900, was one in which farmers' capital gains in fact matched their all-time historical average, a point previously noted by Bowman [1964] and by Fogel and Rutner [1972]. The decade of fastest appreciation was 1900-1910, that Golden Era in which the farmer's terms of trade rose to the all-time peak in 1910-1914, which has been pushed as a norm for price "parity" ever since. In the first decade of this century, the real price of farm land jumped six percent a year, the fastest decadal rate in U.S. history except for the 1970s (and possibly the 1790s, on which more below).

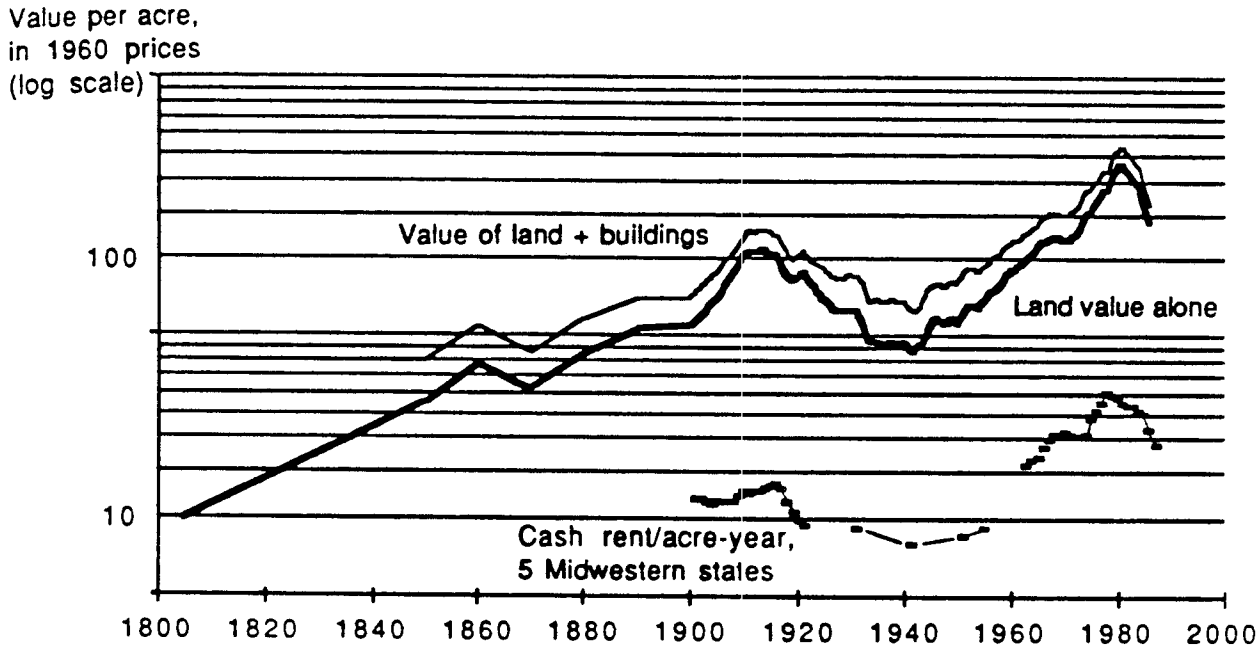
All regions shared the national trend between 1850 and 1915, though with some differences. For the South the Civil War decade brought a 50-percent real capital loss on farm land of given quality. Farmland prices in the South dropped to 55-60 percent of the national average and stayed there through 1915, matching the South's disadvantage in overall income per capita. The Northern states, after their milder losses in farm land in the Civil War, advanced at a fairly uniform pace for the rest of the nineteenth century. Early in this century, owners of Northeastern farms began to experience slower capital-gains rates than the rest of the nation.

The first farm-value crisis of the twentieth century was in fact larger and more prolonged than the crises usually described. What have been billed as two sharp crises -- the land-speculation crisis of 1920/21 and the collapse of the early 1930s -- were in fact just parts of a longer unrelieved decline in farm fortunes. The farm crisis of 1920/21 is consistently viewed as a sharp defeat for the optimistic expectations that had bid up land values during World War I.[4] While agreeing on the severity of this postwar crisis, historians are divided about the rest of the 1920s, some viewing the whole decade as a continuing agricultural depression and others finding a respite in the rise of farm incomes and land values before the next crisis, the great slump of 1929-1933. Both views underestimate the length and depth of what was actually a spreading crisis for landowners and farm operators all the way from 1914 to a trough in 1942. There are two reasons for the common

Table 1. The Purchase-value and Rent on U.S. Farmland, 1805-1986.

Year	Land value per acre: (nominal)	(1960 $/a.)	realty/acre	1960 US$, cash farm rent/acre
1986	516.71	139.56	160.98	19.29
1985	589.52	162.29	186.93	22.07
1984	678.53	193.46	222.96	25.05
1983	682.78	202.96	234.23	25.81
1982	712.19	218.51	252.51	26.76
1981	706.97	230.21	266.69	26.85
1980	635.32	228.33	264.88	27.69
1979	522.21	213.06	256.23	29.18
1978	404.97	183.83	221.52	29.64
1977	371.36	181.49	218.94	30.16
1976	320.81	166.90	201.33	27.76
1975	280.59	154.39	186.53	25.87
1974	249.45	149.80	181.36	23.91
1973	202.71	135.09	163.94	20.75
1972	177.39	125.57	155.03	
1971	164.20	120.07	148.44	
1970	157.94	120.46	149.49	20.86
1969	151.52	122.40	151.87	21.41
1968	144.52	123.01	152.37	
1967	134.77	119.54	149.02	21.07
1966	126.77	115.68	144.18	19.89
1965	116.07	108.95	137.04	18.76
1964	108.95	104.02	131.76	17.08
1963	102.01	98.68	125.75	16.71
1962	96.14	94.13	121.40	15.99
1961	91.18	90.27	116.81	
1960	89.23	89.23	116.00	
1959	84.15	85.47	112.75	
1958	77.25	79.09	105.45	
1957	71.43	75.14	102.05	
1956	67.38	73.35	99.07	
1955	61.58	68.05	93.93	
1954	58.69	64.65	90.32	9.28
1953	59.60	66.26	91.82	
1952	58.69	65.42	91.40	
1951	53.45	60.89	85.44	
1950	45.93	56.51	79.97	8.49
1949	47.14	58.56	81.98	
1948	45.84	56.39	78.74	
1947	43.24	57.30	79.51	
1946	38.23	57.96	80.36	
1945	33.94	55.82	77.29	
1944	30.46	51.23	72.32	
1943	27.14	46.41	64.97	
1942	24.16	43.85	61.71	
1941	22.59	45.40	64.31	
1940	22.59	47.72	67.61	8.03
1939	21.65	46.11	68.17	
1938	22.63	47.52	69.29	
1937	22.63	46.66	68.05	
1936	21.65	46.21	68.31	
1935	22.30	48.11	69.02	
1934	21.31	47.15	68.59	
1933	21.29	48.67	68.58	
1932	26.00	56.32	80.14	
1931	32.00	62.25	85.59	
1930	35.73	63.29	86.80	9.19
1929	35.98	62.14	84.62	
1928	36.24	62.58	84.62	
1927	37.24	63.46	85.21	
1926	39.00	65.27	87.03	
1925	40.78	68.80	91.12	
1924	41.62	72.00	93.41	
1923	44.04	76.44	97.20	
1922	45.72	80.71	100.63	
1921	63.15	87.96	107.57	
1920	57.50	84.93	101.92	9.31
1919	48.31	82.59	99.17	9.87
1918	44.12	86.80	104.28	10.61
1917	40.76	94.02	113.02	11.60
1916	38.25	103.77	124.81	13.01
1915	35.73	104.06	125.23	13.45
1914	36.54	107.64	129.61	13.12
1913	35.69	106.66	128.50	12.83
1912	34.84	105.65	127.36	12.71
1911	33.99	106.20	128.09	12.75
1910	33.14	103.08	124.97	12.44
1909				12.51
1908				12.12
1907				11.47
1906				11.52
1905	21.11	70.20	87.84	11.66
1904				11.57
1903				11.21
1902				11.46
1901				11.81
1900	15.30	54.39	70.32	11.74
1890	16.20	52.19	70.01	
1880	13.98	42.39	57.65	
1870	13.14	30.79	42.79	
1860	11.67	38.81	54.28	
1850	7.68	27.31	39.63	
1805	4.02	9.52		

Figure 2. The Purchase-value and Rent on U.S. Farmland, 1805-1986.



Notes and sources for Figure 2 and Table 1

Farm real estate (land and buildings) per acre, agricultural census years, 1850-1910 and annually, 1910-1986: the official U.S. Department of Agriculture averages for the 48 states, beginning with the first available data or 1850. The figures for 1850-1970 are from Clifton and Crowley [1973]. The estimates for 1905, however, are taken from Holmes [1906, p. 11], spliced to the census values for 1900 using the 1905/1900 ratios from Holmes's estimates. Figures for years since 1970 are from regular publications of the USDA Economic Research Service, with the title at first being *Farm Real Estate Mortgage Market Developments* and later becoming *Agricultural Resources: Agricultural Land Values and Markets.... .*

Farm land value per acre, 1805: Blodget [1806, pp. 60, 196]. The land area is Blodget's 39 million "cultivated" and 150 million "adjoining" acres, at his valuations. See Appendix D for alternative interpretations of Blodget's figures.

Farm land value per acre, 1850-1986: same sources as for farm real estate. The shares of land value in total real estate value from 1900 on are given by the 1920 Census of Agriculture and by Clifton and Crowley [1973]. Those for 1850-1890 were assumed to equal the same state-level shares for 1900. See Appendix B for further details.

Cash rents for farmland, five Midwestern states, 1900-1986: The annual data for 1900-1920 are from Chambers [1924]. Those for 1920, 1930, 1940, 1950, and 1954 are from the agricultural censuses for these years. The annual figures for 1962-1986 are from USDA Economic Research Service, *Farm Real Estate Mortgage Market Developments* and its successors.

The cash rent data are farm-area-weighted averages of the average values for five states sampled by Chambers: Ohio, Illinois, Iowa, Wisconsin, and Minnesota. For 1900-1915, his thinner-sample series were spliced onto the data rich series for 1916-1920. The annual series since 1962 refers to gross cash rents per acre of wholly-rented farms, presumably including buildings, instead of the separate series for cropland and pasture. See Appendix E for a fuller discussion.

Consumer price index: this is a spliced series set at 1960=1.000. For 1850-1913 I spliced together the Adams, Hoover, Long and Rees cost-of-living indices cited in US Department of Labor [1970, p. 285]. To extend back from 1850 to 1805, I spliced on the cost-of-living series by David and Solar [1976].

Table 2. Real Value per Improved Farm Acre, Adjusted for Interstate Drift, by Region, 1850-1986.

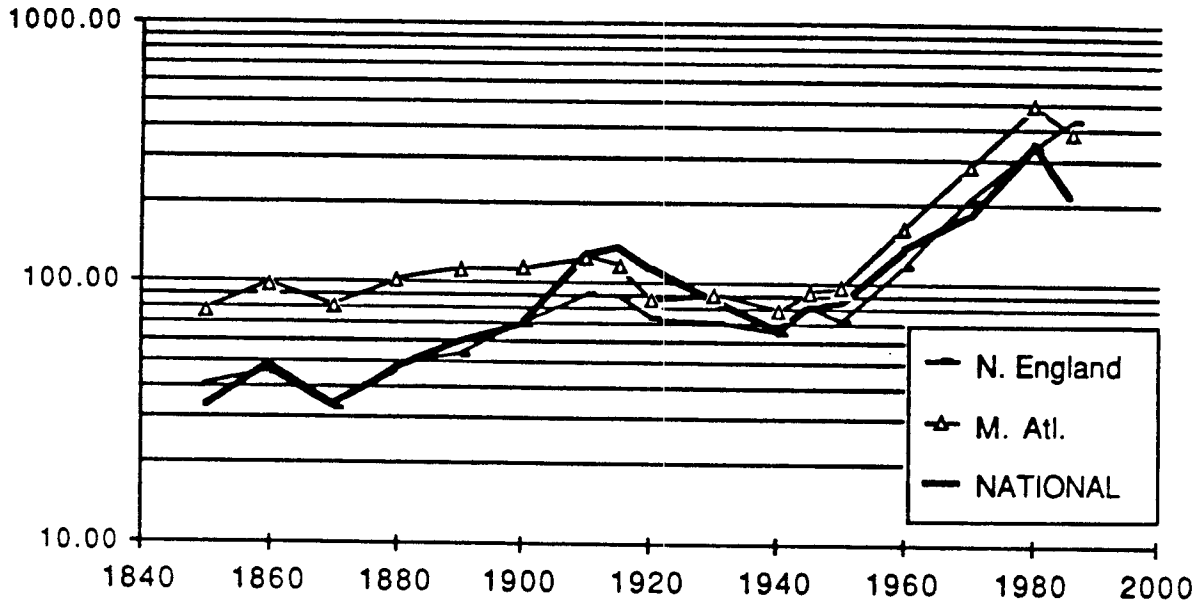
(in 1960 New England consumer dollars per acre)

	1850	1860	1870	1880	1890	1900
N. England	41.26	46.22	33.54	49.07	54.04	71.04
M. Atl.	78.00	98.61	82.23	102.41	112.32	113.83
E.N.C.	57.37	92.66	77.96	99.44	121.53	141.64
W.N.C.	19.03	31.67	30.39	34.01	51.29	67.50
S. Atl.	20.23	29.28	14.98	26.34	41.35	45.30
E.S.C.	32.47	58.85	26.31	30.93	37.96	41.44
W.S.C.	21.73	26.89	16.75	23.43	35.39	38.90
Mountain						
Pacific						
NATIONAL	34.06	49.08	34.78	47.43	59.82	70.88
US % real capital gain/yr.:		3.72	-3.38	3.15	2.35	1.71
US % nominal capital gain/yr.:		4.42	0.06	0.52	1.73	0.71

	1910	1915	1920	1930	1940	1945	1950
N. England	91.57	90.39	74.90	72.19	65.54	83.29	72.92
M. Atl.	126.66	115.94	86.81	91.46	79.54	93.84	97.49
E.N.C.	233.35	232.29	205.20	116.37	104.54	129.01	137.77
W.N.C.	136.22	147.60	146.63	89.71	57.64	67.78	75.24
S. Atl.	87.31	91.24	109.00	87.51	75.02	90.97	87.35
E.S.C.	65.00	70.49	83.04	73.74	67.71	78.01	77.08
W.S.C.	86.12	87.53	89.19	83.91	68.83	87.28	93.55
Mountain		69.22	54.11	43.09	34.67	48.36	49.90
Pacific		241.57	181.95	213.04	148.60	226.44	202.54
NATIONAL	128.19	137.95	114.35	86.98	67.19	83.86	86.26
	6.10	1.48	-3.68	-2.70	-2.55	4.53	0.57
	7.48	2.93	10.31	-4.45	-4.25	9.91	6.58

	1960	1970	1980	1986
N. England	116.53	205.66	323.14	409.22
M. Atl.	163.00	279.40	475.06	373.41
E.N.C.	217.55	271.05	568.72	260.63
W.N.C.	102.41	128.46	269.86	120.24
S. Atl.	184.71	258.06	450.27	337.47
E.S.C.	127.76	206.25	372.80	269.23
W.S.C.	160.78	223.44	302.04	237.53
Mountain	81.90	102.12	191.56	127.03
Pacific	354.92	362.48	514.20	417.99
NATIONAL	134.84	178.28	336.53	205.87
	4.57	2.83	6.56	-7.86
	6.76	5.66	14.88	-3.37

Figure 3. **Real Price per Improved Farm Acre, Adjusted for Interstate Farming Drift, by Region for 17 Benchmark Dates, 1850-1986.**



Dollars per acre
at 1960 New England
purchasing power
(log scale)

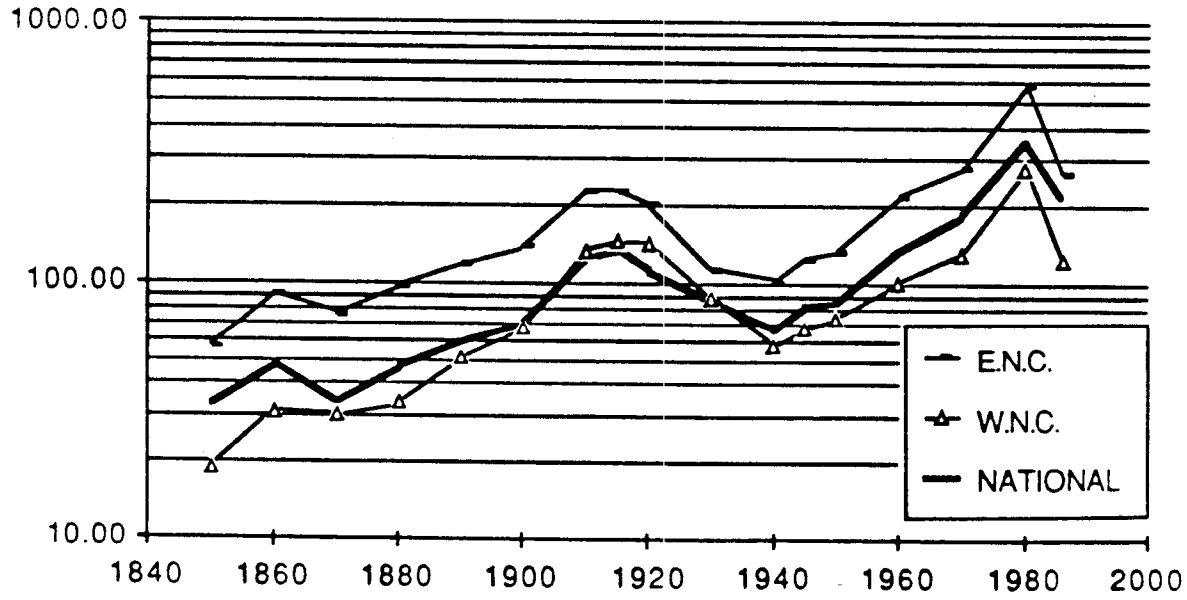
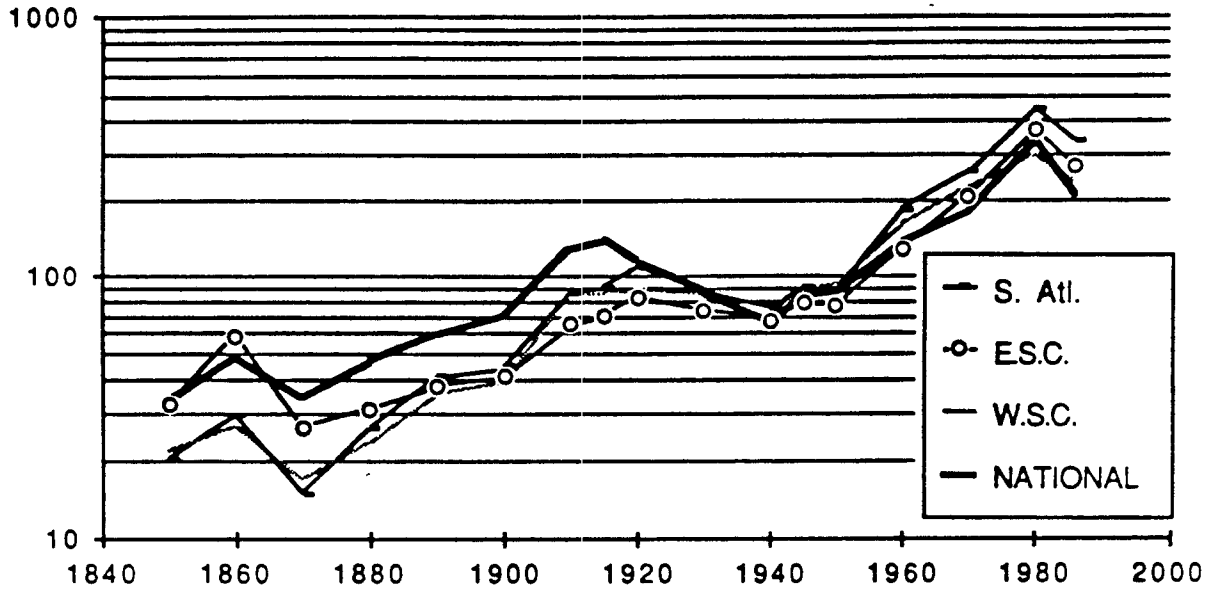


Figure 3. Real Price per Improved Farm Acre, Adjusted for Interstate Farming Drift, by Region for 17 Benchmark Dates, 1850-1986. (continued)



Dollars per acre
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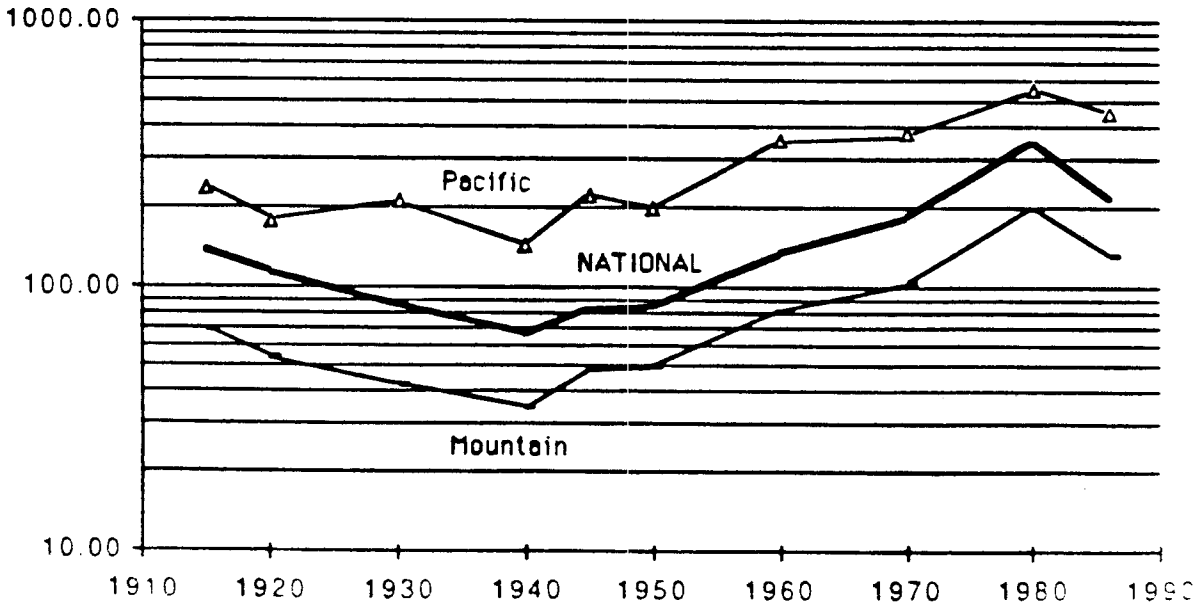


Notes and sources to Table 2 and Figure 3:

The real values of improved land per acre from 1850 to 1986 are derived from the unadjusted Census and USDA figures through a series of steps described at length in Appendices B-D.

The adjustments begin with state-level values of farm land per acre, already excluding the value of buildings, as in the national averages in Table 1 and Figure 2 above. Regional and national averages are re-adjusted so as to remove the effects of geographic (interstate) drift in America's farms. Before World War I the westward drift had a strong tendency to reduce average land quality. Removing its effects on land value thus raises the rates of growth of the prices of land at fixed sites. See Appendix C for details.

Next, region-specific cost-of-living deflators are used to convert nominal to real values. The deflators refer to urban working-class consumer bundles. The resulting real (deflated) values show the purchasing power of an acre of land when the proceeds from selling it are spent in a city of the same region. Appendix C gives details, and Appendix B notes the similar behavior of farm-product price deflators for individual states.

Finally, the effects of land improvement are removed from land values. The adjustment uses the shares of farm land that are "improved," as measured in the Census between 1850 and 1950, and the value ratios for (improved/unimproved) land as estimated by Tostlebe for several regions. For 1950-1986, movements in each state's land quality are those estimated by Peterson [1986]. For details, see Appendix D.

misperception. One is what the economist calls "money illusion:" past authors have followed movements in nominal, or current-price, incomes, overlooking the greater contemporaneous swings in the prices farmers had to pay. The other is that too little attention has been paid to differences in the fortunes of the three main agricultural groups: landowners, tenant farm operators and laborers.[5]

Figures 2 and 3 set the story straight for farmland values and constant-quality farm prices, deflating nominal dollar values by the cost-of-living index. Contrary to the current-price impression of a boom during World War I, the real value of farm land (and of farm-operator incomes) had been falling since 1914. The wartime jump in farm prices was exceeded by the sharper jump in the prices farmers had to pay, and real land values sagged accordingly from 1914 to 1919. How can we reconcile this decline in land values with the rise in real farm-sector income, perhaps as much as 50 percent, from 1910-14 to 1919? The group within agriculture making sharp income gains during World War I, and losing these gains thereafter, were farm laborers, not landowners. Farm operators made money off their family labor, not off capital gains on land.

As for the drop in farmland values from 1919 to 1921, it was actually a slight rise in real terms, given the faster drop in the prices farmers paid. The rest of the twenties saw further decline in farm real-estate values, contrasting with recovery in laborers' real wages and slight gains in farmers' (i.e. farm operators') non-labor, non-land incomes. The slump in the early 1930s was undeniably severe, but should be viewed as part of a greater decline in farm fortunes lasting into World War II. The overall peak-to-trough decline in farmland values, 1914-1942, came to 59 percent (3.16 percent a year). That decline consisted predominantly of true price drops, not changes in land quality. Between 1915 and 1940, for example, real land prices dropped 51 percent (Table 2) while quality dropped only 1.5 percent (Appendix Table D.6). The period from about 1914 to about 1942 stands as a modern refutation to the Malthusian-Ricardian presumption that land values are destined to rise along with the rise in productivity.

Regions did not bear the burden of farmland capital losses equally, according to the results for 1915-1940 in Table 2 and Figure 3. The North Central states fared

worst, especially west of the Mississippi, while farm owners in the Northeast and South lost less than average. It is odd that the South was relatively spared. Indeed, by 1940 Southern farmland prices pulled even with the faster-sagging national average price per improved acre, in contrast to the South's continued backwardness by 40-45 percent in terms of income per capita. It is also odd that almost all of the convergence between Southern and other farmland prices came between 1915 and 1930, before the New Deal government farm programs could have favored Southern landlords.

Between 1940, near the twentieth-century trough, and 1980, the peak, real farmland prices quintupled. The real rate of capital gain was 4.11 percent a year, well above the rate for 1850-1915. As Figures 2 and 3 show, the rise was monotonic and fairly steady. The decade of greatest capital gain was, as noted, the 1970s, when real land prices gained 6.56 percent a year. The forty-year rise was spread across all regions, though New England and the South pulled slightly ahead of the national average in this period. Section III will comment on what little we know about the causes of this impressive sustained rise.

The 1980s brought the sharpest drop in farm prices in American history. From the 1981 peak to 1986, the average acre of U.S. farm land declined 39 percent (or 9.5 percent a year) in real value (Table 1), virtually all of the value loss being a pure price drop. Since it had jumped 83.3 percent over the previous nine years, we may well have an example of the kind of speculative boom and bust that observers have seen in the rise and fall of nominal land values during and after World War I. Whether the rise and fall were really speculative excesses or not is a topic to which we return below. The decline of those five years, at any rate, was more severe in percentage terms than any other five-year decline on record, including the end of World War I and the Great Depression. One need not dig far into the past to study acute farm crisis.

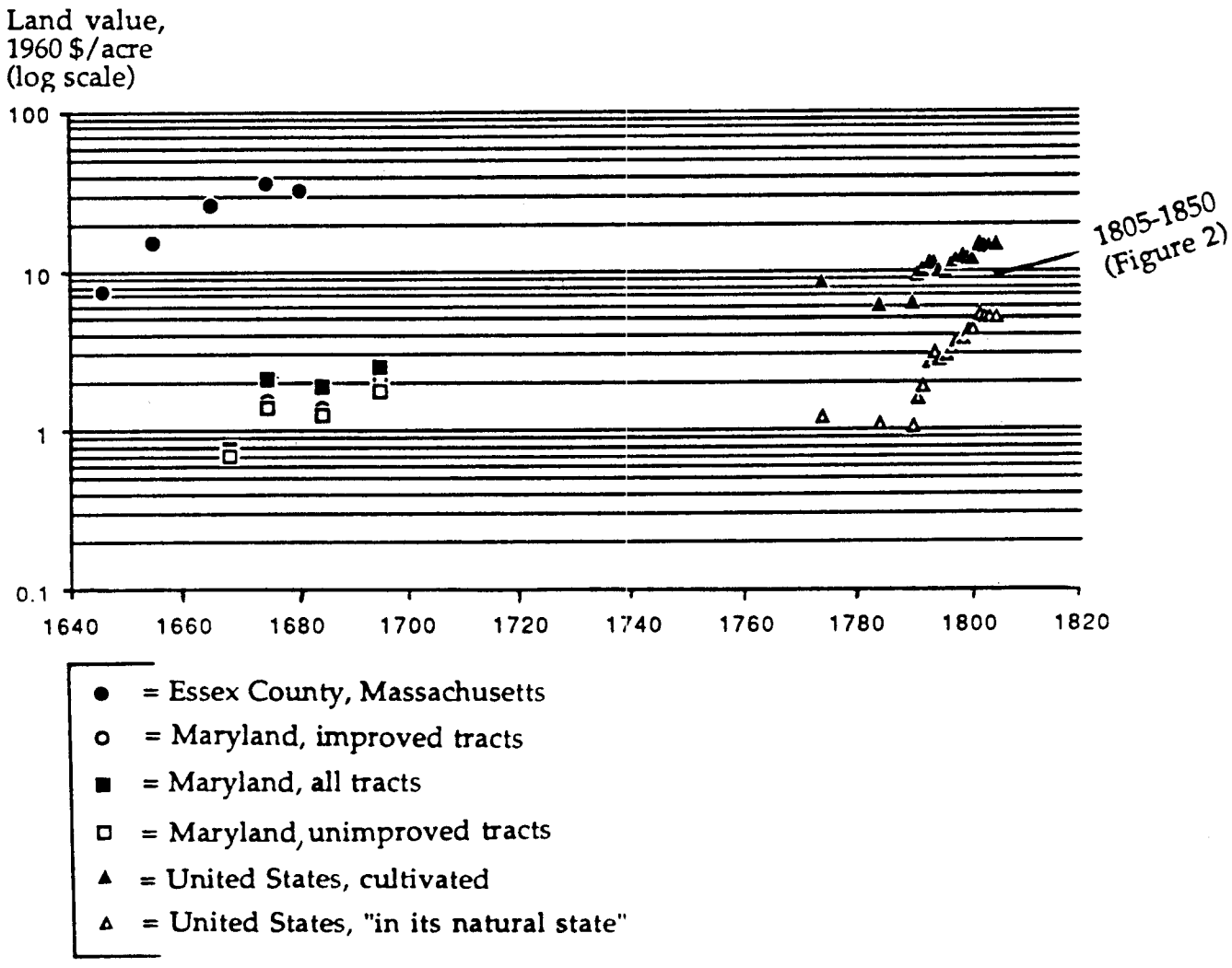
Land Values before 1850. If land prices quadrupled between 1850 and 1915, had they also been rising earlier? Were there increases in land values that were true price increases? That is, could land of given quality have been getting more scarce for a century or even longer despite the pushing back of the frontier?

We enter a statistical darkness before 1850. Past writers have lit a few candles, however, and these at least suggest the general shape of things over two centuries before 1850. First, we have Blodget's [1806] estimate of the value of farm lands in the United States in 1774-1805. Blodget left us some estimates but not others. His average value per acre in 1805, undocumented but worth considering in view of his relative expertise, implies that the real average value of US farm land may have doubled between 1805 and 1850, again despite the opening of cheaper land to the west. Blodget also offered separate price series for two extreme types of land in the United States of his day. Figure 4 graphs his estimated values per acre of cultivated lands and land "in their natural state" between 1774 and 1805. Both series suggest that land values were depressed during the Revolution but soared after it, in the period 1790-1805.

The distinction beteen land-price changes and land-quality changes must again be given its due. In frontier America, land shifted rapidly from being altogether unworked to being "unimproved, but in farms" (untilled grazing land, forest, etc.), to being fully cultivated. The rate of development of the land slowed down progressively. The share of improved land in total farm land did not peak until 1910, and the total land area in farms peaked only in 1950. Of the land ultimately in farms around 1950, only a quarter was in farms a century earlier, in 1850, and even less was developed before that.[6]

Careful accounting makes it possible to show what Blodget's estimates imply about changes in land price and changes in land quality over the periods 1774-1805 and 1805-1850.[7] The precise magnitudes depend on what one assumes about the unimproved land area in farms, a magnitude on which Blodget offered no guesses. The range of implications is still narrow enough, though, to conclude that there were noteworthy capital gains on farm land in both periods. Between 1774 and 1805, Blodget's figures imply that the real price of fixed-quality land rose at least 121 percent, i.e. more than doubled. Since Figure 4 shows that all the real gain came in the subperiod 1790-1805, this era might have competed with the 1970s as the era of greatest capital gains on U.S. farms. From 1805 to 1850, the real price of fixed-quality land more than doubled again, and possibly tripled, depending on how one reads

Figure 4. Some Early-American Series on Land Values per Acre, 1642-1805.



Notes and sources to Figure 4:

▲, Δ: Values for cultivated lands and for lands "in their natural state," All U.S., 1774-1805: Blodget [1806, p. 60]. The extra data point for 1805 is the starting point of the land value series plotted in Figure 2.

■, ◊, □: For colonial Maryland, 1664-1699, these are decadal averages (1664-69, 1670s, 1680s, 1690s) of Wyckoff's [1938] values per acre for improved tracts, all tracts, and unimproved tracts, respectively.

♦: For coastal Essex County, Massachusetts, north of Boston, 1642-1682, these are decadal averages of Davisson's [1967] annual-average land values per acre.

Currency: Wyckoff's figures in pounds of tobacco per acre were converted into sterling using Menard's farmgate price of tobacco in Maryland or the Chesapeake [*Historical Statistics of the United States*, vol. II, Series 2583-4]. The sterling price series for Maryland and Massachusetts were converted into dollars at the $4.15/£ used by Alice Hanson Jones.

Consumer price deflator: Extending the chain of spliced indices used in Figure 2, I followed the David-Solar price index back to 1774. For 1720-1774, it was necessary to use Cole's wholesale prices [*Historical Statistics*, vol. II, Series 2557]. For 1700-1720, I resorted to the Boston price of wheat in units of silver. For 1670/79-1690/99, I used the decadal prices of Anderson [1975] for New England, and hooked to these Davisson's annual consumer price index for seventeenth-century Massachusetts. The resulting price series, converted back into sterling, was also applied to Wyckoff's Maryland land values.

Blodget's estimates for 1805. The whole chain of land price increases from 1790 to 1915 -- at least a doubling (1790-1805) followed by more than a doubling (1805-1850) and more than a quadrupling (1850-1915) -- raises the obvious rhetorical question about the pre-1850 figures: Can we believe the early estimates? Fresh archival data are needed to test Blodget.

If farmland prices rose so rapidly after independence, had they also been rising that fast across the colonial era? Our few dim candles in the darkness suggest not. Let us start with an awkward comparison of seventeenth-century Maryland with the 13 colonies/states for 1774-1805. As Figure 4 shows, the average value of all unimproved farm land in the United States (east of the Mississippi River) in 1790 seems to have been no higher than the value of unimproved Maryland farm land in the late seventeenth century. Even the price of improved land did not rise as fast from the 1690s to 1774 as it did after 1790. The awkward comparison hints that land values increased more slowly from the late seventeenth century to the late eighteenth than they were to rise after independence.

The colonial picture is complicated, of course, by the paucity of data and the heterogeneity of land. Land varied enormously in value. Land in coastal New England was much more valuable than even coastal land in Maryland or the South, as shown for the seventeenth century by Figure 4 and for the nineteenth by Sturm [1969]. Prices were much lower in the interior. One's view of colonial land-price trends will also depend on whether one wants to follow the prices of only those lands actually farmed in colonial times or the prices of all lands in the peak farming area of 1950.

Again, more archival research on land prices is needed. I would hypothesize, however, that the average value of farm land rose much more slowly from the late seventeenth century until Independence than it was to rise later, in the first century of independence.[8]

Rents, Land Values and the Rate of Return. Our overview of the purchase price of land has suggested some conclusions about long-run trends in the scarcity of American farm land. There are weak hints of only a gentle price rise in the colonial era, followed by rapid price increases after independence, and continued price gains

across the late nineteenth century. The main disturbance in this tapered rise was the 29-percent capital loss across the Civil War decade. The twentieth century still stands out as an era afflicted by wide swings in land price: a noticeable rise up to 1914, a 59-percent drop in average value from 1914 to 1942, a tripling from 1942 to 1973, and an unprecedented boom-and-bust swing since 1973. To what extent were these movements caused by forces changing the true productivity of land in current farm production? To what extent do they reflect "speculative" forces, or changes in the interest rates at which land values are capitalized, or tax changes, or other changes in the nature of farm property rights?

The quickest way to progress toward answers is to compare the purchase price of farm land with its annual rental value. Movements in rental value generally reflect influences on the marginal productivity of a farm acre of given quality, since rents should tend to equal the marginal product of land. The other forces -- speculative expectations, interest rates, taxes and property rights -- tend more to influence movements in the rent/price ratio (or the reciprocal of the capitalization ratio, called the number of "years' purchase" in English historical terminology). To give the different forces their due, we turn to farm rents, in three stages: (1) a look at documented twentieth-century trends in real rents, (2) judgments about the rent/price ratio in this century, and (3) indirect inferences about trends in real rents before 1900, using a pattern in the rent/value ratio observed for the twentieth century. Knowing rents as well as rates of capital gain allows us some limited comments on trends in the overall rate of return to owning farm land.

Within the twentieth century, data on the rental value of farm land for five Midwestern states[9] extend back to 1900, thanks to the classic study by Clyde Chambers [1924], the censuses of 1930-1954 and USDA annual surveys since 1962. Unfortunately, the data are not a consistent series, but three juxtaposed series that probably differed in coverage.[10] Worse, the three series do not overlap in time, preventing direct tests of their comparability. Figure 2 above shows the time path implied by Chambers' figures, the agricultural census data for 1930-1954, and the US Department of Agriculture. The rental series shows the same broad trends as the purchase-price series for either the United States or for the Midwest, but with some

differences. Midwestern land rents rose from 1900 to 1915. Real rents followed real land prices downward until World War II, though the decline in rents was less severe. After World War II, both real rents and real prices rose. Both jumped in the 1970s and fell in the 1980s, but here two differences stand out. First, real rents started falling after a peak in 1977, but real farmland prices did not start falling until after a peak in 1981. Second, farmland prices gyrated much more than rents, so that the rent/value ratio dropped sharply from 1974 to 1980, then jumped.

It is not surprising that rents and prices generally moved together over the century as a whole. They should always be linked by asset markets. Investors can choose whether to hold farm land or to hold such other assets as interest-earning bonds or common stocks. Rents are part of the income from holding farm land, the other part being the net gain on price appreciation and government supports for landowners (minus repairs, depreciation, taxes and a risk premium). If rents rose relative to farmland prices for some outside reason, there would be a tendency to invest more in land, bidding up the price until the ratio of rent to price returned to a level consistent with interest rates, price expectations, and other forces. For similar reasons, a drop in rents should be accompanied by a drop in prices.

Yet the ratio between farmland rents and prices has not been a constant. In each of our three data periods (1900-1920, 1930-1954, and 1961-1986) the rent/value ratio gyrated in a way suggesting a *systematic pattern in forecast errors:* the further the real price of farm land is above (below) its previous longrun trend, the greater the likely overoptimism (overpessimism) about the subsequent price trend.

The fall of the rent/value ratio early in this century, for example, cannot be explained by interest rates, or taxes, or government subsidies, or any good reason why the risk of landholding should have seemed to drop. It must be explained by a rise in farmers' expectations about future farmland prices and rents. Were they right in expecting further increases? They were clearly wrong in the one year 1920, when the fall in the rent/value ratio was immediately followed by a drop in both rents and prices. Other writers have documented their naiveté about price trends around 1920.[11] Their behavior in 1920 certainly *looks* like a speculative bubble, and I shall continue this traditional interpretation for the year 1920, though economists rightly

insist that seeing investors make a wrong forecast does not strictly prove irrationality or instability in their behavior.

By 1940, on the other hand, investors seem to have been too pessimistic about farmland values. Interest rates and returns on common stocks were very low, and the onset of war was already ushering in a period of inflation, especially inflation in the relative price of agricultural products. With hindsight, we find it a good year for investing in farm land. Farmers tended to be most pessimistic when the price was lowest relative to trend -- the very moment when it was to start an impressive rise.

The movement of farm rents since 1962 also suggests that investors' forecast errors were pro-cyclical. The rent/price ratio fell from around seven percent to around five percent at the 1980 trough, and then jumped back up in the crisis of the 1980s, regaining its early-1960s level. Again, as in the two earlier periods covered by the rent data, it appears that the market's price-forecast error was positively rated to deviations in land price from prior long-run trend. The trough in the rent/value ratio in 1980 implies that it was then, with price at a cyclical peak but real rents already sliding, that investors most expected acceleration of rents in the future.

Was the fall and rise of the rent/value ratio a speculative land-price bubble? In the wake of the farm-value collapse of the 1980s, economists are drifting back toward an affirmative answer. The econometric study by Moore and Meyers [1986] rejects a variant on the rational expectations hypothesis in the market for farm land, even for time series ending at the 1981 peak in land values. Burt [1981] finds the farm land market responding to revelations of its mistakes with dampened swings. Featherstone and Baker [1987] find overshooting and bubbles in US data on all farm assets for the period 1910-1985.

The belief in speculative bubbles in farm land, while plausible, is not necessary for present purposes. All that is needed is the systematic twentieth-century pattern in the market's revealed forecast errors: the higher the value of land relative to past long-run trend, the greater the tendency to overestimate the future path of rents and land values. Knowing that such a pattern has shown up throughout this century, plus a little asset-market theory, generates a

working hypothesis about how the rent/value ratio, and farm rents themselves, moved in the period 1850-1900, for which we lack rent data. The small infusion of theory concerns asset-market equilibrium. At any point in time, investors will link rates of return as follows:

expected rate of return on owning land	=	rent/value ratio *plus* expected rate of land price gain *minus* taxes *minus* cost and disamenity premium on land	=	rate of interest on the alternative asset

Re-expressing the equilibrium relationship so as to focus on the rent/value ratio yields:[12]

rent/value ratio =	interest rate *minus* actual land-price inflation *plus* tax rate		+	cost and disamenity premium on land *minus* price forecast error
	measureable factors			*unmeasureables (a net residual)*

Breaking down the rent/value ratio into two parts is useful because the two parts are documented differently and reflect different kinds of behavior. Movements in the first term can be followed in the data, even for the nineteenth century. Movements in the second are likely to follow the forecast-error pattern just noted for the twentieth century.

Knowing trends in Midwest farm land values, interest rates, and taxes for the second half of the nineteenth century, we can now infer what probably happened to the undocumented rents of that era. Between 1850 and 1860, investors reaped nominal capital gains on Midwest farm land at the rate of 9.44 percent a year. We would have to believe that rents were also rising unless something could have made the rent/value ratio drop faster than 9.44 percent a year. That was surely not the case. On balance, the rent/value ratio probably did not decline between 1850 and 1860. It would have risen, and real rents would have doubled over the decade, if investors in 1860 had foreseen the upcoming capital losses of the Civil War decade, even though interest rates did decline somewhat [Bogue, 1976, pp. 76-87]. The

likelihood that investors were overoptimistic on the eve of the Civil War means that they probably bid the value/rent ratio higher -- the rent/value ratio lower -- than objective and measurable factors would have warranted. The best working hypothesis about the 1850s is that real rents rose, though they did not double, as the changes in measureable factors would have implied.

For the Civil War decade and the farm-protest period 1870-1900, the same reasoning lets us see that real farm rents were probably stable, or rose only slightly, despite wider swings in the purchase value of farm land. In the Civil War decade, the fall in land values was probably due to a shift toward investor pessimism, reinforced by a slight rise in nominal interest rates. The rent/value ratio should therefore has risen enough to cancel the drop in real value, leaving no great change in real farm rents. For 1870-1900, real rents probably again failed to follow farmland values. The rise in values was sufficiently nurtured by a drop in interest rates. With interest rates declining strongly, the rent/value ratio should have declined, and again there should have been no strong upward trend in real farm rents, except perhaps in the 1880s.

In sum, real Midwest farm rents probably moved as follows:[13]

1850s -- real rents up, though they probably did not double;
1860s -- no clear change in rents, unlike the drop in land values;
1870s -- no clear trend in rents;
1880s -- rents up, perhaps by 1.6 percent a year;
1890s -- no clear trend in rents;
1900-1915 -- rents up 0.9 percent a year;
1915-1940 -- rents down, perhaps 2.0 percent a year;
1940-1977 -- rents up strongly, perhaps 3.6 percent a year;
1977-1986 -- rents down 4.8 percent a year.

If rents and capital gains on farm land were both subject to increasingly dramatic swings, and the swings were nearly contemporaneous, it should follow that the same was true of the overall rate of return on owning farm land. That is the

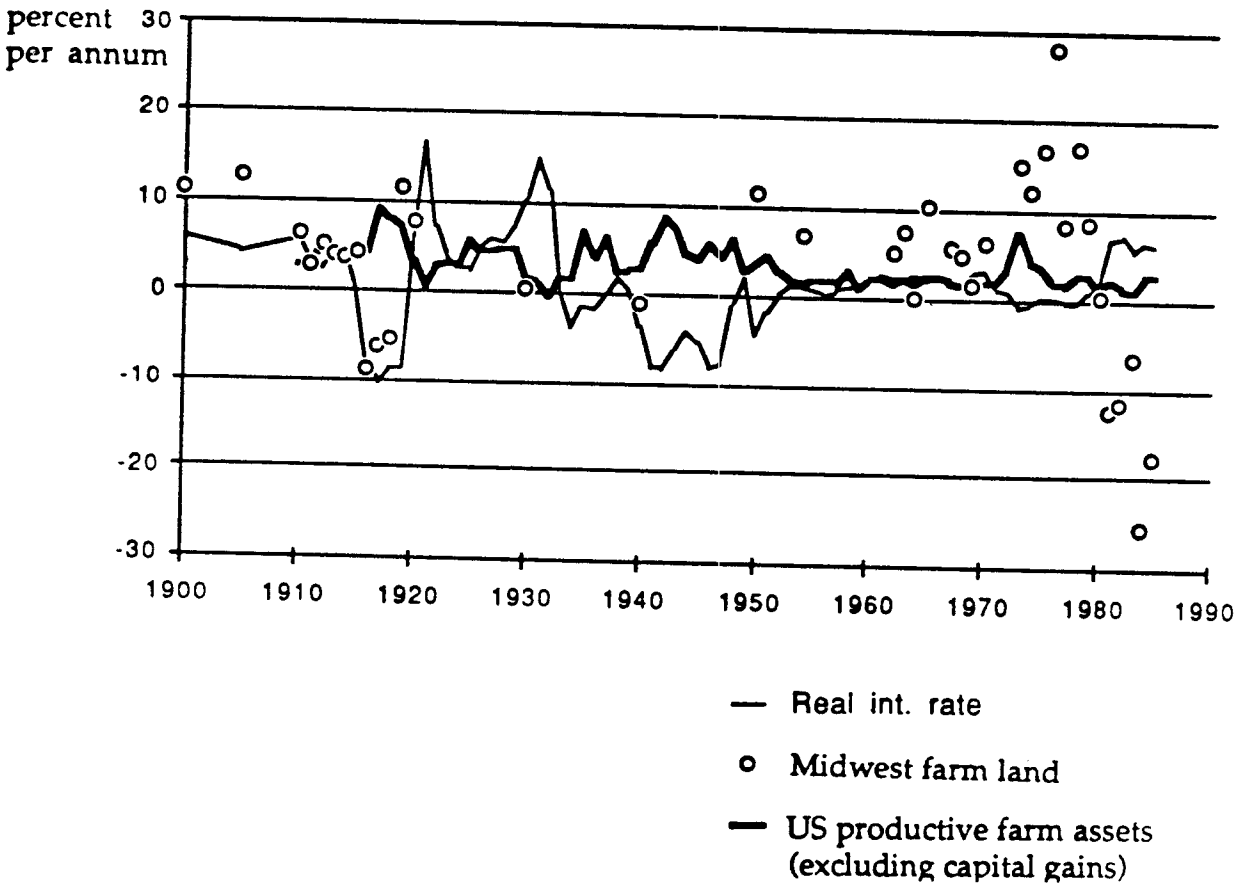
case.

The rate of return on investments in farm land can be traced for parts of the twentieth century, and limited inferences can be made about its movement in the second half of the nineteenth. First, however, it is wise to step back and reflect on what a measure of realized rates of return would tell us. Obviously, they reveal something about the real resources that end up in the hands of landowners, to be spent or reinvested. Yet for most debates, one is more concerned with the ex ante expected rate of return, relative to both the expected return on other assets and the subsequent realized return on farm land. Unfortunately, the expected rate of return cannot be observed. Even if each investor were in asset-market equilibrium, the expected rate of return could depart from the expected (or even certain) return on other assets for several reasons that cannot be separately quantified. Consider the role of unobservable concepts in these equations, where only the italicized terms are observable in data: (i) *realized (ex post) return on farm land* equals expected (ex ante) return on farm land plus net forecast error; and (ii) expected return on farm land minus *interest rate on an alternative asset* equals a pure disequilibrium gap plus a relative-disamenity premium on owning farm land due to risk aversion, etc., minus the amenity value, the joy and comfort, of being a farm land owner. With so many concepts unobservable, the overall gap between the realized return and the alternative interest rate can tell us little.

Note, however, that all those unobservable differences between the things we can measure are usually thought of as unchanging over the decades. The forecast error should always have a mean value of zero, however wide its year-to-year swings. So should any pure portfolio-disequilibrium gap. The disamenity of risk aversion and the amenity of owning your own farm are values that are supposed to be inherent in the farm sector, changing slowly or not at all. Therefore, if we observe sustained systematic swings in the departure of realized returns on farm land from alternative interest rates, we should ask which of the "unchangeables" actually changed.

Figure 5 offers clues on historic swings in the rate of return and what might have caused them. Note first the solid line representing the rate of current return

Figure 5. Real Rate of Annual Return on Midwest Farm Land, Compared with Real Annual Current Income Rate on All US Farm Productive Assets and the Real Interest Rate on Commercial Paper, 1900-1985.



Notes and sources for Figure 5:

Midwest farm land: each rate equals the rent/value ratio plus the net value appreciation (relative to the cost-of-living deflator) minus estimated depreciation and property taxes (but ignoring income and capital-gains tax). The tax rates for 1900-1905 and 1985 were extrapolated from 1910 and 1984, respectively. Depreciation rate = 0.40% per annum for 1900-1954, based on Chambers's estimates for circa 1920, and 1.25% for 1962-1985, based on USDA estimates for 1967-1970. All figures refer to five Midwestern states (Ohio, Wisconsin, Illinois, Iowa and Minnesota), averaged by total areas in farms. For numbers and details, see Appendix E.

Real interest rate: equals the 6-month commercial paper rate adjusted for consumer-price inflation from that year's average to the next year's average. The real rates for 1910-1984 were pre-calculated by Featherstone and Baker [1987, pp. 545-6], and those for 1900, 1905 and 1985 were added from *Historical Statistics* and from the *Economic Report of the President*.

Real rate of current return on all US farm productive assets: from Featherstone and Baker [1987, pp. 545-6]. This measure, based on work by Melichar, excludes capital gains and allegedly excludes all farm income from management and labor (a famously difficult separation to make).

(excluding any capital gains) on all productive farm assets. Its numerator is the rental stream that the market price of farm assets, dominated by real estate, is supposed to capitalize. Its trend is slightly downward in this century, and it has become more stable. The rate of current return on productive farm assets has remained near the short-term interest rate except during the inflationary surprises of the World Wars, which seem to have slightly buoyed real current returns on farm assets, while cutting the real rate of interest. The stable downward drift in current returns suggests that the net disamenity of owning farm assets drifted downward, perhaps because of the reduction of risk as proxied by movements in the current-return series.

From the turn of the century to World War II, the market for Midwestern farm land followed current rental returns and the real interest rate in the way it should, according to what data we have.[14] The shocks of World War I and the great depression had only a limited effect on the capitalized value of farm land. The worst years for real capital loss were 1916-17 = -8.8%, 1917-18 = -7.7%, 1931-32 = -9.5% and 1932-33 = -13.6%. Against these losses must be counted the positive rents, like those positive real returns on all farm assets referred to in the preceding paragraph. None of these losses, nor the gains documented for 1919-1920, is badly out of line with either the interest rate or the subsequent movement of current returns. The same reasonableness of farm land movements seems to have been characteristic of the latter half of the nineteenth century.

Since World War II, on the other hand, the rate of return on Midwestern farm land (and probably all US farm land) has shown more dramatic swings. Capital gains sent the rate of return on farmland ownership well above its current return, as Figure 5 shows. What expectations could have made investors raise the capitalized price so much faster than rents (current returns) were rising? As noted, the rents (current returns) that farm asset values are supposed to capitalize were not very volatile and were gradually declining relative to the asset values themselves. The take-off of capital gains on land above current returns on land and other productive farm assets, and above real interest rates was already in evidence in the period 1950-1972. From 1973 to 1979, the real net return on (Midwestern) farm land

reached unpreceded heights, with an average rate of 15 percent a year. Between 1980 and 1985, the same real rate of return averaged -13 percent a year. Small wonder that the literature on farm land pricing should now be shifting from capital-asset-pricing and efficient-market models toward seeing bubbles and rejecting rational expectations hypotheses.

The striking part of the instability is that it is recent. Earlier swings in farm land values, for all their fame, cannot compare with the gyrations just experienced. The key question for further research, again, is what has changed to make land prices gyrate when current returns do not. That research might benefit from the statement of this *working hypothesis:*

> The dramatic capital gains on U.S. farm land between 1945 and 1972 reflected the progressive realization that the future of government farm supports would be more generous and secure than investors had believed in the gloom of the Great Depression and in World War II. After 1973, farm land prices took on their own dynamic, due to some mixture of an endogenous speculative bubble and a misreading of the post-OPEC inflation shocks.

II. Land Appreciation and Capital Accumulation.

The estimates of price appreciation on farm land open up avenues for new research. Particularly ripe for re-examination is the role of capital gains, on land or other assets, in the overall process of modern capital accumulation. This section points out two avenues for further research on American capital accumulation in the nineteenth century.

Land appreciation and the rise and fall of America's savings rate. Scholars have long puzzled over the jump in America's rate of conventional capital formation across the Civil War era -- almost as much as they have fretted over the decline of personal and national savings since the early 1970s [Davis and Gallman 1973; David 1977; Davis and Gallman 1978; Williamson and Lindert 1980, Ch. 12; Ransom and Sutch 1984]. There was a marked rise not only in the conventional rate

of capital formation (investment/national product, at fixed prices), but also in the conventional rate of national saving (saving/national product, at current prices). The private savings rate remained high and steady for the first three quarters of the twentieth century [David and Scadding 1974], so that the national saving rate fluctuated only with shifts in government saving, and then dropped off after 1973. Why that happened is still a subject of considerable debate.

Taking capital gains into account will accentuate and reshape the rise and fall of the American savings rate. The savings rate should be defined as the share of resources coming available in the current period that becomes a change in perceived net worth -- i.e., is devoted to future, rather than present, consumption. The resources coming available are not just currently earned income but also any property gains, in the form of transfers (e.g. an inheritance) or capital gains on already-held assets. The savings rate is thus properly measured as the ratio (conventional savings plus capital gains)/(current income plus capital gains). Confining our view of possible capital gains to those on farm land, we find the following approximate effects on the national saving rate:[15]

Year	Conventional net national rate of savings out of NNP, current prices	Net national savings rate augmented by annual capital gains on farm land
1849/50	12%	15%
1879/80	15%	16%
1899/1900	19%	22%
1912	15%	16%
1929	10%	9%
1939	4%	5%
1950	14%	15%
1973	11%	12%
1978	9%	10%
1986(prelim.)	2%	2%

The figures suggest a possible re-dating of the postbellum rise in the savings rate. The "grand traverse" across the Civil War, here from 1850 to 1880, was less impressive in the perceived savings rate than in the real investment share. By

cutting the rise in the savings share further, farm capital gains reinforce a revision in the literature already being advanced by recent estimates of Ransom and Sutch [1984]. The farmland capital losses of the Civil War era further underline the importance of the war and emancipation on wealth and the incentive to re-accumulate, another point stressed by Ransom and Sutch. The higher savings rates, however, should perhaps be dated at the turn of the century or the first decade of this century, thanks in large part to the farmland value boom. The re-dating of America's peak rate of national savings must, however, await better estimates of nonfarm, especially urban, capital gains.

Within this century capital gains on land reinforce the impression of a fall in rates since 1973. The effect of farmland price gyrations by itself is small, because farm land is less than 6 percent of national net worth. But the period 1950-1973 saw capital gains of about 6 percent a year on nonfarm land [Lindert 1974, Appendix Table 1], raising the augmented savings rate by another 3 percentage points. The capital-gains adjustments suggest a net national savings rate that averaged 15 percent from 1940 to 1973, and a much lower rate since then. For recent years, as for the nineteenth century, the history of American savings is still in flux.

Farmland values and the Habakkuk debate. The fact that capital gains on land can satisfy the savings motive gives another twist to a rich, enjoyable and curious debate in Anglo-American economic history. H. J. Habakkuk's famous book on *American and British Technology in the Nineteenth Century* [1962] spawned two decades of debate over why American industry, and the whole American economy, was more mechanized and capital-intensive than Britain's around 1850. After a dozen fine articles with alternative theories of American capital-intensity, it fell to Alex Field [1983, pp. 419-420] to show that American production was *much less* capital-intensive and mechanized than British, and to James and Skinner [1985, p. 517] to note that Habakkuk had not really asserted otherwise! Both Field and James-Skinner offered reasons why land abundance should have lowered capital-intensity.

What needs to be added to the resolution of the Habakkuk debate is an explanation of why Americans had accumulated and installed less capital overall,

and not just in certain manufacturing industries, by 1850. The usual explanations about competing for labor against the vast frontier do not explain why Americans and America's foreign creditors accumulated so little tangible reproducible capital in the United States. Nor do the models offered by Field or by James and Skinner.

The other side of abundant farm land, its attraction as a form of savings, can play a supporting role in the revision led by Field and by James and Skinner. Agricultural land was half of America's tangible assets in 1774 and 1805 and still 36 percent of tangible assets in 1850. In Great Britain, by contrast, it dropped from 51 percent in 1760 to 20 percent in 1860 [Goldsmith 1985, pp. 122-123 and Figure 1 above], and the decline was even sharper in England and Wales alone, which the debate had meant to contrast with America. The portfolio shares gap suggests that Americans deferred more of their demand for savings into farm land. In this extra way, the farm frontier played a role in reducing America's accumulation of conventional capital, even though it was less important than the simple fact that America was still undercapitalized overall, in the sense of a low national ratio of all tangible assets to GNP.

III. The Main Determinants of Trends in Farmland Prices.

The price of pig is something big
because its corn, you'll understand
is high-priced too,
because it grew
upon the high-priced farming land.

If you want to know why
that land is high, consider this:
its price is raised
because it pays
thereon to raise
the costly corn, the high-priced pig.

-- *H. J. Davenport*

To explain the diverse movements in land scarcity is obviously a complex task. Everybody who has lived through, or written about, changes on the land knows of several forces that probably played some kind of role. To decide which of these have been most important, one needs a framework for weighing different possible explanations against each other, giving each its quantitative due.

The trained economic historian must choose between two familiar paths in deciding how to pursue a quantitative accounting. One path, the one not chosen here, is formal quantitative modeling. It has the virtue of explicitness: its assumptions and its final judgments are transparently clear to the trained scholar. The kind of formal model most appropriate to explaining long-run movements in a market price of farm land would be a computable general equilibrium (CGE) model dividing the economy into sectors that use land differently. Such models have been applied to similar tasks elsewhere [the working-paper version of Lindert, 1974; Williamson and Lindert, 1980]. CGE models, however, have only limited persuasive powers. They are not easy to read. Furthermore, most readers retain doubts about their simplifying assumptions, doubts that are hard to dispel because the CGE models are seldom easy to test. Even when tested, they seem to perform only respectably at best, never brilliantly. For all their power of suggestion, they tend to persuade only those readers who use such models themselves.

The less formal path chosen here begins with a review of the forces that seem likely to have had the most influence on farmland prices. As a rough preliminary test of their explanatory power, we shall then examine how well they seem to correlate with historical movements in land prices over several periods of U.S. history since 1800. The objective here is modest. I shall seek only patterns in a few leading forces that seem to explain the direction of contrast between any two historical periods. No attempt is made to develop a concrete percentage-point accounting of the observed price trends.

Even a crude view of rough historical correlations, however, yields a useful and simple perspective: with minor exceptions, *the kinds of forces that have given farm landowners higher land prices are those that slow down the advance of real wage rates and GNP per capita* . While more harmonious events are conceivable in theory, in practice there tends to be a conflict between the farm landowning interest and general progress.

The first major influence on farmland prices and rents is the terms of trade faced by farmers, or the ratio of the prices they receive to the prices they pay. Whenever some outside force raises this ratio, shifting the terms of trade in farmers'

favor, the real value of owning or using farm land rises. Indeed, it should rise by an even greater percentage than the percentage shift in the terms of trade, according to the "magnification effect" of modern trade theory. If a sector of the economy is favored by, say, a 10 percent increase in its terms of trade, the inputs used in that sector will benefit unevenly. Those used in similar proportions across all sectors of the economy will not benefit much. At the other extreme, those inputs that are highly concentrated in this sector will gain large increases in price or profit. They will necessarily gain more than 10 percent because the weighted average of the large and small effects on different input suppliers must average out to a 10 percent gain.

The terms of trade ratio for farmers must be viewed as a force that is itself affected by other things. It is affected, firstly, by transportation improvements that, in effect, move farms economically closer to their urban and foreign markets. It is also affected by price conditions in those distant markets, and by government policies designed to change the terms of trade (tariffs, taxes, subsidies, etc.). It is not fully exogenous to the model sketched here, though it will be discussed as an additional force for expositional convenience.

A second leading force is government subsidization of agriculture, including the provision of public goods net of taxes. It is a difficult force to measure because it takes so many different forms. To the extent that it affects the prices farmers receive and pay, its influence is already built into the terms of trade. But the terms of trade ratio fails to reflect some kinds of government aid, such as payments to compensate for low prices (e.g. "deficiency payments") and payments for leaving land uncultivated or at least not cultivated with certain crops (e.g. "acreage retirement" payments). To be sure that these extra dimensions are given their due, we shall look at a crude measure of government subsidization, namely the ratio of government farm payments to net farming income. Such payments should raise the price of farm land, though only payments going to tenants would raise rents.

Population growth is likely to raise the price of farm land through two channels. First, to the extent that it raises the size of the labor force, it supplies more labor, especially more unskilled labor. The resulting downward pressure on unskilled wage rates would enhance the return to owning farm land. Second, faster

population growth tends to raise the share of non-working dependents in the population. The extra dependents tend to affect product demand in the same way that extra poverty would affect: they shift demand back toward food and other staples. This demand shift would raise the demand for, and the price of, agricultural land. Both the labor-supply and the product-demand effects could raise the price of farm land even apart from any influence transmitted through the terms of trade, by cheapening the supply of labor and other inputs to the farm sector.

Productivity growth in agriculture is likely to raise the price of land, as long as one sets aside its effect on the relative price of farm products (the terms of trade). For any given terms of trade, farm productivity improvements raise the marginal product of land, bidding up both rents and purchase prices. The opposite result would hold in the case of "immiserizing progress," in which farm productivity improvements lowered the price of farm products so much as to worsen the returns to owning farm land, but this perverse possibility seems less likely, and is not pursued here. Productivity growth gives a still stronger stimulus to farm values if it has a land-using bias, an effect estimated below.

A greater supply of farm land should clearly lower its price. On this point there should be little controversy. The magnitude of this effect is uncertain, however. The larger the direct effect, the more it might be magnified through an influence on savings. If a 10 percent expansion of the supply of farm land directly lowered its price by, say, 14 percent, the real value of farmland wealth would be reduced by about 4 percent. The reduction in wealth would cause individuals having lifetime savings targets (for old age, bequests, etc.) to save more in the form of manmade capital to compensate for the lower value of land. The extra manmade capital should draw extra labor and other inputs away from agriculture, further depressing the price of farm land. Conversely, if a 10 percent expansion of the land supply had less than a 10 percent direct effect on the land price, the extra land wealth would work to dampen the effect on land price. Here we need only argue that the direction, but not the magnitude, of the effect of extra land on the land price is clear.

Finally, economic progress in general, represented by a rise in income per capita resulting from capital accumulation and nonfarm technological progress,

Table 3. Movements in Farm Land Prices and Influences on them, Seven Periods, 1800-1984

	(Rates of change in percent per year)						
	early federal c 1800-1839	antebellum 1839 - 1859	late 19th century 1869 - 1899	start of 20th c. 1899-1913	long price drop 1913-1945	postwar 1945-1973	post-OPEC 1973-1984
Land Scarcity:							
Price of farm land per acre	1.99	2.86	2.40	4.89	-1.62	3.31	3.32
Rent on Midwest farm land	rising	rising	no clear trend[e]	0.69	-1.37	≤3.35	1.73
Factors that should raise farm land prices:							
Terms of trade for farmers[a]=P_f/P_{all}	0.36[b]	0.59	0.00	1.11	0.24	-0.68	-1.61
[Not fully exogenous]							
Government payments as a % of income	0	0	0	0	0→5.8%	5.8%→7.8%	7.8%→24.3%
U.S. population growth	2.99	3.09	2.19	1.89	1.14	1.49	1.01
Productivity growth in agriculture	0.00	0.00	0.79	-0.24[f]	1.02[g]	1.65	1.83
Land-using bias in productivity growth[h]			0.04	-0.13	0.07	0.46	-0.63
Factors that should lower farm land prices:							
Supply of farm land	0.98[c]	3.32	2.44	0.54	0.74	-0.36	-0.80
Gross national product per capita[d]	1.11	1.59	2.51	2.17	1.99	1.04	1.19

Notes and sources for Table 3:

[a]The terms of trade for farmers are the ratio of an index of the prices farm operators receive (P_f) to an index of the prices they pay for productive inputs and family living (P_{all}). For the years up to 1910, this is the ratio of wholesale prices of farm products to the overall wholesale price index, usually in New York (but see footnote b in this table, and the discussion in the text). For 1910 on, this is the official "parity" ratio: prices received by farmers divided by the prices they pay, including wages, taxes, etc.

[b]In Cincinnati, Berry's ratio of the price of products of Northern agriculture to the prices of all products. The corresponding ratio in New York had no trend at all from 1800 to 1839.

[c]1805-1850

[d]As noted in the text, the growth rate in GNP per capita is used as a summary measure standing for nonfarm technological progress and all capital accumulation per person, with the side-effect of shifting demand away from food products (according to Engel's Law).

[e]Between 1869 and 1899, interest rates dropped considerably. This should have lowered the ratio of rent to purchase price, perhaps enough to imply no trend in rents despite a rise in purchase prices.

[f]1899-1909. [g]1909-1948. [h]The numbers in this row refer to the following periods: 1880-1900, 1900-1915, 1915-1945, 1945-1975, and 1975-1980.

Sources: For farm land prices and rents, see the sources for Figures 2 and 3 above. Figures for the terms of trade, government payments as a percentage of farming income, population growth, the supply of farm land from 1839 on, and the growth of GNP per capita since 1869 are all from US Census Bureau publications (*Historical Statistics of the United States, Statistical Abstract of the United States)* and *The Economic Report of the President.* Estimates of the growth rate for total factor productivity in agriculture are discussed in Williamson and Lindert [1980, Chs. 7, 10, 11], extended to 1984 with the help of USDA, *Agricultural Statistics, 1985.* The land-using bias of productivity change in U.S. agriculture is from Hayami and Ruttan [1985, p. 191]. The supply of farm land for c1800-1839, actually 1805-1850, is from Blodget [1806] and USDA [1973]. The growth rates for product per capita, c1800-1839 and 1839-1859, are from David [1967].

should have a negative effect on the price of farm land, though the result depends on the degree of technological bias and the effect of such progress on the farm product prices [Lindert, 1974, pp. 870-3]. If product prices (the terms of trade) and interest rates were fixed by international markets or some other outside force, economic progress would bid a nation's labor and other productive inputs away from agriculture, lowering the land price there. It would do so through Engel effects, shifting product demand and therefore input supplies away from agriculture. The opposite result could be imagined, of course. For example, if technological progress were greatly labor-saving, it could release so much labor to the agricultural sector that farm landowners would benefit. I judge such cases to be historically rare, however, and presume that the rise in material living standards comes in a way that draws resources away from agriculture.

American historical experience suggests that the simple list of forces just presented helps explain the historical contrasts in price trends for farm land. To see how, let us follow trends over long periods of time, periods starting and ending with the U.S. economy near full employment, so that we can abstract from the distortions that arise from shorter-run depressions. Table 3 divides the experience since 1800 into seven periods chosen with an eye to data availability and distinctive farmland price trends. A causal history can be sketched, with due caution, period by period.

The Long Rise in Land Prices before World War I. The ten- fold increase in the real price of farm land between 1800 and 1913 was the logical result of trends in the terms of trade and rising population density, which together outweighed the price-depressing effect of the general economic progress. So Table 3 suggests, with its view of conditions common to four prewar periods (c1800-1839, 1839-1859, 1869-1899, and 1899-1913).[16] Over the whole era of more than a century, the terms of trade shifted in favor of agriculture. In fact, the true price trends favored agriculture more than the rates in Table 3 can show. Unmeasured product-quality improvement, which was presumably greater for nonfarm products, means that nonfarm products were cheapened, and farm products made relatively more expensive, at a faster rate than the available price indices can show. In addition, transportation improvements gave farmers better price trends than the usual series can show. The

relevant price trends are those at the farm gate, but the available series tend to be more urban. Missing from our view is most of the 4.68 percent per annum productivity improvement in domestic American transportation between 1815 and 1859 [Williamson and Lindert, 1980, p. 171, citing Mak and Walton and Fishlow], much of which got passed onto farmers. Missing also is the 1.89 percent productivity growth in American railroads, 1870-1910 [Fishlow, 1966, p. 626] and the drop in ocean freight rates on American grain shipped to Europe in the late nineteenth century. Even these unknown adjustments, raising the long rise in farmers' terms of trade toward one percent per annum (or more?), would leave us with a likely understatement of the effect of better product prices on the value of farm land. We must remember the "magnification effect," through which a one percent rise in the terms of trade would eventually raise by much more the price of land highly concentrated in the farm sector. The terms of trade improvement alone could account for perhaps half of the long historic rise in farm values before World War I.

The other main explanation for the long rise would seem to be the fact that population (and the labor force) grew faster than the supply of land, despite some efforts of the U.S. government to make land relatively cheap for would-be yeomen. Both in the early federal period and in the first decade of this century, the frontier did not expand fast enough to match the demographic contributions to labor force and food demand. As long as the unit effect of each percent growth in labor supply matches that for land supply, as experiments with computable models suggest, the net effect should have been to raise the price of farm land further. To be sure, the Engel effects and other labor-absorbing effects of the rise in per capita income probably acted to retard the advance of farmland prices, but this effect, formal models suggest, should have been weaker for each percent of income growth than the effects just discussed. We have at least the core of an explanation for the long rise.

The long rise was not steady, of course. The start of the twentieth century stood out, with the real price of farm land rising faster than five percent a year. What was different about this period? Above all, the product-price "scissors" cut in favor of farmers, in America as in other countries. Indeed, 1910-1914 still stands out as the all-time peak in farmers' relative prices, the era still fondly cited as an index

base for discussing "parity" in discussions of farm price policy. The improvement in prices was apparently due to an acceleration of population growth worldwide without an acceleration in the growth of income per capita. The other factor pushing up real farm prices in this era was the accelerated rise of the population/land ratio, as immigration reached flood tide and the land frontier was closed.

The Long Price Drop. The long drop in real land prices across the two world wars and the intervening decades can be explained, more or less, though some side-questions must remain unanswered. Our explanatory variables behaved differently in the 1913-1945 era of price decline,[17] as compared with earlier experience. For most of the period, the terms of trade moved against the farm sector, though they jumped back up in the late 1930s and World War II. Population growth slowed down, primarily because America imposed tight restrictions on immigration after 1924, while the supply of land actually grew a bit faster than before. Both changes contributed to the softening of the market for farm land.

Starting in 1933, the government made a determined attempt to counteract the price decline, with programs to cut agricultural supply. Yet by World War II, the impact of the new programs was still quite limited. Table 3 might mislead in this respect, by showing that government payments to farmers were as much as 5.8 percent of net farming income. In fact, that share of support was a temporary phenomenon around 1945, with most of the rise of government transfer payments to farmers yet to come.

A somewhat different question about the long price decline is harder to answer without further study. Instead of comparing 1913-1945 with earlier experience, let us compare it to a "no-change" economy in which none of the explanatory variables in Table 3 changed at all. Relative to such a null economy, why should 1913-1945 have been one of farmland price decline? The question poses a difficult challenge. The terms of trade did not shift against agriculture for the period as a whole. Population growth slightly exceeded the expansion of farm land. Newfound productivity advances in agriculture should have raised the productivity of land further. So why the price decline? The best tentative answer is that in

1913-1945, relative to a no-change economy, income per capita continued to advance, albeit very unevenly, at an overall rate of about two percent a year. For the moment the best answer seems to be that this drew enough labor and other resources away from agriculture to undermine farmland prices. But this is hardly a firm conclusion.

The Postwar Rise -- and Decline? The impressive postwar rise in farmland prices requires a different kind of explanation, because more things were changing. Let us begin with the postwar period 1945-1973, which is given separate treatment in Table 3. The terms of trade moved seriously against farmers, making the rise in land prices look paradoxical. Other forces did move in the direction necessary to help explain an impressive price rise: the population/land ratio re-accelerated, agricultural productivity continued to accelerate and now shifted toward a land-using bias, income per capita growth slowed down and the government continued the march toward subsidization. The fact that the terms of trade declined in the face of such price-raising forces is best explained by the worldwide shift from wartime agricultural scarcity (World War II and Korean War) to increasing productivity as yield-raising advances spread from country to country. We can take only temporary comfort, though, in knowing that the number of land-price-raising factors exceeds the number of land-price-cutting ones in this period. Until a better way is found for weighing the different effects quantitatively, we can only conjecture that the forces just listed were the reasons for the postwar price rise.

The post-OPEC period 1973-1984 is especially hard to analyze in terms of long-term forces. Eleven years is a short period, and it was an unstable 11 years at that. Table 1's display of net changes for this era can only suggest what might be the trend underlying the recent boom and bust in farmland prices. Basically, 1973-1984 has thus far been an accentuated (and unstable) version of 1945-1973. Again the terms of trade have dropped, again because the acceleration of agricultural productivity is worldwide (and possibly because the growth of world population has begun to slow down, cancelling the likely Engel effects of the income deceleration caused by the oil shocks). Yet again the population/farmland ratio has risen, along with US agricultural productivity and government payments to farmers. There is

the start of an explanation here, but only the start.

IV. Conclusions.

The long history of farmland prices in the United States shows some striking changes in trend. After what may have been a trendless colonial era, the value of farm land rose impressively across the nineteenth century, despite the expansion of the land supply as a continent was settled. Soon after its fastest rise, in the early twentieth century, the real price of farm land went into a thirty-year slump. It then resumed its impressive upward trend after 1945. The most unstable period by far has been the boom and bust since 1973. Neither the Civil War decade, nor the famous bust in farmland speculation in 1920, nor the Great Depression brought as pronounced a crash as that since 1980.

The historic price movements were "real" in more than one sense. They were movements in relative-price ratios and not just nominal-price inflations and deflations. They were not just, or even mainly, the result of shifts in the quality of farm land -- instead, they were genuine price movements. And they were shared by all regions of the United States, despite some regional differences noted above.

The twentieth-century behavior of real rents and the rate of return on Midwestern farm land paralleled those in its purchase value. Again, there was a rise before World War I, a long decline to World War II, a rise into the 1970s, and a serious decline thereafter. Each swing of rents, however, was more restrained than the nearly contemporaneous swing in purchase prices. The overall rate of return also moved with both rents and prices, though with still wider fluctuations. The market for farm land has shown what look like endogenous bubbles, especially in the boom and bust of 1973-1986.

Charting the long-run movements in farmland prices, rents and returns reopens two issues relating to capital accumulation in American history. First, incorporating capital gains and losses on farm land into measures of savings accentuates and slightly re-dates the famous rise and fall of American savings. Second, the attraction of investment in farm land may have played a role in

explaining the lower capital-intensity of the American economy relative to the British in the middle of the nineteenth century. Both conjectures about accumulation, however, require further research.

A tentative explanation of the peculiar movements in American farmland prices focuses on six factors: the terms of trade (farm prices divided by the prices farmers must pay), government farm supports, population growth, productivity growth in agriculture, the supply of farm land, and general economic "progress," proxied here by the growth of GNP per capita. There is a pattern to the roles played by these separate forces: those changes that historically acted to raise the price of farm land are changes that should harm the advance of wages and average income. The farmer landowner's best friends in the play reviewed here were such forces as rapid population growth, the loss of the frontier, government subsidy payments, and the advance of farm productivity. All but one of these land-price-raisers tended to reduce the growth rate for real wages and average income. The one exception, which probably raised wage rates and national product while also raising farmland values, was the advance of agricultural productivity growth, aided by government research and extension subsidies. This factor aside, the interests of farm landowners have been in conflict with general economic progress. So says a tentative history of three centuries of American farmland values.

FOOTNOTES

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[1]Changes in nature, such as the Dust Bowl of the 1930s, could be viewed as changing either the price or the quality of farm land, depending on one's immediate purpose. The semantic choice matters little, since such occurrences play a negligible role in accounting for historical movements in farmland values.

[2]For fuller development of the price-change estimates by state and region, see Appendices B-D. Appendix A deals with the prior question of whether the abundant official land valuations are as reliable as scarcer market sales-price data, tentatively answering in the affirmative.

[3]In the following discussion of national movements, all "real" magnitudes refer to dollar units of the 1960 U.S. consumer bundle. Regional "real" land values are derived using regional cost-of-living deflators, standardized in dollar units of the 1960 New England urban workers' consumer bundle. See Appendix B for a discussion of the cost-of-living deflators and the similarity of their movements to those in farm product prices.

Some of the broad trends noted in this section have been noted before. Postwar trends are heavily covered in USDA publications and scholarly articles. Few accounts span the whole period since 1850. Two convenient brief overviews are Lindert [1974] and Dovring [1987, pp. 282-290].

[4]For a detailed narrative of the farm crisis after World War I, see Shideler [1957]. For a survey of the literature, some quantitative data, and a close look at financial conditions, see H. Thomas Johnson [1973-74]. Johnson, however, ignored the present perspective gained by looking at real, rather than nominal, values.

[5]Farm operators and their families often belong to more than one of these

groups at once, of course, especially in the yeoman-dominated agriculture of the United States before the 1930s. Think of the three groups as types that fit different families differently depending on their wealth and their management ability.

[6]Defining the 1158.6 million acres in farms in 1950 as the ultimate supply of farmland in the 48 states, historical data give us the following percentages:

	(land areas as a % of area in farms in 1950)						
	1774	1805	1850	1870	1910	1950	1985
"Cultivated" or "improved"	1.8	3.4	9.8	16.3	41.3	45.9	..
Total land in farms	..	16.3	25.2	35.2	75.9	*100.0*	87.7
Share "cult." or "improved"	..	21%	39%	46%	54%	46%	..

(Sources: Blodget [1806, pp. 60, 196], Clifton and Crowley [1973], US Census of 1850, Tostlebe [1957, p. 50], and USDA, *Agricultural Statistics*, 1985.)

[7]The detailed decompositions of land-value changes for 1774-1805 and 1805-1850 are presented in Appendix D, which also discusses ambiguities and inconsistencies in Blodget's data on improved area and land values.

[8]Here I refrain from conjecture about trends in the market value of *potential* US farm land, most of which was unsettled until the late nineteenth century. There was presumably a decline in another concept of land price not pursued in the text: the cost of settling on farm land and preparing it for use. As the frontier advanced, this presumably dropped.

[9]Illinois, Iowa, Minnesota, Ohio and Wisconsin.

[10]See Appendix E for details on the three rental series.

[11]See Murray [1967, pp. 461-468] and, again, Shideler [1957] and Johnson [1973-1974].

[12]For a more detailed treatment, see Appendix E.

[13]Again, see Appendix E for more details.

[14]This paragraph and the next are based on a reading not just of Figure 5, but also of the capital gains for additional years covered in Table 1.

[15]The savings rate were calculated by making a number of adjustments to

estimates available in Goldsmith [1977]. Goldsmith provided estimates of all the magnitudes used here, but it was necessary to improve on his figures for land values and GNP. Farmland values are taken from the present study. For nonfarm land values, Goldsmith assumed a share of land in total real estate value (land plus buildings) that bounced from 1/6 for 1805 to 1/3 for 1850 and back to 1/6 for 1880, ignoring Winnick's estimate of a 40% share for residential real estate as of 1890; his 1/6 shares were changed to 1/3 in side-calculations used indirectly here. Finally, Goldsmith's use of Berry's national-product estimates seems inferior to the Gallman estimates for 1850 and 1880, though his choice of Berry over Davis-Gallman [1978] and David [1967] made no difference for 1805.

[16]The Civil War decade has been omitted here, to save on the space required to discuss its special events (slave emancipation, wartime destruction in the South, inflation and deflation, and population slowdown). Its drop in farmland prices can be explained, however, in terms consistent with the present framework.

[17]It should be noted that the present analysis is somewhat sensitive to the choice of 1913 and, especially, of 1945, as period boundaries. The basic conclusions suggested here would seem to hold up if 1940 were used in place of 1945, but 1940 was a year of high unemployment, complicating the present interpretation, which focuses on long-term market pressures that should show up at full employment. It seemed wiser to span well across the Great Depression of the 1930s, as argued in an earlier article [Lindert, 1974, p. 877].

If 1948 or 1950 were chosen instead of 1945, the present interpretation of the role of income/capita growth would be somewhat undermined. More research should be devoted to fitting trends, to avoid such sensitivity to the choice of period boundaries.

APPENDIX A.

ARE THE OFFICIAL LAND VALUES TRUE MARKET VALUES?

A study relying on official census and USDA valuations of land must face the possibility that the data so conveniently gathered may misrepresent economic realities. The official figures are based on farm occupiers' statements of market value, and it is natural to worry that the stated values might depart systematically from some sort of true worth. But what true worth, and what independent data could we use to resolve fears about bias in the official figures?

Merely opting for market values as the yardstick for true worth does not suffice. The concept of market value is ambiguous when applied to assets that do not change hands. The fact of non-exchange means that the lowest price at which the owner would part with the land exceeded the highest price that any buyer was willing to pay. In any given year, most farmland is not exchanged. To posit a market price is to imagine that conditions somehow changed so as to bring a transaction. But what conditions are imagined to have changed? Does the hypothetical market value refer to the best price sellers could get if something made them more eager to sell, or is it the best price buyers could get if their demand were raised enough to buy? The former concept -- the most that a buyer would be willing to offer -- fits most uses. It is tied to the capitalization of expected future rents, and therefore to the marginal product of land as perceived by the user. It should also be what sellers perceive as the value they could get if they had to sell. Yet the actual answers to the question about market value might reflect implicit imagination about the prices sellers could get if buyers were as eager, or desperate, as actual market buyers of other properties. We don't know which concept farm operators had in mind when surveyed.

The usual instinct is to turn to the market prices of other properties that were exchanged, and view each market price as an option that both owners and potential buyers of the unsold properties willingly passed up. The market price of just-sold property A does tell us a little bit about the value of property B that is comparable in the eyes of the buyer of A. It tells us that the price of A is a lower bound on what

unsold "comparable" property B was worth to its owner. But that is about all it tells us. Worse, the word "comparable" bears enormous weight here, again because of the great heterogeneity of land. We must believe that the exchanged properties are really like those that were not exchanged.

Similar doubts about the representativeness of sales prices was shown by USDA officials at the dawn of their twentieth-century land value series. In a special survey sent out to about 45,000 statistical correspondents in 1905, the USDA gave these guidelines on valuation:

> Avoid fanciful values on the one hand and on the other a depression due to temporary or local causes, of from forced sales.
>
> You are not necessarily confined to actual transfers for your values, and yet a visionary figure above them should not be adopted. Sale prices should be taken into account if they represent fair valuations of the medium farms. Avoid speculative prices and the speculative expectations of owners. [As quoted in Holmes, 1906, p. 10.]

Clearly, officials at the turn of the century had doubts about whether going to the local records office and averaging sales prices would fairly represent "the medium farms." Since then, the USDA statisticians have explicitly tied their definitions and annual estimates to those of the US Censuses of Agriculture, leaving sales prices to occasional studies by local experiment stations. To understand why theirs might be the better decision, let us look more closely at the sales-price series.

If the sales prices were unrepresentative of the would-be values of all lands by some conveniently fixed percentage, one could follow sales prices as an index of the true market value of all properties. Alas, the literature on sales prices versus census/USDA values hints to the contrary. In the twentieth century *sales prices may have risen relative to the market values of all farm lands.* For example, across the 1940s South Dakota farm lands sold showed progressively higher proportions of resales, suggesting a drift toward more improved lands [Lundy and Pengra, 1951, p. 17]. For Nebraska, too, there may have been a drift from selling relatively cheap farms to selling relatively expensive ones. At the turn of the century, farms sold may not have been as valuable as the average farm. By 1964, however, Nebraska farms that were sold averaged 212 acres in size, while all farms averaged 596 acres

[Greer, 1969, p. 22]. The drift toward smaller farms was probably also a drift toward relatively valuable acreage in land sales. The value-size relationship is suggested by these data for Nebraska in 1964:

Acreage class	Ave. value of sold acres	Share of farms in this class sold in 1964
40-99	$200	19.5%
100-259	167	6.4%
260-499	113	1.4%
500+	50	0.9%

The bias toward small farms raises the average price of those sold well above the price of all farms. For the Nebraska farms over 40 acres in size in 1964, those sold averaged $165.26 an acre in value, while all farms over 40 acres (assuming the same average values within each class) would have been worth only $119.05. Farms sold that year were fully 38.8 percent more valuable merely on grounds of their smallness, an attribute presumably related to soil quality and to proximity to cities. The same negative value-size relationship showed up in a study of Ohio farm sales in 1945 [Moore and Bailey, 1951, p. 12].

If farm turnover did drift from cheaper-than-average acreage to acreage more valuable than average, then *sales prices would show an even faster rise than the official values used here.* This was probably the case. The evidence just noted suggests that sales prices may actually be less reliable than official census/USDA values as measures of the would-be market value of all farm land. Such a suggestion springs from the fact that in the Nebraska study the sold lands had a peculiar value-related attribute -- i.e. they were small. By contrast, the census valuations have at least the virtue of referring to the whole "population" of farm lands.

At this point, one might decide in favor of the census/USDA values. The evidence above, however, is too frail to convince all observers. The notion that the value bias in sold lands drifted upward over time is just a working hypothesis. Since many readers will still suspect that sales prices might be better reflections than the official valuations, I note the following five sets of empirical comparisons of sales prices and officials values.

1. Nebraska, 1930-1965. The studies by Gauger, Muehlbeier and Kristjanson (1954) and by Greer (1969) yield the comparisons of sales prices, official values, and tax assessment values shown in Figure A.1 and Table A.1. In a quest for true market value, one should begin by setting aside tax assessment values. They are historically below sales prices and declared market values, and move much more sluggishly over time. The only comforts the Nebraska data offer to a scholar given only assessment values are that the asessed values are a safe lower bound on market value, and that their movements suggest even stronger movements of market value in the same direction.

The comparison of sales prices and official values is somewhat encouraging. Over 26 years, the two series moved together, with an average gap of only 7.53 percent of the official value. The standard deviation in the log (official/sales) value ratio was 11.46 in logs, implying about a 12 percent standard error.

The gap changed signs in the mid-1950s, with the sales price rising above the official census/USDA value. I interpret this reversal as the result of a drift in market sales from lands that were less improved than the average to small plots that were of higher than average value because they were more improved or closer to cities. That is, I think the bias in the sales prices shifted, with official values still being a better guide to market value of all properties. Readers may favor the opposite interpretation, arguing that the official values are the biased ones, and that their bias shifted from overvaluation to undervaluation in the 1950s. If so, then the present study has *understated* the dramatic rise in farmland values between 1950 and 1965.

2. South Dakota, 1945-1954. It is possible to compare sales prices for farm land in eight South Dakota counties [Lundy and Pengra, 1951, p. 15; Pengra and Lundy, 1957, p. 8] with the official values per acre for all farms in the same counties in 1945, 1950, and 1954 [Pressly and Schofield, 1965, p. 38]. The comparisons yield the following summary statistics:

	1945	1950	1954	All three dates
Sales price below official value:	9.5%	8.0%	12.9%	10.1%
Standard deviation in logs (8 co's):	0.138	0.101	0.056	0.101

Again, as in Nebraska, the two values are tolerably close together, with a standard

deviation low enough to permit some firm conclusions. In the South Dakota case, however, the sales price remained below the values. In fact, the gap even widened somewhat between 1945 and 1954. The South Dakota study notes that a high percentage of the South Dakota sales were resales by corporations and by individual nonfarmers, who had acquired properties through foreclosures in the interwar years (Lundy and Pengra, 1951, pp. 15-18). This may or may not explain why the transferred lands had a slightly lower average price.

3. Arkansas, 1945. Again, limited county data on average sales price [Southern, Scoggins, and White, 1951, p. 17] can be compared with average official values for 1945:

	Sales price/acre	Official value	Ratio
Arkansas County	$31.99	$49	0.653
Crittenden County	79.42	92	0.863
Nevada County	19.21	23	0.835

This time the ratio drops further below unity, enough to cause concern. The Arkansas study notes, however (p. 19), that the land sellers were predominantly corporations and nonfarmers unloading previously foreclosed lands, as in the South Dakota case. The transferred lands may have been atypically low in value.

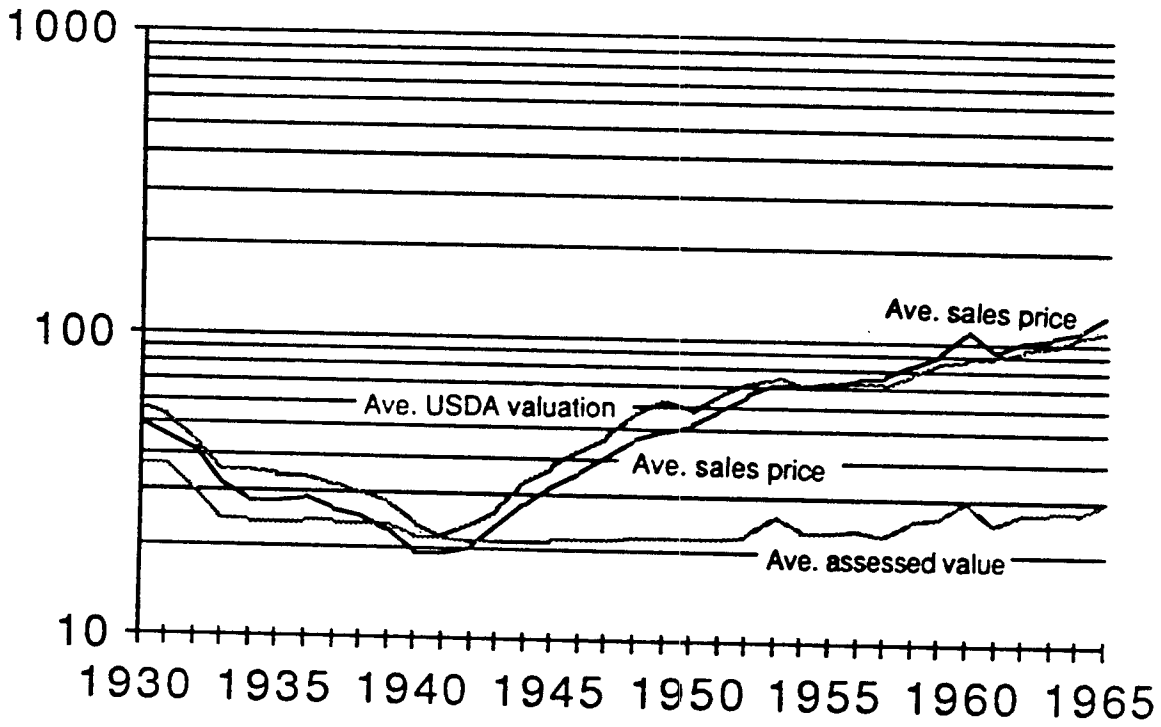
4.Two Misleading Cases: Ohio, 1945 and California, 1912-1926. A study of farmland sales prices in a three-county area of Ohio yields an average of $112 per acre, as compared with a weighted average of $82.81 for census values [Moore and Bailey, 1951, pp. 12, 19], for a ratio of 1.352. At first glance, the 35.2% gap between sales price and official value looks bad for any argument that the two are trying to measure the same thing. Yet the gap is due in large part (or even more than 100% due) to a difference in weighting. Moore and Bailey explain that their $112 figure (for farms over 10 acres) was weighted by the *number of farms in each size class and county* in the 1945 census. Small farms thus got inordinate weight compared with proper acreage-weighting of values per acre. Since small farms were more valuable (e.g. those 10-49 acres sold at an average of $163 versus only $96 for those over 50 acres), weighting by farm numbers across size classes raises the average noticeably.

The same difference in weighting marred an early study that seemed to show sales prices well below the official averages. David Weeks [1929, pp. 470-473] found

San Joaquin Valley sales prices per acre to be well below the official USDA figures. Yet he, like the later authors studying Ohio, weighted the sales prices by numbers of sold farms, not by land area, a procedural difference that halved the average 1926 value per acre. Using the same weighting procedure for both series might have eliminated the difference, though possible differences in geographic coverage leave us in doubt.

In conclusion, what we know about sales prices does not indict the official land-value series. The sales prices themselves seem to have different biases at different times, biases always cautioning us in the direction favoring acceptance of the official land values. And given the hypothetical nature of the concept of a market price for assets most of which are not marketed in any one year, we must defer to the best informed guesses about what unsold land would have sold for. There are no better authorities for such guesses that the farmland occupants themselves, i.e. the very people whose opinions the census and USDA recorded. Nonetheless, readers still preferring the sales prices of transferred lands can use the gaps documented in this appendix to judge the alleged biases in the official figures.

Figure A.1. Three Series on Average Farmland Value per Acre in Nebraska, 1930-1965.



Sources: For sales and assessment values of land sold, James D. Greer, Land Sales, Prices, Values and Assessed Values in Nebraska, 1930-1968 (Lincoln: Nebraska Agricultural Experiment Station, 1969), pp. 13, 14; except that the assessed values for 1930-1952 are from the predecessor study, Land Sales and Assessed Values in Nebraska, 1930-1952, by Louis Kaye Granger, John Muehbeier, and Kris Kristjanson (Lincoln: Nebraska Agricultural Experiment Station, 1954), p. 19.

For Census/USDA values, Ivery D. Clifton and William D. Crowley, Farm Real Estate Historical Series Data: 1850-1970 (Washington: USDA, Economic Research Service, 1973), p. 24.

TABLE A1. ALTERNATIVE SERIES ON NEBRASKA FARM REAL ESTATE VALUES PER ACRE, 1930-1965. (current $/acre, including buildings)

Year	Sale price of lands sold	Census/USDA value of all farm land	Assessed value of farmland sold	Ratio of sales price to census -USDA value	Log of ratio
1930	50.25	56	36.46	0.90	-0.11
1931	45.25	52	36.50	0.87	-0.14
1932	41.00	44	30.20	0.93	-0.07
1933	31.75	35	24.20	0.91	-0.10
1934	28.00	35	23.97	0.80	-0.22
1935	28.00	34	23.98	0.82	-0.19
1936	28.75	34	24.03	0.85	-0.17
1937	26.50	32	23.91	0.83	-0.19
1938	25.25	30	23.78	0.84	-0.17
1939	22.75	28	23.63	0.81	-0.21
1940	19.25	24	21.75	0.80	-0.22
1941	19.25	22	21.72	0.88	-0.13
1942	20.25	24	21.30	0.84	-0.17
1943	23.75	27	21.34	0.88	-0.13
1944	28.00	33	21.32	0.85	-0.16
1945	32.25	37	21.38	0.87	-0.14
1946	36.00	42	21.48	0.86	-0.15
1947	40.50	47	21.45	0.86	-0.15
1948	46.00	56	21.87	0.82	-0.20
1949	49.50	62	22.01	0.80	-0.23
1950	52.50	58	22.17	0.91	-0.10
1951	58.75	66	22.14	0.89	-0.12
1952	66.00	72	22.80	0.92	-0.09
1953	71.75	75	26.00	0.96	-0.04
1954	71.00	70	23.50	1.01	0.01
1955	72.00	73	23.50	0.99	-0.01
1956	75.50	73	24.00	1.03	0.03
1957	76.75	72	23.00	1.07	0.06
1958	83.50	79	25.50	1.06	0.06
1959	92.00	86	26.00	1.07	0.07
1960	109.25	89	29.75	1.23	0.21
1961	93.25	90	25.25	1.04	0.04
1962	101.50	95	27.50	1.07	0.07
1963	104.75	97	27.75	1.08	0.08
1964	110.00	105	27.25	1.05	0.05
1965	126.00	111	29.50	1.14	0.13

Average log ratio:	-0.0782665
Geometric average ratio:	0.92471793
Sale price below census/USDA	-7.53%
Standard Dev. in logs:	0.11464736

APPENDIX B.
STATE AVERAGE FARMLAND VALUES PER ACRE, 1850-1986.

The most convenient building blocks for reconstructing regional and national patterns in farmland values are the state averages available in the occasional agricultural censuses since 1850 and in annual USDA series since 1910. This is not to say that states are the finest geographic areas for which data are available. It is possible to work with complete county data for all census years since 1850 [Pressly and Schofield, 1965, plus recent censuses]. But using county data is too tedious even for census years, and impossible on an annual basis unless one secures unpublished data. The state data used here come from two sources. For the census years 1850-1920, we* used the most extensive data set available, that in the 1920 Census of Agriculture, with interpolations to the peak year 1915. For later years, we repaired to USDA publications, especially Clifton and Crowley [1973], gaining the convenience of more compact compilations at the cost of using rounded whole-dollar/acre figures.

To derive values of land per acre, it was necessary to remove the estimated values of buildings from the published figures on the value of farm real estate. Razing the buildings from (the value of) the land was straightforward for census years since 1900. For the intervening years 1915 and 1945, however, it was necessary to interpolate the ratio (land value/land plus building value) from the nearest census years.

For years before 1900, I had to assume that the same (land/land plus buildings) ratio was fixed at its 1900 value for each state. Fixing the ratio at the state level, rather than at the national level, proved important for correct extrapolation back into the nineteenth century. Not only has the ratio differed across states, but its geographic pattern has been consistent throughout this century. Since 1900 the ratio

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(*Maite Cabeza-Gutes, Rob McClelland, and Peter Lindert.)

has been lowest in the greater Northeast area reaching from Maine west to Wisconsin and south to Virginia. Northeastern agriculture, with its poorer lands, is more building-intensive, specializing in the more indoor products, such as dairy products, poultry and dry storage of ready-for-market hay. Thus the (land/land plus buildings) ratio runs 53-60 percent in New England states, rising into the 70-79 percent range at the borders of the greater Northeast. For the whole rest of the nation, the ratio tends to be between 80 and 89 percent. The durability of this pattern makes it a suitable assumption for backcasting back into the nineteenth century.

Table B.1 presents the state average land values (usually winter values) for selected years since 1850. The decennial years are supplemented by data for 1915, roughly a peak year for real value per acre, for 1945, roughly a trough, and for 1986, the latest year available at the time of calculation.

Close examination will reveal strange gyrations in values per acre for several Western states before 1910. These are due, wholly or in large part, to swings in the proportion of unimproved acreage. A comment in the 1920 Census of Agriculture [pp. 31-32] warns that successive censuses switched large areas of Western grazing land back and forth between the public sector and the private farm sector. Thus, in particular, the curious dip in the average value of New Mexico territory farms in 1860 is due to a jump in the amount and share of grazing land in the farm figures. Similar dips in the values for several Western states in 1900 are also explained by sudden inclusions of vast low-value grazing areas. Appendix D and the main text of this paper have taken care to adjust values for such shifts in land quality, so that they have little or no effect on this paper's conclusions about land price movements. (By contrast, no such shift in data coverage can account for the jump and drop in Florida land values in 1890 and 1900.)

In this paper, state data like those in Table B.1 are adjusted in several ways, in an attempt to distill measures that reflect movements in real prices. The state data already reflect the removal of two land-"quality" contributions to land value. One is the increase in value coming from the initial incorporation of land into farms, an increase that has been removed by considering data on farm lands alone. The other is the removal of the value of buildings. The next two appendices take the next

steps, removing the effects of general inflation/deflation, spatial drift of the nation's farm lands, and farmers' improvements in the land itself.

One other exhibit should be entered here, however, in an appendix that looks directly at state-level farm data. The corrections for general inflation/deflation, presented in Appendix C are not local to individual states or to the farm sector. Rather, Appendix C will use *regional urban* consumer price deflators. It is harder to come up with farmgate price deflators for individual states. One might wonder whether the regional urban consumer price deflators might be subject to trend bias, inviting wrong inferences about the prices farmers faced at the state level.

Fortunately, scholars have studied farmgate (or at least not-so-urban) prices in several states over long stretches of history, developing annual price indices. Table B.2 and Figure B.1 use six of the best of these state indices as deflators for state farmland values per acre between 1850 and 1950.[1] The deflators are in this case price indices for products sold by the state's farmers, rather than consumer price indices as in Appendix C. It is the appropriate index for viewing the real price of farm land as a capitalized measure of the (expected) marginal physical product of land. Here I note only that the series show the same trends as those shown at the regional level in Appendix C. From 1850 to 1915, the real value of farm land stagnated in the two northeastern states, Vermont and New York, while advancing strongly in the other four. This is the same pattern noted in the main text and in Appendix C. All six states participated in the nationwide drop in real value from 1915 to 1920. After 1920, the trends are harder to judge, because the series are fewer. We can conclude, nonetheless, that the movements in real values were much the same whether one uses price deflators that are state or regional, or rural or urban.

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[1] Additional effort could yield similar deflators for other states. For Iowa 1851-1940 and for South Dakota 1890-1930, we have annual price series for the main farm products but no weighted aggregate series [Strand 1942, Orr 1931]. In these two cases, the aggregate series could be constructed by adding product-value weights from the census. Bowman and Keehn [1974] have done the necessary weighting for Iowa and for Illinois, 1870-1900, in addition to the Wisconsin and Indiana series already presented here. For still other states that could yield such series from 1914 or earlier to 1935, see Martin [1938].

Table B.1. State Farmland Values per Acre, 1850-1986.

(Current dollars per acre)

	1850	1860	1870	1880	1890	1900	1910	1915	1920
State:									
MAINE	6.21	7.08	7.27	8.05	8.22	7.90	13.78	13.78	21.02
N. H.	8.15	9.31	8.94	10.19	9.57	9.72	13.83	14.64	18.05
VT.	8.51	12.23	13.64	12.41	10.14	9.74	12.60	13.57	19.61
MASS.	17.90	20.33	18.79	23.96	23.42	27.65	36.54	37.01	51.23
R. I.	17.42	21.20	19.42	28.41	26.34	28.69	33.76	34.37	43.08
CONN.	16.36	19.44	22.54	26.45	22.60	22.59	33.02	36.87	53.26
N. Y.	17.99	23.76	28.47	27.56	27.35	24.33	32.13	31.16	38.44
N. J.	25.19	34.84	39.74	37.58	34.50	33.00	48.21	49.57	62.29
PA.	17.50	24.92	29.70	31.57	32.16	29.69	33.90	32.26	41.11
DEL.	13.36	21.17	24.02	22.82	25.37	21.85	33.79	33.97	44.30
MD.	12.90	20.70	20.71	22.17	24.24	23.23	32.39	35.09	54.59
MICH.	8.60	16.64	23.13	26.29	27.36	24.12	32.48	35.64	51.95
WIS.	7.40	12.83	15.85	18.00	21.97	26.69	43.29	46.46	73.09
MINN.	4.69	8.48	10.09	12.08	15.23	21.32	36.84	45.93	91.00
OHIO	15.72	26.13	30.65	36.26	35.47	33.37	53.35	59.09	85.70
IND.	8.71	17.79	22.90	25.42	30.29	31.81	62.36	67.36	104.57
ILL.	5.95	14.56	21.18	23.73	30.83	40.09	95.04	106.04	164.20
IOWA	5.11	9.99	16.96	19.23	23.60	36.34	82.59	105.20	199.52
MO.	5.35	9.50	11.92	11.09	16.74	20.44	41.80	46.46	74.59
N. DAK.		3.19	4.83	7.29	8.60	11.18	25.70	27.09	35.33
S. DAK.		3.14	4.74	4.29	8.10	9.91	34.71	37.82	64.44
NEBR.		5.17	9.83	8.97	15.70	16.27	41.80	44.68	78.86
KANS.		5.70	10.57	9.09	15.34	12.79	35.44	37.84	54.51
VA.	6.11	8.83	6.94	8.05	9.84	10.08	20.26	21.47	40.75
W. VA.	5.91	8.87	7.60	10.42	11.74	12.60	20.68	22.24	32.17
N. C.	2.35	4.39	2.29	4.42	5.91	6.23	15.32	19.37	42.82
KY.	6.61	10.99	9.64	10.06	11.68	12.56	21.83	24.30	48.64
TENN.	3.76	9.58	6.53	7.30	8.79	9.51	18.46	21.47	43.07
S. C.	4.00	6.79	2.33	4.02	5.92	7.13	19.90	20.05	52.09
GA.	3.15	4.42	2.40	3.23	4.52	5.21	13.73	14.05	35.27
FLA.	2.99	4.26	2.53	4.65	14.97	7.07	17.92	20.10	37.77
ALA.	4.03	6.99	2.75	3.18	4.25	4.95	10.56	11.78	22.49
MISS.	3.95	9.11	3.77	4.43	5.49	6.30	13.70	14.94	35.26
ARK.	4.57	7.44	3.28	4.79	6.19	6.32	14.13	14.43	34.83
LA.	11.64	16.87	5.95	5.46	6.86	9.77	17.97	18.40	38.33
OKLA.					4.65	6.50	22.48	21.72	36.67
TEX.	1.23	2.97	2.24	4.02	6.65	4.70	14.52	16.75	28.47
MONT.			3.55	6.77	11.03	4.45	16.74	17.02	19.73
IDAHO			4.29	7.25	11.23	11.07	41.63	37.33	61.11
WYO.			2.91	5.83	6.85	2.88	10.41	10.84	17.86
COLO.			7.19	18.32	15.72	9.54	26.81	23.01	31.22
N. MEX.	4.73	1.59	1.80	7.26	8.30	3.38	8.77	7.07	8.04
ARIZ.			4.94	6.94	4.65	5.90	33.97	26.16	26.98
UTAH	5.28	11.76	9.83	16.96	17.02	9.78	29.28	26.54	41.78
NEV.		4.58	6.04	8.65	6.31	5.17	12.99	16.97	25.16
WASH.		5.20	5.26	8.43	17.15	11.68	44.18	45.17	60.22
OREG.	5.62	6.31	8.00	11.54	14.32	11.23	35.23	35.44	43.29
CALIF.	0.88	4.97	11.01	14.06	28.97	21.87	47.16	64.38	94.77

Table B.1. State Farmland Values per Acre, 1850-1986 (continued).

(Current dollars per acre)

	1930	1940	1945	1950	1960	1970	1980	1986
State:								
MAINE	20.50	13.10	18.92	24.26	41.50	92.73	380.93	657.39
N. H.	16.40	12.06	24.55	28.03	47.86	135.87	686.46	1,157.20
VT.	16.42	12.16	19.62	27.43	43.13	141.50	491.77	826.88
MASS.	58.89	46.79	77.74	81.43	172.52	348.13	983.13	1,744.45
R. I.	60.00	50.35	71.25	105.45	197.08	460.55	1,922.29	3,004.65
CONN.	76.02	62.56	93.20	96.05	260.56	614.00	1,632.14	2,614.70
N. Y.	33.37	23.75	30.62	41.77	65.84	160.23	486.70	572.63
N. J.	86.98	58.32	100.88	127.06	346.76	811.28	2,260.74	3,055.02
PA.	34.62	24.79	39.84	56.29	102.65	229.04	1,057.00	1,070.48
DEL.	38.82	29.95	44.04	59.94	151.38	363.85	1,465.78	1,450.83
MD.	45.28	34.40	51.59	67.80	191.86	476.88	1,776.87	1,521.00
MICH.	37.26	25.64	40.59	54.94	118.16	229.53	859.94	736.86
WIS.	45.06	26.11	37.47	50.36	76.23	153.36	713.83	517.57
MINN.	47.03	27.38	38.10	50.48	97.64	155.72	919.83	521.27
OHIO	47.97	37.43	63.38	89.62	172.62	301.63	1,451.48	859.46
IND.	48.69	41.65	67.42	96.73	195.88	324.41	1,609.60	922.52
ILL.	83.24	61.35	94.61	136.94	256.27	413.57	1,873.64	1,054.76
IOWA	93.67	55.69	80.58	114.16	205.61	326.15	1,639.44	754.71
MO.	38.71	22.06	35.81	46.14	82.00	173.37	769.41	522.14
N. DAK.	18.63	9.29	13.57	22.29	41.62	79.99	363.27	286.27
S. DAK.	28.33	9.55	14.42	23.83	39.74	69.97	259.58	192.53
NEBR.	45.81	18.58	28.97	56.67	71.55	132.13	581.67	335.21
KANS.	40.32	24.57	38.15	51.54	84.03	138.97	527.70	350.21
VA.	31.92	23.93	35.09	47.45	89.63	197.30	803.91	910.80
W. VA.	25.33	18.22	25.79	36.71	39.44	73.89	503.06	411.67
N. C.	31.79	25.88	38.75	54.43	115.95	228.41	959.34	903.37
KY.	29.87	25.46	37.75	50.44	91.95	175.05	766.14	693.89
TENN.	28.61	24.40	36.23	46.19	81.32	178.51	751.52	777.18
S. C.	25.03	21.26	32.85	36.27	84.31	182.00	737.19	723.45
GA.	17.90	13.33	20.83	24.33	63.76	167.30	751.73	697.37
FLA.	70.28	30.81	49.82	49.23	196.10	323.40	1,252.56	1,309.34
ALA.	20.18	14.99	21.82	28.19	54.76	130.57	624.02	617.67
MISS.	23.67	18.16	26.19	33.49	66.03	163.79	698.59	647.91
ARK.	25.41	18.65	31.99	41.25	85.63	211.39	788.55	611.40
LA.	33.47	26.00	40.26	49.32	117.05	241.39	1,109.07	894.28
OKLA.	30.54	19.93	26.06	39.01	72.33	149.98	541.54	427.56
TEX.	24.56	15.94	25.89	36.80	75.14	134.23	396.76	495.16
MONT.	9.91	6.47	10.05	14.26	30.45	53.45	215.03	187.66
IDAHO	36.40	25.99	43.20	52.41	88.89	148.35	603.79	562.18
WYO.	7.43	4.91	7.50	10.83	18.97	36.29	145.71	140.24
COLO.	17.70	9.37	17.21	26.53	45.21	82.08	342.89	318.68
N. MEX.	5.87	4.26	8.65	12.83	21.16	37.97	166.50	121.39
ARIZ.	15.31	5.10	9.95	14.03	45.32	66.72	245.37	213.39
UTAH	31.03	16.09	23.98	32.50	45.77	74.84	455.24	414.55
NEV.	13.26	10.46	15.43	16.76	28.16	49.01	217.53	175.96
WASH.	44.98	28.87	47.01	59.90	95.62	173.61	613.12	684.31
OREG.	30.33	20.49	35.14	45.00	69.19	123.29	481.92	433.19
CALIF.	108.22	58.58	115.79	134.43	322.19	431.30	1,267.37	1,408.31

Table B.2. Real Farmland Values per Acre, Using State Farm Price Deflators, 1850-1950.

(The purchasing power of an average farm acre, in dollars of 1910 farm products within the same state.)

	1850	1860	1870	1880	1890	1900	1910
Vermont	13.82	16.58	12.28	17.07	15.69	14.18	12.60
New York	28.40	33.81	25.45	36.15	37.33	33.21	32.13
Wis.	13.57	25.93	17.63	27.42	40.28	41.28	43.29
Indiana	15.21	26.17	24.83	39.67	53.79	52.01	62.36
Maryland	18.43	22.26	17.26	26.08	32.76	32.72	32.39
Virginia	7.52	8.92	5.74	9.31	11.38	14.02	20.26

	1915	1920	1930	1940	1945	1950
Vermont	13.17	9.03	10.49	9.87		
New York	31.79	18.23	23.73			
Wis.	45.54	35.65	34.58			
Indiana	67.36	54.40	38.58	44.68	35.43	39.07
Maryland	32.79	24.15				
Virginia	20.82	17.16				

Notes and Sources to Table B.2 and Figure B.1:

Nominal land values per acre from Table B.1 were divided by a state-specific price index for products sold by the state's farms, the index set so that 1910 = 1.000. The sources for the state-specific farm price indices are:

Vermont: Adams [1944, pp. 105-106].

New York: Ronk [1935, pp. 35-36].

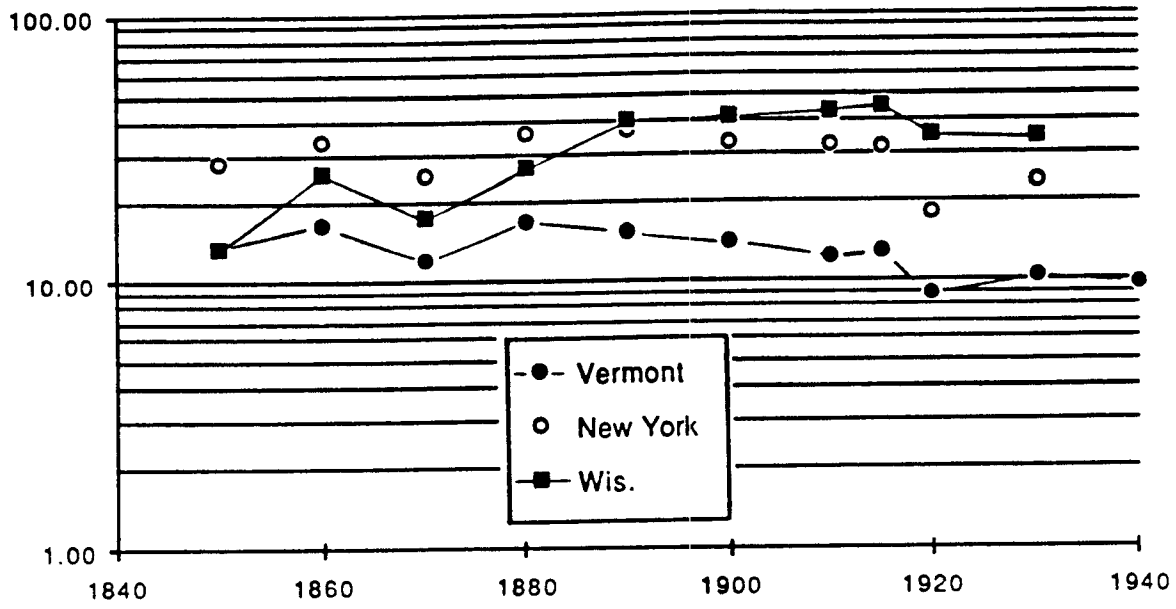
Wisconsin: Mortenson et al. [1933, pp. 75-77, Col (13)].

Indiana: Farris and Euler [1957, p. 26].

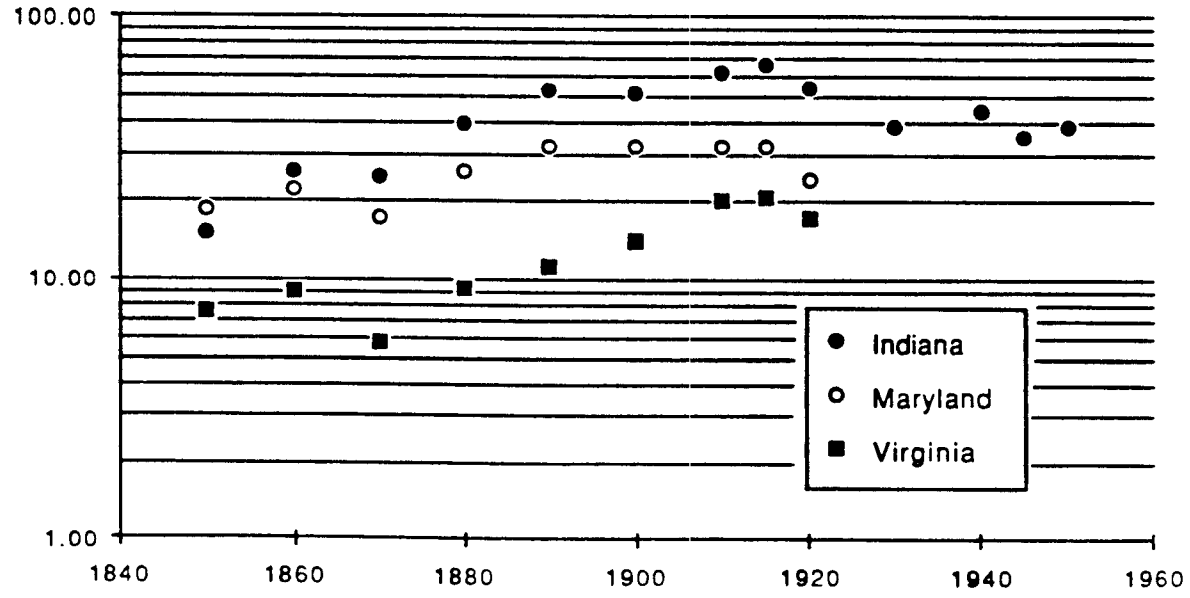
Maryland: Hale [1930, p. 182], starting with 1851 instead of 1850.

Virginia: Peterson [1929, pp. 196-197].

Figure B.1. Real Farmland Values, using State Farm-price Deflators, 1850-1950.



In 1910 dollars
per acre
(log scale)



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Wis.	13.57	25.93	17.63	27.42	40.28	41.28	43.29
Indiana	15.21	26.17	24.83	39.67	53.79	52.01	62.36
Maryland	18.43	22.26	17.26	26.08	32.76	32.72	32.39
Virginia	7.52	8.92	5.74	9.31	11.38	14.02	20.26

	1915	1920	1930	1940	1945	1950
Vermont	13.17	9.03	10.49	9.87		
New York	31.79	18.23	23.73			
Wis.	45.54	35.65	34.58			
Indiana	67.36	54.40	38.58	44.68	35.43	39.07
Maryland	32.79	24.15				
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Notes and Sources to Table B.2 and Figure B.1:

Nominal land values per acre from Table B.1 were divided by a state-specific price index for products sold by the state's farms, the index set so that 1910 = 1.000. The sources for the state-specific farm price indices are:

Vermont: Adams [1944, pp. 105-106].

New York: Ronk [1935, pp. 35-36].

Wisconsin: Mortenson et al. [1933, pp. 75-77, Col (13)].

Indiana: Farris and Euler [1957, p. 26].

Maryland: Hale [1930, p. 182], starting with 1851 instead of 1850.

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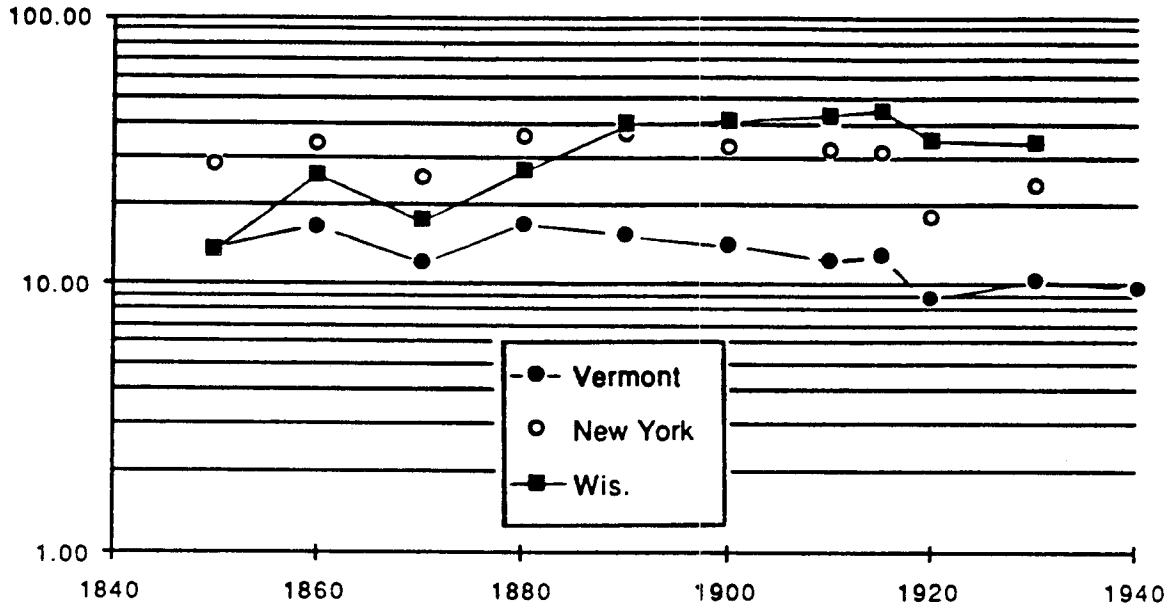
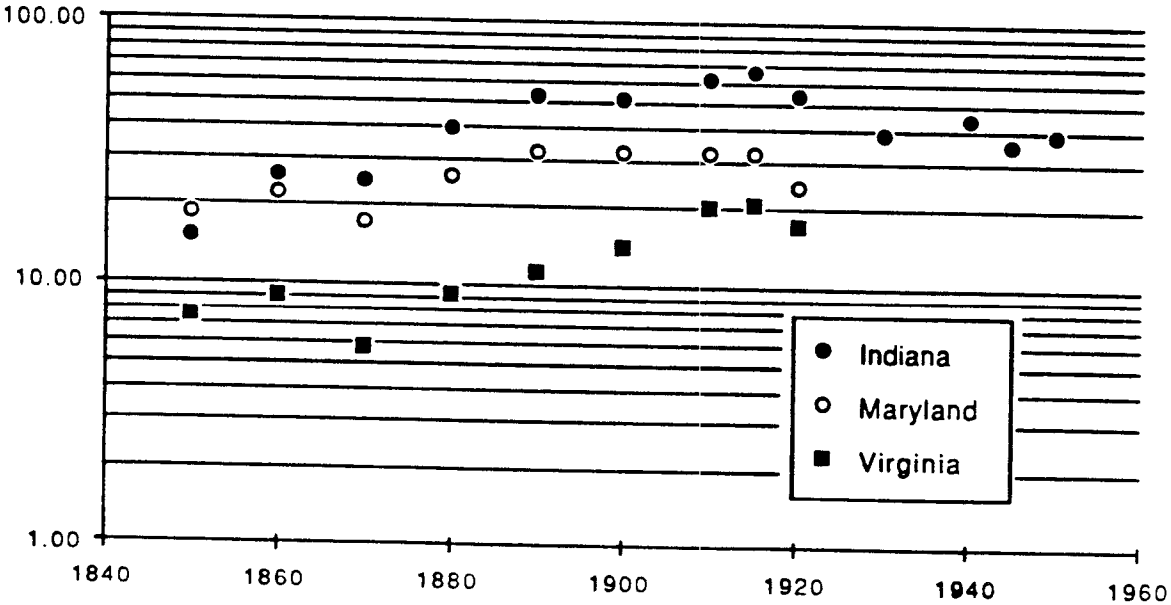
Figure B.1. Real Farmland Values, using State Farm-price Deflators, 1850-1950.



In 1910 dollars
per acre
(log scale)



APPENDIX C.
THE EFFECTS OF INTERSTATE DRIFT ON FARMLAND VALUES, 1850-1986.

As mentioned in the text, I follow the strategy of removing quality- change components from the overall change in farm values per acre to arrive at a nearly-pure residual measure of price changes. Appendix B removed the value of buildings and improvements due to switching of acres between nonfarm and farm status. This appendix removes another kind of quality change, one that affects aggregate movements. Shifts in aggregate value per acre are affected by shifts between places with lands of differing quality. For example, the drift toward settling the frontier was a drift toward lower-quality land in the sense that it was land that carried a lower value in the market setting of any one year. To separate out this component, one needs to develop a *fixed-place* measure of average movement in value per acre.

In quantifying the effect of spatial drift on land values, the first step is to define regions of interest. Table C.1 divides the (48 contiguous) United States into nine regions, following Census and USDA practice except for the placement of Delaware and Maryland in the Middle Atlantic instead of the South Atlantic. The figures in Table C.1 serve as a basis for comparison with what follows. They are regional and national averages computed in the usual current-weight manner. Each state's average value per acre is weighted by its farm acreage from the same year.

To distill the effects of drift in the nation's farmland between lands of different productivity in any given year, one needs to start with the basic algebra that decomposes overall changes in value per acre into quality and price components, including the quality effects of place shifts. Consider the changes that take place in a region's (or nation's) land value from any initial date "0" to any final date "1:"

initial year	*final year*
$V_0 = \Sigma_i V_{i0} = \Sigma_i p_{i0} q_{i0} A_{i0}$	$V_1 = \Sigma_i V_{i1} = \Sigma_i p_{i1} q_{i1} A_{i1}$

where all summations are across the states (the i's) and

p_{it} = the true fixed-quality value of land per acre in state i at time t;

q_{it} = the average quality per acre of the farmland in state i at time t; and

A_{it} = the number of acres of farmland in state i at time t. A_{it} grows when lands are brought into farming, and declines when urbanization and governmental programs pull land out of farming,

The change in total value of farmland is decomposed into changes in price, quality and acreage as follows:

$$\Delta V = V_1 - V_0 = \Sigma (p_{i1}q_{i1}A_{i1} - p_{i0}q_{i0}A_{i0})$$

$$= \Sigma [(p_{i1}q_{i1} - p_{i0}q_{i0})A_{i0} + p_{i1}q_{i1}(A_{i1} - A_{i0})]$$

$$= \Sigma [((p_{i1}q_{i1} - p_{i0}q_{i0})/p_{i0}q_{i0})V_{i0} + V_{i1}(A_{i1} - A_{i0})/A_{i1}].$$

This appendix calculates the underlined (first) term on the right-hand side, setting aside the second term, which reflects only changes in value due to shifts in location. Notice that as the expression stands, it is not an expression in p's alone, but in pq's. That is, price and quality elements of value *within* each state have still not been separated. It remains for Appendix D to remove as much of the quality change within states as possible, leaving measures of fairly-pure price change.

The underlined expression for value changes in fixed locations is calculated separately for each time gap between adjacent benchmark dates. The benchmark dates are those already introduced in Appendix B and Table C.1 above, namely 1850, 1860, ..., 1980, 1986. For each period we use start-of-period value weights (V_{it}'s as shares of the grand sum ΣV_{it}): weights from 1850 for 1850-1860, weights from 1860 for 1860-1870, ... weights from 1980 for 1980-1986. The weight base is updated every period to minimize on index-number distortion. The rates of change produced by this procedure for the nine regions and the nation appear in Table C.2. Each rate

measures a nominal rate of value gain, one that mixes pure capital gains with value gains caused by investments in improving land quality.

Table C.3 splices these rates of change together to get implied levels of nominal land value per acre based on 1960 values. That is, each level is calculated in relation to the value for 1960 and then multiplied by the actual nominal 1960 dollar value per acre for that region. Each figure in the resulting spliced series represents a level that would have been observed historically had the bundle of farm lands never changed.

To convert from nominal to real values, we need a price deflator. The preferred concept is a cost-of-living deflator, to derive the purchasing power one would obtain by selling farmland and spending the proceeds on consumer goods and services in the same year. We would like the deflators to be state-specific and to apply to the rural-urban mixture of places where proceeds of land sales would probably be spent. Limitations on data availability, however, force us to accept a fair substitute. We must use regional (not state) urban (not rural-urban) deflators.[1] They are appropriate to the following slight revision of the question one would have first asked: If one sold an average farm, how much consumer goods and services could each acre have bought if spent in the cities of the same region? The figure used are given in Table C.4.

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[1]There is the alternative of using the "Koffsky-adjusted" cost-of-living deflators developed by Williamson and Lindert (1980). The Koffsky-adjusted deflators combine the first two of these three influences on changes in the rural-and-urban cost of living over time: (i) changes due to movements in the urban cost of living, (ii) changes due to shift in the rural-urban residential mix, and (iii) changes in the rural cost of living for given movement in the urban cost of living. But we cannot observe (iii), apart from Adams' study of Vermont up to 1940. The Koffsky-adjusted indices add only the (ii) component to the presentation of (i) given in Table C.4. The Koffsky-adjusted hybrid is a less appealing concept than the urban cost of living, and did not behave much differently from it anyway. Accordingly, I use only the urban (workers') cost of living in Table C.4.

Deflating by the cost of living yields the real values per acre shown in Table C.5 and graphed in Figures C.1 through C.4. These are an intermediate product, embodying the adjustments for building value, spatial drift and the cost of living, but not yet adjustments for investments in land improvement. Yet they show the same patterns that will emerge after Appendix D, with only a slight exaggeration of the rise to 1915 and the fall to 1940.

Comparing Figures C.1-C.4 with the results derived in Appendix D and the main text confirms that the same story of regional trends emerges with or without adjustment for land improvements. Farm land appreciated much more slowly in the Northeastern states than in the US as a whole up to the 1910s (Figure C.1). Its value also fell less in the slump from 1915 to 1940. The postwar movements were parallel, except that New England's farm land values actually rose in real terms in the general crisis of the 1980s. Trends in the North Central region (Figure C.2) paralleled those of the nation as a whole, partly because of the heavy weight of this region in US farmland value and acreage.

For the South, the long history divides at a watershed around 1930 (Figure C.3). Before that time, movements in the South were more dramatic. The Civil War defeat and slave emancipation widened the gap between Northern and Southern land values. Yet by 1930, farm land values in the South had caught up with those for the nation as a whole, even though the South lagged badly in product per capita until about the 1960s. Since the 1920s, the value of farm land in the South has matched, and moved with, the national average. In the West (Figure C.4), there is again broad similarity with national trends within this century.

Table C.1. Regional Average Values of Farmland per Acre. Using Current-year Acreage Weights, 1850-1986 (current dollars per acre, not deflated)

	1850	1860	1870	1880	1890	1900
New England	10.87	12.69	12.82	14.49	13.26	13.78
Mid Atlantic	17.63	24.52	28.80	29.00	29.18	26.68
East North Central	10.48	18.56	23.40	26.47	29.86	32.44
West North Central	5.30	9.29	12.93	12.36	16.44	19.37
South Atlantic	4.00	6.15	3.87	5.44	7.33	7.60
East South Central	4.67	9.18	6.00	6.47	7.70	8.45
West South Central	4.41	6.87	3.27	4.39	6.54	5.40
Mountain	4.80	2.28	4.26	12.18	11.29	6.13
Pacific	1.35	5.22	10.25	13.22	24.34	17.78
National	7.68	11.67	13.14	13.98	16.20	15.30

	1910	1915	1920	1930	1940	1945
New England	19.28	20.30	28.72	30.84	23.74	37.13
Mid Atlantic	33.70	32.97	42.41	37.60	27.11	39.92
East North Central	61.32	67.33	102.81	55.63	40.55	63.69
West North Central	43.21	49.02	83.05	43.86	23.18	34.24
South Atlantic	17.19	18.71	40.13	28.85	21.18	33.11
East South Central	16.30	18.27	37.85	25.75	20.78	30.46
West South Central	16.05	17.48	31.19	26.19	17.39	27.15
Mountain	19.73	17.95	23.87	12.94	7.64	12.90
Pacific	43.76	53.14	74.21	70.97	40.83	77.35
National	32.40	35.44	57.50	35.50	22.07	34.04

	1950	1960	1970	1980	1986
New England	41.73	81.72	201.08	674.43	1137.04
Mid Atlantic	54.66	108.57	258.32	974.28	1013.84
East North Central	90.55	174.11	303.77	1389.95	850.42
West North Central	50.29	84.31	145.76	673.97	400.12
South Atlantic	40.71	104.87	213.53	892.46	900.83
East South Central	39.21	73.41	162.94	713.07	686.17
West South Central	38.23	77.50	148.06	490.38	513.87
Mountain	18.20	35.71	60.43	254.23	223.52
Pacific	92.66	197.23	289.91	902.54	970.76
National	46.19	88.98	157.36	635.48	516.56

Notes and sources

The regions are defined as follows: *New England* = Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut. *Middle Atlantic* = New York, New Jersey, Pennsylvania, Delaware, Maryland. *East North Central* = Michigan, Ohio, Indiana, Illinois, Wisconsin. *West North Central* = Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas. *South Atlantic* = Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida. *East South Central* = Kentucky, Tennessee, Alabama, Mississippi. *West South Central* = Arkansas, Louisiana, Texas, Oklahoma. *Mountain* = Montana, Idaho, Wyoming, Colorado, New Mexico, Utah, Arizona, Nevada. *Pacific* = Washington, Oregon, California.

Sources: Appendix B above, U.S. Census of Agriculture, and Clifton and Crowley (1973).

Table C.2. Rates of Change in Nominal Farmland Value per Acre for Fixed Interstate Distributions of Farm Acreage, 1850-1986.

(Note: rates of change over whole periods, not annual rates.)

from:	1850	1860	1870	1880	1890	1900	1910	1915	1920
to:	1860	1870	1880	1890	1900	1910	1915	1920	1930
N.England	0.205	0.0292	0.1251	-0.079	0.0401	0.4233	0.0447	0.4148	0.0971
M.Atl.	0.39	0.1722	0.0086	0.0073	-0.087	0.2651	-0.021	0.2839	-0.108
E.N.C.	0.872	0.2847	0.1419	0.136	0.0936	0.9085	0.1008	0.5272	-0.46
W.N.C.	0.814	0.4114	0.031	0.4163	0.2386	1.3198	0.1508	0.712	-0.469
S.Atl.	0.551	-0.383	0.425	0.5096	0.0547	1.2703	0.0903	1.1037	-0.279
E.S.C.	1.004	-0.371	0.0959	0.206	0.1012	0.9274	0.123	1.0569	-0.319
W.S.C.	0.327	-0.193	0.4089	0.4519	-0.133	1.9111	0.0878	0.788	-0.158
Mountain	-0.38	0.0602	1.3983	-0.015	-0.376	2.2888	-0.044	0.3487	-0.431
Pacific	2.768	0.9647	0.3062	0.9236	-0.248	1.4796	0.9159	0.2926	0.0042
	(Bordered values based on only a subset of states.)								
NATIONAL	0.601	0.0484	0.1179	0.2184	0.0541	1.1189	0.1681	0.6318	-0.36

from:	1930	1940	1945	1950	1960	1970	1980
to:	1940	1945	1950	1960	1970	1980	1986
N.England	-0.242	0.5829	0.1557	1.03	1.43689	2.32081	0.68546
M.Atl.	-0.283	0.478	0.3635	0.9961	1.35613	2.72199	0.04614
E.N.C.	-0.268	0.5731	0.4168	0.8953	0.71324	3.60393	-0.3901
W.N.C.	-0.469	0.4999	0.4809	0.4179	0.73443	3.59724	-0.407
S.Atl.	-0.274	0.5178	0.2317	1.4852	0.99866	3.17648	-0.0025
E.S.C.	-0.187	0.4697	0.2985	0.8615	1.2081	3.37428	-0.0388
W.S.C.	-0.335	0.5641	0.4068	1.035	0.91339	2.28525	0.04666
Mountain	-0.394	0.7143	0.4016	0.9439	0.70681	3.17075	-0.1175
Pacific	-0.427	0.881	0.1921	1.1623	0.43796	2.13036	0.08191
NATIONAL	-0.367	0.579	0.3707	0.7329	0.78267	3.04981	-0.1858

Table C.3. Nominal Value of Farmland per Acre, by Region, Adjusted for Interstate Drift and Spliced to the Actual 1960 Value per Acre, 1850-1986.

	1850	1860	1870	1880	1890	1900
N. England	9.42	11.34	11.67	13.13	12.10	12.58
M. Atl.	17.56	24.41	28.62	28.86	29.07	26.55
E.N.C.	9.53	17.83	22.91	26.16	29.72	32.50
W.N.C.	3.76	6.82	9.62	9.92	14.05	17.40
S.Atl.	3.81	5.92	3.65	5.20	7.85	8.28
E.S.C.	4.57	9.16	5.76	6.31	7.61	8.38
W.S.C.	2.87	3.81	3.08	4.33	6.29	5.46
Mountain	5.34	3.33	3.53	8.48	8.35	5.21
Pacific	0.82	3.10	6.10	7.96	15.32	11.52
NATIONAL	5.34	8.55	8.96	10.02	12.21	12.87

	1910	1915	1920	1930	1940	1945	1950
N. England	17.91	18.71	26.47	29.04	22.00	34.83	40.26
M. Atl.	33.58	32.88	42.22	37.66	26.99	39.89	54.39
E.N.C.	62.03	68.28	104.28	56.28	41.22	64.84	91.87
W.N.C.	40.37	46.46	79.53	42.21	22.40	33.59	49.74
S. Atl.	18.81	20.51	43.14	31.10	22.57	34.26	42.20
E.S.C.	16.16	18.15	37.32	25.41	20.67	30.37	39.44
W.S.C.	15.88	17.28	30.89	26.01	17.31	27.07	38.08
Mountain	17.15	16.40	22.11	12.58	7.62	13.07	18.31
Pacific	28.56	54.71	70.72	71.02	40.68	76.51	91.21
NATIONAL	27.27	31.86	51.99	33.28	21.08	33.28	45.61

	1960	1970	1980	1986
N.England	81.72	199.14	661.31	1114.62
M. Atl.	108.57	255.80	952.10	996.04
E.N.C.	174.11	298.29	1373.32	837.63
W.N.C.	84.32	146.25	672.33	398.72
S. Atl.	104.87	209.60	875.39	873.22
E.S.C.	73.41	162.10	709.06	681.52
W.S.C.	77.50	148.29	487.16	509.89
Mountain	35.60	60.76	253.42	223.66
Pacific	197.23	283.61	887.80	960.52
NATIONAL	88.98	158.62	642.40	523.02

Table C.4. Cost-of-Living Indices for Urban Workers, by Region, 1850-1986

	1850	1860	1870	1880	1890	1900	1910	1915	1920
New England	0.310	0.331	0.470	0.363	0.323	0.298	0.337	0.362	0.626
Mid Atlantic	0.305	0.326	0.450	0.353	0.318	0.297	0.340	0.367	0.635
East North Central	0.248	0.265	0.388	0.325	0.294	0.275	0.316	0.350	0.606
W. North Central	0.312	0.334	0.439	0.358	0.322	0.300	0.340	0.363	0.629
South Atlantic	0.382	0.408	0.472	0.373	0.336	0.313	0.358	0.368	0.638
E. South Central	0.258	0.276	0.379	0.335	0.311	0.299	0.353	0.362	0.626
W. South Central	0.285	0.305	0.385	0.340	0.308	0.289	0.332	0.351	0.607
Mountain								0.432	0.748
Pacific								0.375	0.650
National	0.281	0.301	0.427	0.330	0.310	0.281	0.320	0.344	0.677

	1930	1940	1945	1950	1960	1970	1980	1986
New England	0.584	0.482	0.610	0.803	1.000	1.347	2.859	3.805
Mid Atlantic	0.595	0.484	0.596	0.785	0.951	1.281	1.718	3.618
E. North Central	0.582	0.480	0.591	0.779	0.947	1.275	2.706	3.601
W. North Central	0.585	0.475	0.590	0.777	0.950	1.280	2.716	3.615
South Atlantic	0.572	0.453	0.555	0.731	0.881	1.187	2.519	3.353
E. South Central	0.557	0.440	0.541	0.713	0.865	1.166	2.474	3.293
W. South Central	0.557	0.443	0.540	0.711	0.854	1.150	2.440	3.248
Mountain	0.547	0.476	0.587	0.774	0.941	1.267	2.689	3.579
Pacific	0.588	0.482	0.599	0.789	0.967	1.303	2.765	3.680
National	0.565	0.473	0.608	0.813	1.000	1.310	2.780	3.700

Notes and Sources

For 1850-1970, Lindert (1978, App. G) and Williamson and Lindert (1980). For 1980 and 1986, each region's cost of living was assumed to change since 1970 proportion as for the US cost-of-living index for urban workers.

Table C.5. Real Value per Farm Acre, Adjusted for Interstate Drift, by Region, 1850-1986.

(in 1960 New England consumer dollars per acre)

	1850	1860	1870	1880	1890	1900
N. England	30.42	34.27	24.84	36.18	37.45	42.22
M. Atl.	57.59	74.89	63.59	81.76	91.43	89.38
E.N.C.	38.41	67.30	59.05	80.50	101.09	118.19
W.N.C.	12.05	20.41	21.92	27.71	43.63	58.00
S. Atl.	9.99	14.50	7.74	13.95	23.38	26.47
E.S.C.	17.71	33.19	15.20	18.85	24.48	28.04
W.S.C.	10.08	12.49	7.99	12.75	20.43	18.88
Mountain						
Pacific						
NATIONAL	18.99	28.44	21.00	30.39	39.34	45.76

	1910	1915	1920	1930	1940	1945	1950
N. England	53.13	51.75	42.28	49.72	45.65	57.15	50.13
M. Atl.	98.77	89.60	66.49	63.65	56.07	65.24	67.74
E.N.C.	196.30	195.09	172.08	97.34	85.94	106.65	114.40
W.N.C.	118.73	127.98	126.44	77.96	49.27	57.95	64.60
S. Atl.	52.54	55.73	67.62	58.13	49.95	59.28	54.80
E.S.C.	45.78	50.13	59.62	51.81	48.04	54.24	51.97
W.S.C.	47.85	49.30	50.90	51.73	40.37	49.15	51.66
Mountain		37.95	29.56	22.91	16.42	22.00	23.13
Pacific		145.89	108.80	124.47	85.37	126.26	113.59
NATIONAL	85.20	92.72	76.79	58.95	44.53	54.73	56.12

	1960	1970	1980	1986
N. England	81.72	147.84	237.88	301.25
M. Atl.	114.16	199.69	342.48	269.20
E.N.C.	183.85	233.96	494.00	226.39
W.N.C.	88.76	114.26	241.85	107.76
S. Atl.	119.04	176.58	314.89	236.00
E.S.C.	84.87	139.02	255.06	184.19
W.S.C.	90.75	128.95	175.24	137.81
Mountain	37.83	47.96	91.16	60.45
Pacific	203.96	217.66	319.35	259.60
NATIONAL	88.981142	120.98	231.08	141.36

(For 1960-1986, all regional deflators were assumed to rise in fixed proportion to the U.S. consumer price deflator.)

Figure C.1. Real Value per Farm Acre, Adjusted for Interstate Drift, Northeast vs. US, 1850-1986.

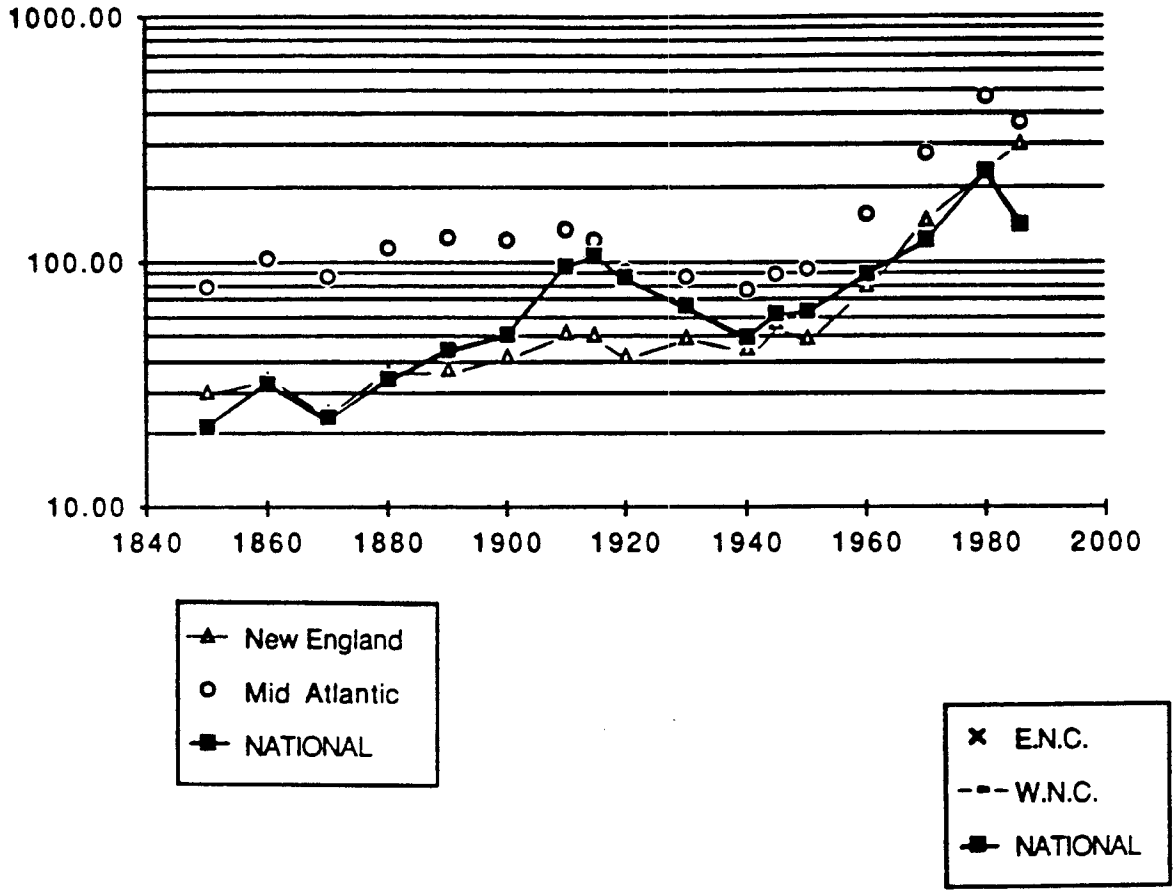


Figure C.2. Real Value per Farm Acre, Adjusted for Interstate Drift, North Central vs US, 1850-1986. (In 1960 New England Consumer $)

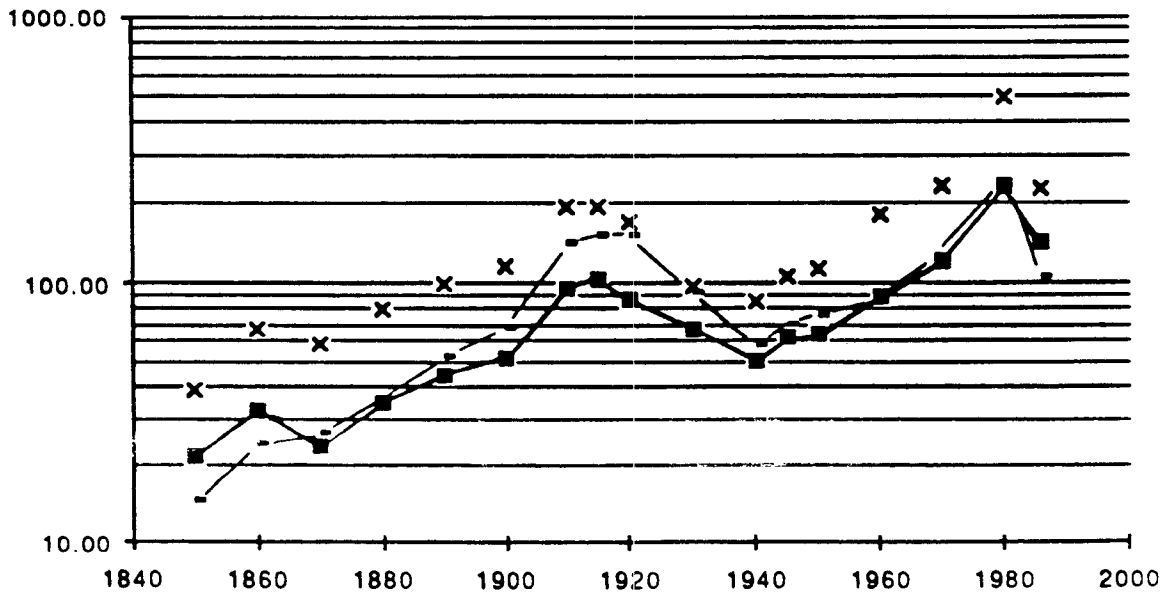


Figure C.3. Real Value per Farm Acre, Adjusted for Interstate Drift, South vs. US, 1850-1986. (In 1960 New England Consumer $)

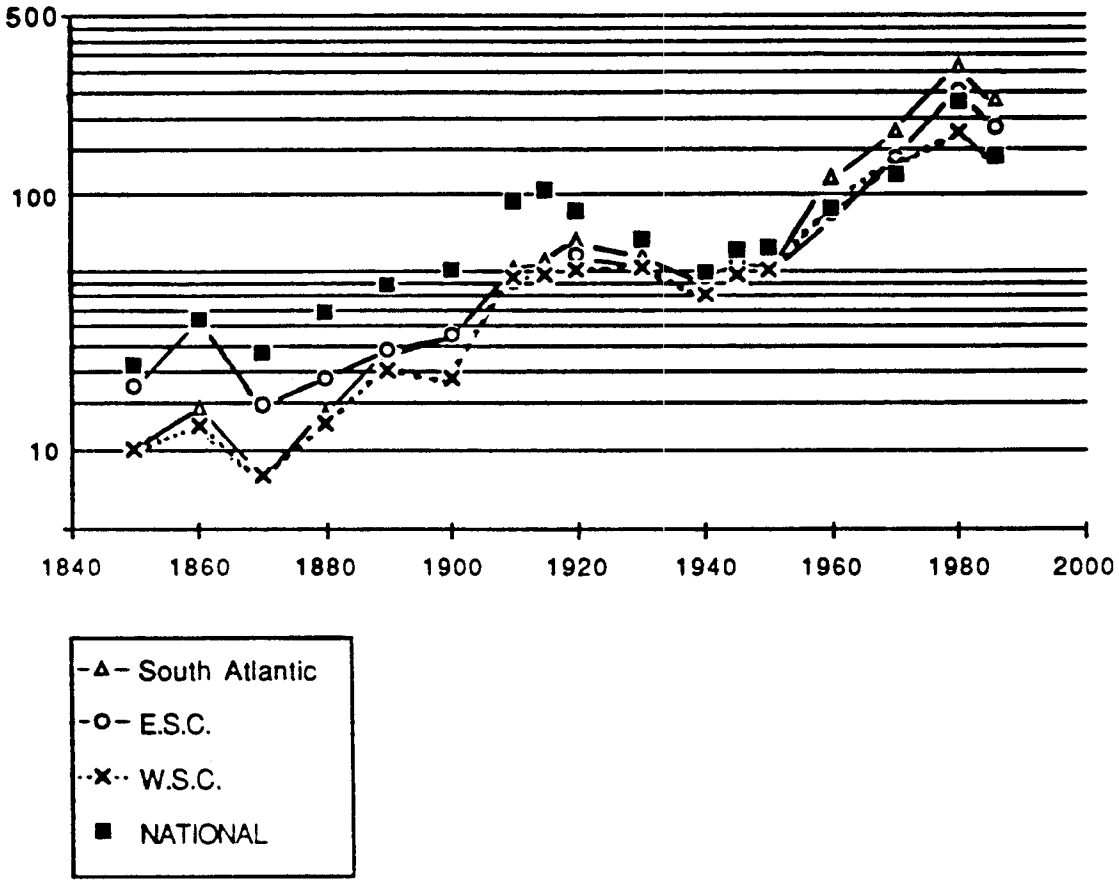
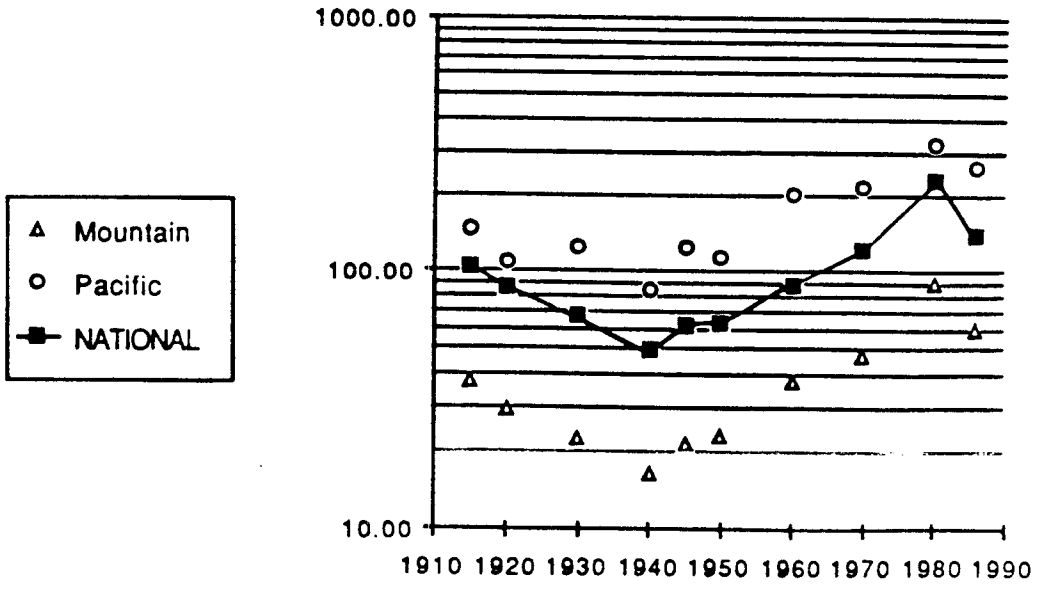


Figure C.4. Real Value per Farm Acre, Adjusted for Interstate Drift, West vs. US, 1850-1986. (In 1960 New England Consumer $)



APPENDIX D.

THE EFFECTS OF LAND IMPROVEMENT ON FARMLAND VALUES, 1774-1986.

Now that the measures of land values have been purged of the effects of building values, spatial land-quality drift, and the cost of living, the remaining task of quality adjustment is to remove the contribution to land value stemming from intra-state investments in the quality of lands.

Farm owners and operators can invest in the quality of land in several ways. The available data series that best reflects their investments in the land itself is the official census series on "improved" acreage. The 1920 Census of Agriculture defines types of farm land as follows:

> *Improved land* includes all land regularly tilled or mowed, land in pasture which has been cleared or tilled, land lying fallow, land in gardens, orchards, vineyards, and nurseries, and land occupied by farm buildings.
>
> *Woodland* includes all land covered with natural or planted forest trees which produce, or later may produce, firewood or other forest products.
>
> *Other unimproved land* includes brush land, rough or stony land, swamp land, and any other land which is not improved or in forest. [14th Census, Vol. V, 1922, p. 17].

Official data often dropped the distinction between the second and third categories, as in the censuses of 1890 and 1900. For all years through 1950 we shall use only the single distinction between improved and all other farm land. After 1950, Census and the USDA dropped the "improved" distinction, preferring breakdowns by a few types of cropland, pasture forest and so on. The change in data presentation might have prevented our following land quality changes after 1950. Fortunately, a recent study by Willis Peterson [1986] generates useful indices of land quality by state for the censuses of 1950, 1960, 1970, and 1978.

In terms of the algebra of Appendix C, we seek to break the underlined value-change term --

$\Delta V'$ = Change in land value/acre for fixed place weights $= \Sigma \left((P_{i1}q_{i1} - p_{i0}q_{i0})/p_{i0}q_{i0}\right)V_{i0}$

-- into price-change and quality-change components. The chosen decomposition is

$$\Delta V' = \Sigma_i V_{i0} \left[\frac{p_{i0}q_{i1} - p_{i0}q_{i0}}{p_{i0}q_{i0}} + \frac{p_{i1}q_{i1} - p_{i0}q_{i1}}{p_{i1}q_{i1}} \cdot \frac{(p_{i1}q_{i1})}{(p_{i0}q_{i0})} \right]$$

land-improvement effect | price-change effect

To quantify the land-improvement effect for 1950 and all earlier years, one can either capitalize the values of prior investments into the land itself or use estimates of the current land-price markup of improved over unimproved land. The latter approach is easier, thanks to Tostlebe's estimates of the extent and price markup value of land improvements (1957, pp. 50-51, 177-186). Let θ_{mi} be the share of acreage in state i that has been "improved," as this term is defined by the US agricultural censuses. Let μ be the markup ratio on land improvement, that is, the ratio of the price of improved land (p_m) to the price of unimproved farm land (p_u). The observed average value of farm land per acre in state i is a weighted average of the values of improved and of unimproved land. Omitting the subscripts for state and time ($_{it}$'s), the algebra is:

$p = \theta_m \mu p_u + (1 - \theta_m) p_u$, so that the ratio of true average value to improved value is

$$p/p_m = (1+(\mu-1)\theta_m)/\mu.$$

This ratio will serve as the measure of land quality (q_{it}) for a given set of sites, here all the farms in a single state, on a given date. (Interpreting p/p_m as a quality measure is safe enough as long as μ is fixed. If μ changes over time, there is an index-number problem of deciding between initial and final values of μ.)

1850-1950. Data from the censuses and from Tostlebe make it possible to estimate θ_m and μ for the period 1850-1950. The 1920 census gives the shares of farm land improved (θ_m) for each state for 1850-1920. Tostlebe gives the same θ_m share for regions from 1870 through 1950, from which we will draw data for 1930-1950. Tostlebe estimates the improved-land markup ratio (μ) for available dates, usually the 1910s. For most states the ratio ($\mu = p_m/p_u$) is 3.00. For Illinois, Iowa and four Great Plains states, the ratio is only 1.50, because of the greater ease of land clearing on the prairies and plains. For the Western states Tostlebe leaves no clear answer. Clearing forest and preparing for irrigation are two expensive types of land improvement for farming purposes, while much other Western land was easily readied for cultivation. I shall assume that for the Western states, as for the humid East, $\mu = 3.00$ overall.

The calculations just sketched are summarized in the following tables. Table D.1 reproduces the shares of farmland that are improved, in each state since 1850. In general, the shares rose slowly to 1910, except for a few sudden jumps due to definition changes for some Western states. From 1910 to 1950, the shares declined somewhat in several states, but were nearly stable, leaving a net rise over the whole century 1850-1950.

Table D.2 uses the state improved-land shares and the Tostlebe estimates of μ to derive the implied nominal dollar values of *improved* farm land per acre, according to the formula $p_m = \mu p/(1+(\mu-1)\theta_m)$. Table D.3 shows the state-specific movements in land quality (p/p_m) implied by the same calculations.

Tables D.4 and D.5 use the state data to derive the regional and national

movements in the price of improved farm land, the movements used to portray post-1850 capital gains in this paper.

Table D.6 spells out what the present calculations imply for movements in land quality by region. These figures could be multiplied by land areas in farms and by rent/value ratios to derive movements in land inputs into regional agriculture over the 136 years. The national estimates slightly reinforce Robert Gallman's (1972) conclusion that there was little total factor productivity growth in agriculture between 1840 and 1900, because (using Tostlebe's μ, which is higher than Gallman's) they imply greater productivity gains from the shift toward improved land. If the growth of the land input was indeed a bit faster than Gallman implied, his conclusion of no productivity growth is a little more secure.

Land Quality, 1950-1986. The quality of land can be extended toward the present with the help of Willis Peterson's recent [1986] regession study. For the censuses of 1950, 1960, 1970 and 1978 Peterson ran cross-sectional regressions on state data, explaining land values per acre in terms of several variables. Most variables (irrigation, etc.) were relevant to the land's agricultural productivity. These correspond well enough with the investments in land quality stipulated in the present definition of quality change as opposed to price change. By holding constant the price-type variable (population density), Peterson generated predictions of land quality by state for each census. With one exception (Nevada for the 1960 census), his estimates look reasonable. They are adopted here (letting the 1978 quality apply to 1980 and 1986).

Extension back to 1805 (or, How Well Did Blodget Know the America around Him?). Before 1850, we only have, again, Blodget's offhand view of what was happening to farm values and land use around 1805. Blodget complicated our task by giving out various estimates in the same book. What needs explaining here is how Blodget's estimates differ widely in some respects, but not in the implied rate of capital gains from his 1805 to the census values of 1850.

Option A: Gallman and Blodget's Page 60. Regarding improved and unimproved farm acres around 1805, one could start with Gallman's [1972, pp. 202-203] tentative assumptions in favor of using Blodget's figures with minor

modifications. Using Blodget's figures and an assumed ratio from 1840, Gallman infers 28.45 million improved farm acres, and 48.4 million unimproved farm acres, for 76.85 million total farm acres in 1800. Using Gallman's assumptions and the 1805 figures from Blodget yields 30.575 million improved acres out of a total of 82.55 million farm acres in 1805, for θ_m = .370.

The value multiplier μ is not easily stated for 1805. If we stayed with Tostlebe's gleanings from a wide set of estimates around the 1910s, we would again use μ = 3.00 for the eastern states settled in 1805. Gallman, on the other hand, opts for μ = 2.00 on the basis of Towne-Rassmussen costs of clearing. Yet I would be more comfortable with Blodget's own ratio of "improved" or "cultivated" value per acre to that of "natural state" land in 1805, or \$6.25/\$2.20 = μ = 2.84 [Blodget, 1806, pp. 60, 70].

Blodget's figures, as amplified here, imply the following accounting for land value and quality in 1805 versus 1850:

Option A:	1805	1850
Land in farms (millions of acres)	82.55	293.56
Improved land in farms (millions of acres)	30.58	113.03
Share improved = θ_m =	37.0%	38.5%
Value ratio for improved/unimproved = μ =	2.84	2.35
Average nominal farmland values per acre:		
improved = p_m =	\$6.25	\$11.88
unimproved = p_u =	\$2.20	\$5.05
average = p =	\$3.70	\$7.68
Implied ave. farmland "quality" = (p/p_m) =	0.592	0.647
Average real farmland values per acre (1960 US urban consumer dollars):		
improved = p_m/p_c =	14.81	42.24
unimproved = p_u/p_c =	5.21	17.96
average = p/p_c =	8.77	27.31
(where p_c = the urban consumer price deflator)		

On this accounting the average acre of US farm land (p/p_c) more than tripled in real value between 1805 and 1850, and even tripled when the degree of improvement is held constant (using a fixed average of p_m/p_c and p_u/p_c).

Option B. Blodget's Page 196. Blodget's Page 196 presented different figures,

ones not cited by Gallman. The discrepancy is bothersome, of course, for any attempt to lean on Blodget regarding farmland values. It can be said, however, that if *either* Blodget story is near the mark, the present analysis of capital gains comes out much the same, though the discrepancy would be more serious for other purposes.

Specifically, Blodget's Page 196 allows us to imagine much more unimproved acreage, and makes slight alterations in land prices. On Page 196, he estimates

39 millions acres at $6.00 (the $6.25 from Page 60 rounded?),

150 million acres at $3.50 "adjoining or near the cultivated lands,"

and 451 million acres at $2.00, "the residue of all the lands in the United States."

Taking the first two categories as land in farms yields this revised accounting for 1805:

Option B (preferred in this paper):	1805	1850 (as above)
Land in farms (millions of acres)	189.00	293.56
Improved land in farms (millions of acres)	39.00	113.03
Share improved = θ_m =	20.6%	38.5%
Value ratio for improved/unimproved = μ =	1.71	2.35
Average nominal farmland values per acre:		
improved = p_m =	$6.00	$11.88
unimproved = p_u =	$3.50	$5.05
average = p =	$4.02	$7.68
Implied aver. farmland "quality" = p/p_m =	0.669	0.647
Average real farmland values per acre (1960 US urban dollars):		
improved = p_m/p_c =	14.22	42.24
unimproved = p_u/p_c =	8.30	17.96
1805-wt. ave. = $(\theta_m p_m + (1-\theta_m)p_u)/p_c$ =	9.52	22.96
variable-weight average = p/p_c =	9.52	27.31

The two Blodget-based options are in serious disagreement about the rise in farmland quality and the overall rise in farm values. But the choice makes only an 8.5 percent difference in the average land price as of 1805, with little effect on the rate of capital gain between 1805 and 1850. Choosing between the two options on their merits seems a toss-up, since the only glaring difference is in the extent of unimproved lands that should be considered "in farms," a concept Blodget did not

care to invoke. I shall prefer Option B for a single reason: it is biased against the conclusions being advanced in this paper.

To view the 1805-1850 change in the light of later changes, one could splice the above accounting onto the real fixed-place value per improved acre in Table D.5. Doing so yields a real fixed-quality value (1850 improved-land weights) equal to 37.80 x 9.52/22.96 = $15.55 in New England prices of 1960, where the 1850 value in Table D.5 was $37.80.

Extension from 1805 back to 1774 (or, How Well Did Blodget Know his Colonial History?). It is possible to extend the decomposition of land-value changes into price and quality components back to 1774, using Blodget's time series on land prices and land areas plus Gallman's assumption about the share of pasture improved. Doing so further strains our belief in Blodget. To trust him about conditions thirty-one years earlier is takes more faith than just trusting his judgment of conditions at the time of his writing, after two national censuses. We should, however, quantify an important implication of Blodget's figures about early land-price and land quality movements.

Faith in Blodget's figures must be supplemented with different assumptions about the extent of lands "in farms" before one can estimate price and quality movements for 1774-1805. Two extreme assumptions serve to make the key points, without commitment to any best guess about the truth that probably lay in between. (i) To *overestimate* the pure capital gains from 1774 to 1805, let us assume a low share of land cultivated in 1774, since Blodget's price for land "in its natural state" rose faster than that for cultivated land. Specifically, let us assume that total farm acres were already as high in 1774 as they were in 1805 (using Gallman's assumption, as in Option A above). Assumption (i) implies that all the rise in cultivated land between these two dates came at the expense of unimproved land within farms, which is too high an estimate of unimproved acreage back in 1774. (ii) To *underestimate* the pure capital gains from 1774 to 1805, assume that the share of farm lands already improved by 1774 was as high as in 1805. This seems unlikely for an age so early in the process of land improvement.

Combining the two sets of extreme assumptions with the Option-A estimates

from the preceding section (so as to bias the look of 1774-1805 capital gains downward) yields this accounting for changes consistent with Blodget's estimates:

	1774	1805 (Option A)
Land in farms (millions of acres)	(ii) 42.92 *to* (i) 82.55	82.55
Improved land in farms (millions of acres)	15.88	30.58
Share improved = θ_m =	(i)19.2% *to* (ii) 37.0%	37.0%
Value ratio for improved/unimproved = μ =	7.14	2.84
Average nominal values/acre:		
improved = p_m =	$2.50	$6.25
unimproved = p_u =	$0.35	$2.20
average = p =	(i) $ 0.76 *to* (ii) $1.15	$3.70
Implied average farmland "quality" = p/p_m =	(i) 30%-(ii)46%	59.2%
Average real farmland values/acre, in 1960 dollars:		
improved = p_m/p_c =	8.61	14.81
unimproved = p_u/p_c =	1.21	5.21
average = p =	(i) 2.62 *to* (ii) 3.96	8.77

Thus, the overall real value per acre (p/p_c) at least doubled, but did not triple, if Blodget is correct. Again, the pure price gain is a fixed-weight average of the capital gains on improved and unimproved lands. The fixed weights (θ_m's) depend on which assumption we choose. Using Assumption (i) overstates the rate of capital gain as 169 percent, or 3.25 percent a year. Noting from Figure 4 that all the real gain came after 1790 means that the rate of capital gain for 1790-1805 could have been as high as 6.82 percent a year, about matching the record decadal rate of gain experienced in the 1970s. Using Assumption (ii) understates the rate of capital gain as only 121 percent, assuming no rise in the share of farm land improved. This is still a doubling of the real price. The implied gain is large enough to give ample reason for pursuing fresh data to test the accuracy of Blodget's lonely estimates.

Final Caveats on Land Improvement. (1) Omission of geographic drift in farming for 1774-1850. Unlike the figures for 1850-1986 in Tables D.4 and D.5, those

for earlier periods cannot distill out the effects of shifting toward farms of different inherent productivity. Taking account of the westward drift in farm settlement would slightly add to the apparent capital gains, because farm land was more valuable in the Middle Atlantic states and less valuable in the West North Central states than in other states, where regional average values were similar (see Tables D.4 and D.5 for details).

(2) Improvements on already-"improved" land. All calculations of the effects of land improvement on land value are confined to geographic-shift effects and transfers between the census land type categories -- "unimproved" and "improved" land up through 1950, and the different categories introduced with the 1954 census. One suspects that even within each category within individual states, further investments, such as laying better drains, raise land values anew. The omission of such extra investments might seriously understate quality improvement and overstate capital gains, especially for the postwar era. At its worst, confining intra-state quality change to just the binary variable "improved" (1850-1950) could be analogous to measuring educational investments by literacy alone. If only literacy were our guide, it would appear that the educational quality of the American labor force stopped advancing around 1940, when adult literacy was close to the ceiling of possibility. Fortunately, the improved-land share is not that extreme. The usual historical value has been below two-thirds. Furthermore, the improved share actually dropped when real land values dropped between 1915 and 1940, and rose slowly thereafter. There is at least a suggestion that what could drop could also rise when the incentive for improvement existed, so that the modesty of the postwar rise in the share of acreage improved faintly suggests little improvement activity within the areas already classed as improved. And after 1950, Peterson's quality index drew on a greater number of land classes, reducing further the likely importance of intra-class quality shift.

Table D.1. Percentage Shares of Farmland Acreage "Improved," by State, 1850-1986.

	1850	1860	1870	1880	1890	1900	1910	1915	1920
MAINE	44.8	47.2	50	53.2	49.3	37.9	37.5	36.95	36.4
N. H.	66.4	63.2	64.7	62	49.9	29.8	28.6	27.8	27
VT.	63.1	66	67.9	67.3	60.4	45	35	37.45	39.9
MASS.	63.6	64.6	63.6	63.4	55.3	41.1	40.5	38.45	36.4
R. I.	64.4	64.3	57.5	58	58.5	41.1	40.2	40.15	40.1
CONN.	74.2	73.1	69.6	66.9	61.2	46	45.2	41.05	36.9
N. Y.	64.9	68.5	70.4	74.5	74.6	68.9	67.4	65.6	63.8
N. J.	64.2	65.2	66.1	71.5	75.1	69.6	70.1	69.15	68.2
PA.	57.8	61.5	64	67.8	71.9	68.2	68.2	67.65	67.1
DEL.	60.8	63.4	66.3	68.5	72.2	70.7	68.7	68.9	69.1
MD.	60.4	62.1	64.6	65.3	68.9	68	66.3	66.1	65.9
MICH.	44	49.4	50.9	60.1	66.7	67.2	67.8	67.85	67.9
WIS.	35.1	47.5	50.4	59.7	58.3	56.6	56.5	56.35	56.2
MINN.	17.4	20.5	35.8	54.1	59.6	70.3	71	71.05	71.1
OHIO	54.7	61.7	66.6	73.7	78.5	78.5	79.8	79.35	78.9
IND.	39.4	50.3	55.8	68.2	74.2	77.2	79.5	79.35	79.2
ILL.	41.9	62.6	74.7	82.5	84.2	84.5	86.2	85.8	85.4
IOWA	30.1	37.7	60.5	80.3	83.4	86.5	86.9	86.2	85.5
MO.	30.2	31.3	42.1	60.1	64.3	67.4	71.1	71.25	71.4
N. DAK.		8	14.1	25.3	60.8	62.1	72	69.9	67.8
S. DAK.		8	14.1	32.1	61.1	59.2	60.8	56.65	52.5
NEBR.		18.8	31.2	55.4	70.6	61.6	63.1	58.9	54.7
KANS.		22.8	34.8	50.1	73.8	60.1	68.9	68.15	67.4
VA.	39.6	36.8	45	42.9	47.8	50.7	50.6	50.8	51
W. VA.			30.3	37.2	44.1	51.6	55.1	56.4	57.7
N. C.	26	27.4	26.5	29	34.6	36.6	39.3	40.1	40.9
KY.	35.2	39.9	43.4	49.9	55.2	62.5	64.7	64.7	64.7
TENN.	27.3	32.9	34.9	41.1	46.4	50.4	54.3	55.8	57.3
S. C.	25.1	28.2	24.9	30.7	39.9	41.3	45.1	47.45	49.8
GA.	27.9	30.3	28.9	31.5	38	40.2	45.6	48.45	51.3
FLA.	21.9	22.4	31	28.7	31.2	34.6	34.4	36.2	38
ALA.	36.5	33.4	33.8	33.8	38.8	41.8	46.8	48.65	50.5
MISS.	32.8	32	32.1	32.9	39	41.6	48.5	49.85	51.2
ARK.	30.1	20.7	24.5	29.8	36.8	41.8	46.4	49.6	52.8
LA.	31.9	29.1	29.1	33.1	39.5	42.2	50.5	53.35	56.2
OKLA.					35.1	37.3	60.8	58.75	56.7
TEX.	5.6	10.5	16.1	34.9	40.4	15.6	24.3	25.85	27.4
MONT.			60.7	67.7	46.6	14.7	26.9	29.15	31.4
IDAHO			34.5	60.2	46.6	44.1	52.6	53.25	53.9
WYO.			7.8	66.8	26.1	9.8	14.7	16.25	17.8
COLO.			29.8	52.9	39.7	24	31.8	31.75	31.7
N. MEX.	57.2	10.6	17.2	37.6	33.4	6.4	13	10	7
ARIZ.			66.9	41.4	8	13.2	28.1	20.2	12.3
UTAH	34.9	85.9	80	63.5	41.4	25.1	40.3	37.15	34
NEV.		25.2	44.4	64.9	43.5	22.3	27.7	26.45	25.2
WASH.		22.4	29.6	34.4	43.6	40.8	54.4	54.1	53.8
OREG.	30.7	43.5	46.7	52.2	50.9	33	36.6	36.45	36.3
CALIF.	0.8	28.3	54.4	64.3	57	41.5	40.8	40.6	40.4

Table D.1. Percentage of Farm Land "Improved" (continued).

	1930	1940	1945	1950 through 1986
MAINE	55.4	56.6	55	55.2
N. H.	55.4	56.6	55	55.2
VT.	55.4	56.6	55	55.2
MASS.	55.4	56.6	55	55.2
R. I.	55.4	56.6	55	55.2
CONN.	55.4	56.6	55	55.2
N. Y.	55.4	56.6	55	55.2
N. J.	55.4	56.6	55	55.2
PA.	55.4	56.6	55	55.2
DEL.	54.3	56.5	55.6	54.2
MD.	54.3	56.5	55.6	54.2
MICH.	66.9	67.8	69.8	70.3
WIS.	66.9	67.8	69.8	70.3
MINN.	66.9	67.8	69.8	70.3
OHIO	77.5	73.2	73.6	74.4
IND.	77.5	73.2	73.6	74.4
ILL.	77.5	73.2	73.6	74.4
IOWA	77.5	73.2	73.6	74.4
MO.	77.5	73.2	73.6	74.4
N. DAK.	68.4	63.2	61.5	62.6
S. DAK.	68.4	63.2	61.5	62.6
NEBR.	68.4	63.2	61.5	62.6
KANS.	68.4	63.2	61.5	62.6
VA.	54.3	56.5	55.6	54.2
W. VA.	54.3	56.5	55.6	54.2
N. C.	54.3	56.5	55.6	54.2
KY.	54.3	56.5	55.6	54.2
TENN.	54.3	56.5	55.6	54.2
S. C.	53.4	50.8	47.2	40.7
GA.	53.4	50.8	47.2	40.7
FLA.	53.4	50.8	47.2	40.7
ALA.	53.4	50.8	47.2	40.7
MISS.	57.6	58.3	54.1	49.4
ARK.	57.6	58.3	54.1	49.4
LA.	57.6	58.3	54.1	49.4
OKLA.	42.7	37.2	33.7	32.5
TEX.	42.7	37.2	33.7	32.5
MONT.	29.7	21	18.2	19.5
IDAHO	29.7	21	18.2	19.5
WYO.	29.7	21	18.2	19.5
COLO.	29.7	21	18.2	19.5
N. MEX.	29.7	21	18.2	19.5
ARIZ.	29.7	21	18.2	19.5
UTAH	29.7	21	18.2	19.5
NEV.	29.7	21	18.2	19.5
WASH.	39.8	38.3	35.7	36.2
OREG.	39.8	38.3	35.7	36.2
CALIF.	39.8	38.3	35.7	36.2

Table D.2. Nominal Value of Improved Land per Acre, by State, 1850-1986.

	1850	1860	1870	1880	1890	1900	1910	1915	1920
MAINE	9.82	10.93	10.91	11.70	12.42	13.48	23.63	23.78	36.50
N. H.	10.50	12.33	11.69	13.65	14.36	18.26	26.40	28.22	35.16
VT.	11.29	15.81	17.36	15.88	13.78	15.38	22.24	23.28	32.71
MASS.	23.63	26.61	24.81	31.70	33.37	45.52	60.56	62.76	88.93
R. I.	22.84	27.82	27.10	39.46	36.42	47.24	56.13	57.19	71.72
CONN.	19.75	23.69	28.27	33.94	30.49	35.30	52.02	60.73	91.94
N. Y.	23.49	30.08	35.47	33.20	32.93	30.69	41.05	40.43	50.66
N. J.	33.09	45.37	51.34	46.39	41.37	41.39	60.21	62.40	79.05
PA.	24.35	33.53	39.08	40.20	39.57	37.68	43.02	41.14	52.66
DEL.	18.09	28.00	30.98	28.89	31.14	27.15	42.70	42.86	55.79
MD.	17.52	27.70	27.11	28.84	30.58	29.53	41.78	45.33	70.65
MICH.	13.73	25.11	34.38	35.82	35.17	30.87	41.35	45.36	66.09
WIS.	13.05	19.74	23.67	24.61	30.43	37.55	60.98	65.53	103.24
MINN.	10.44	18.03	17.64	17.40	20.84	26.59	45.66	56.92	112.71
OHIO	22.52	35.08	39.42	43.97	41.40	38.96	61.66	68.52	99.73
IND.	14.61	26.60	32.47	32.26	36.58	37.51	72.23	78.11	121.41
ILL.	7.38	16.64	23.14	25.20	32.55	42.27	99.62	111.30	172.60
IOWA	6.66	12.61	19.53	20.58	24.99	38.05	86.36	110.28	209.65
MO.	10.01	17.53	19.42	15.11	21.97	26.11	51.78	57.48	92.17
N. DAK.		4.60	6.76	9.71	9.89	12.80	28.35	30.11	39.58
S. DAK.		4.53	6.64	5.54	9.31	11.47	39.93	44.21	76.56
NEBR.		7.09	12.76	10.54	17.40	18.66	47.66	51.78	92.89
KANS.		7.68	13.50	10.90	16.80	14.75	39.54	42.33	61.15
VA.	10.23	15.26	10.96	12.99	15.10	15.01	30.21	31.95	60.51
W. VA.	17.73	26.61	14.20	17.92	18.72	18.61	29.51	31.35	44.81
N. C.	4.64	8.51	4.50	8.39	10.48	10.80	25.73	32.24	70.66
KY.	11.64	18.34	15.48	15.10	16.66	16.74	28.55	31.78	63.60
TENN.	7.30	17.34	11.53	12.02	13.68	14.21	26.56	30.43	60.22
S. C.	7.99	13.02	4.67	7.46	9.88	11.72	31.39	30.85	78.30
GA.	6.07	8.25	4.56	5.94	7.71	8.67	21.55	21.40	52.22
FLA.	6.25	8.82	4.69	8.86	27.66	12.53	31.84	34.98	64.38
ALA.	6.98	12.58	4.92	5.70	7.18	8.08	16.37	17.90	33.57
MISS.	7.15	16.66	6.88	8.02	9.24	10.32	20.86	22.45	52.29
ARK.	8.56	15.79	6.61	9.01	10.70	10.33	21.99	21.73	50.83
LA.	21.32	31.98	11.29	9.86	11.49	15.90	26.82	26.71	54.13
OKLA.					8.19	11.17	30.44	29.96	51.55
TEX.	3.32	7.37	5.08	7.10	11.03	10.75	29.32	33.13	55.17
MONT.			4.81	8.63	17.13	10.32	32.65	32.26	36.36
IDAHO			7.61	9.86	17.44	17.65	60.86	54.23	88.22
WYO.			7.54	7.49	13.51	7.22	24.13	24.54	39.51
COLO.			13.52	26.71	26.29	19.34	49.16	42.22	57.32
N. MEX.	6.61	3.93	4.02	12.43	14.94	8.99	20.88	17.68	21.16
ARIZ.			6.34	11.39	12.02	14.00	65.24	55.90	64.96
UTAH	9.33	12.98	11.34	22.41	27.94	19.53	48.64	45.68	74.61
NEV.		9.13	9.60	11.29	10.12	10.73	25.08	33.30	50.23
WASH.		10.78	9.92	14.99	27.49	19.30	63.48	65.09	87.02
OREG	10.45	10.12	12.41	16.93	21.29	20.30	61.02	61.49	75.24
CALIF.	2.60	9.52	15.81	18.45	40.61	35.85	77.91	106.59	157.25

Table D.2. Nominal Value of Improved Land per Acre, 1850-1986 (continued).

	1930	1940	1945	1950	1960	1970	1980	1986
MAINE	29.18	18.43	27.03	34.60	54.91	123.81	474.10	818.19
N. H.	23.34	16.98	35.06	39.97	63.79	170.01	794.12	1338.68
VT.	23.37	17.11	28.03	39.11	60.03	172.34	552.87	929.60
MASS.	83.81	65.84	111.05	116.11	235.20	470.49	1212.67	2151.75
R. I.	85.38	70.84	101.79	150.36	281.01	640.26	2466.81	3855.78
CONN.	108.19	88.03	133.15	136.95	364.51	798.68	2016.90	3231.09
N. Y.	47.49	33.42	43.75	59.55	92.07	209.95	610.21	717.94
N. J.	123.79	82.07	144.11	181.17	468.79	1088.73	2968.39	4011.30
PA.	49.27	34.88	56.91	80.27	145.06	304.62	1371.24	1388.73
DEL.	55.83	42.18	62.55	86.28	211.86	509.23	1969.37	1949.30
MD.	65.13	48.45	73.28	97.60	278.37	665.68	2389.84	2045.69
MICH.	47.81	32.65	50.83	68.51	139.51	261.74	940.41	805.81
WIS.	57.82	33.25	46.92	62.80	90.53	172.27	760.74	551.58
MINN.	60.35	34.87	47.71	62.95	118.70	181.74	1048.36	594.11
OHIO	56.43	45.58	76.92	108.06	202.67	336.43	1566.69	927.67
IND.	57.29	50.71	81.82	116.64	229.24	368.82	1779.10	1019.66
ILL.	89.99	67.36	103.74	149.72	272.76	428.82	1905.83	1072.88
IOWA	101.27	61.15	88.36	124.82	221.62	337.30	1672.90	770.11
MO.	45.54	26.85	43.45	55.63	97.25	190.04	818.60	555.52
N. DAK.	20.83	10.58	15.57	25.47	47.54	90.46	410.82	323.74
S. DAK.	31.66	10.89	16.54	27.22	45.94	79.94	296.55	219.95
NEBR.	51.20	21.18	33.23	64.74	78.50	139.44	546.25	314.80
KANS.	45.07	28.01	43.77	58.88	95.11	149.01	551.33	365.89
VA.	45.90	33.71	49.84	68.31	134.82	281.00	1087.12	1231.67
W. VA.	36.43	25.67	36.64	52.84	58.11	98.44	642.89	526.10
N. C.	45.73	36.45	55.05	78.36	130.45	256.96	1011.29	952.29
KY.	42.96	35.86	53.63	72.62	133.47	258.40	1076.21	974.71
TENN.	41.15	34.36	51.46	66.49	117.06	256.97	1044.86	1080.53
S. C.	36.30	31.64	50.70	59.98	140.74	306.73	1175.23	1153.34
GA.	25.97	19.84	32.14	40.24	106.53	271.20	1089.19	1010.43
FLA.	101.96	45.86	76.89	81.41	313.13	387.29	1328.29	1388.50
ALA.	29.28	22.31	33.68	46.61	97.24	220.25	993.06	982.95
MISS.	33.00	25.15	37.74	50.54	105.17	234.81	902.25	836.80
ARK.	35.42	25.84	46.09	62.25	127.97	293.13	1011.46	784.24
LA.	46.66	36.01	58.01	74.43	186.10	349.46	1530.94	1234.44
OKLA.	49.41	34.28	46.70	70.94	136.87	267.44	965.69	762.42
TEX.	39.74	27.42	46.39	66.90	126.66	219.41	642.03	801.26
MONT.	18.65	13.67	22.10	30.78	65.72	115.37	456.85	398.74
IDAHO	68.50	54.91	95.01	113.10	187.68	306.55	1138.68	1060.20
WYO.	13.99	10.36	16.50	23.37	40.53	76.76	282.75	272.12
COLO.	33.32	19.80	37.85	57.27	100.45	174.66	690.71	641.95
N. MEX.	11.04	8.99	19.02	27.70	40.16	69.66	295.59	215.51
ARIZ.	28.82	10.78	21.89	30.28	101.52	151.37	523.20	455.01
UTAH	58.40	33.99	52.74	70.15	102.31	167.29	949.79	864.90
NEV.	24.95	22.09	33.93	36.18	89.91	105.77	469.49	379.76
WASH.	75.14	49.05	82.29	104.24	162.13	280.01	921.42	1028.42
OREG.	50.66	34.81	61.51	78.31	119.18	200.24	720.91	648.01
CALIF.	180.77	99.51	202.66	233.93	528.62	663.41	1746.68	1940.92

Table D.3. Relative "Quality"of Farmland by State (q = p/pm), 1850-1986.

	1850	1860	1870	1880	1890	1900	1910	1915	1920
MAINE	0.632	0.648	0.667	0.688	0.662	0.586	0.583	0.580	0.576
N. H.	0.776	0.755	0.765	0.747	0.666	0.532	0.524	0.519	0.513
VT.	0.754	0.773	0.786	0.782	0.736	0.633	0.567	0.583	0.599
MASS.	0.757	0.764	0.757	0.756	0.702	0.607	0.603	0.590	0.576
R. I.	0.763	0.762	0.717	0.720	0.723	0.607	0.601	0.601	0.601
CONN.	0.828	0.821	0.797	0.779	0.741	0.640	0.635	0.607	0.579
N. Y.	0.766	0.790	0.803	0.830	0.831	0.793	0.783	0.771	0.759
N. J.	0.761	0.768	0.774	0.810	0.834	0.797	0.801	0.794	0.788
PA.	0.719	0.743	0.760	0.785	0.813	0.788	0.788	0.784	0.781
DEL.	0.739	0.756	0.775	0.790	0.815	0.805	0.791	0.793	0.794
MD.	0.736	0.747	0.764	0.769	0.793	0.787	0.775	0.774	0.773
MICH.	0.627	0.663	0.673	0.734	0.778	0.781	0.785	0.786	0.786
WIS.	0.567	0.650	0.669	0.731	0.722	0.711	0.710	0.709	0.708
MINN.	0.449	0.470	0.572	0.694	0.731	0.802	0.807	0.807	0.807
OHIO	0.698	0.745	0.777	0.825	0.857	0.857	0.865	0.862	0.859
IND.	0.596	0.669	0.705	0.788	0.828	0.848	0.863	0.862	0.861
ILL.	0.806	0.875	0.916	0.942	0.947	0.948	0.954	0.953	0.951
IOWA	0.767	0.792	0.868	0.934	0.945	0.955	0.956	0.954	0.952
MO.	0.535	0.542	0.614	0.734	0.762	0.783	0.807	0.808	0.809
N. DAK.		0.693	0.714	0.751	0.869	0.874	0.907	0.900	0.893
S. DAK.		0.693	0.714	0.774	0.870	0.864	0.869	0.856	0.842
NEBR.		0.729	0.771	0.851	0.902	0.872	0.877	0.863	0.849
KANS.		0.743	0.783	0.834	0.913	0.867	0.896	0.894	0.891
VA.	0.597	0.579	0.633	0.619	0.652	0.671	0.671	0.672	0.673
W. VA.	0.333	0.333	0.535	0.581	0.627	0.677	0.701	0.709	0.718
N. C.	0.507	0.516	0.510	0.527	0.564	0.577	0.595	0.601	0.606
KY.	0.568	0.599	0.623	0.666	0.701	0.750	0.765	0.765	0.765
TENN.	0.515	0.553	0.566	0.607	0.643	0.669	0.695	0.705	0.715
S. C.	0.501	0.521	0.499	0.538	0.599	0.609	0.634	0.650	0.665
GA.	0.519	0.535	0.526	0.543	0.587	0.601	0.637	0.656	0.675
FLA.	0.479	0.483	0.540	0.525	0.541	0.564	0.563	0.575	0.587
ALA.	0.577	0.556	0.559	0.559	0.592	0.612	0.645	0.658	0.670
MISS.	0.552	0.547	0.547	0.553	0.593	0.611	0.657	0.666	0.675
ARK.	0.534	0.471	0.497	0.532	0.579	0.612	0.643	0.664	0.685
LA.	0.546	0.527	0.527	0.554	0.597	0.615	0.670	0.689	0.708
OKLA.					0.567	0.582	0.739	0.725	0.711
TEX.	0.371	0.403	0.441	0.566	0.603	0.437	0.495	0.506	0.516
MONT.			0.738	0.785	0.644	0.431	0.513	0.528	0.543
IDAHO			0.563	0.735	0.644	0.627	0.684	0.688	0.693
WYO.			0.385	0.779	0.507	0.399	0.431	0.442	0.452
COLO.			0.532	0.686	0.598	0.493	0.545	0.545	0.545
N. MEX.	0.715	0.404	0.448	0.584	0.556	0.376	0.420	0.400	0.380
ARIZ.			0.779	0.609	0.387	0.421	0.521	0.468	0.415
UTAH	0.566	0.906	0.867	0.757	0.609	0.501	0.602	0.581	0.560
NEV.		0.501	0.629	0.766	0.623	0.482	0.518	0.510	0.501
WASH.		0.483	0.531	0.563	0.624	0.605	0.696	0.694	0.692
OREG.	0 538	0.623	0.645	0.681	0.673	0.553	0.577	0.576	0.575
CALIF.	0.339	0.522	0.696	0.762	0.713	0.610	0.605	0.604	0.603

(1.000 = land completely "improved" in that year by the 1950 census standard.)

Table D.4. Nominal Value of Improved Farm Land per Acre, Adjusted for Interstate Farming Drift, and Spliced to the 1960 Improved Value per Acre, by Region, 1850-1986.

	1850	1860	1870	1880	1890	1900
N. England	12.77	15.30	15.76	17.81	17.45	21.17
M. Atl.	23.79	32.15	37.01	36.15	35.72	33.81
E.N.C.	14.23	24.56	30.25	32.32	35.73	38.95
W.N.C.	5.94	10.58	13.34	12.17	16.52	20.25
S.Atl.	7.73	11.95	7.07	9.83	13.89	14.18
E.S.C.	8.38	16.24	9.97	10.36	11.81	12.39
W.S.C.	6.19	8.20	6.45	7.96	10.90	11.24
Mountain	8.73	6.25	6.13	12.38	14.43	10.87
Pacific	2.57	6.53	10.06	12.07	24.51	21.45
NATIONAL	9.58	14.76	14.85	15.64	18.57	19.94
US % nom. capital gain:		4.42	0.06	0.52	1.73	0.71

	1910	1915	1920	1930	1940	1945	1950
N. England	30.86	32.68	46.89	42.16	31.59	50.76	58.56
M. Atl.	43.06	42.55	55.12	54.10	38.28	57.38	78.29
E.N.C.	73.74	81.30	124.35	67.28	50.13	78.44	110.63
W.N.C.	46.31	53.58	92.23	48.56	26.20	39.29	57.94
S. Atl.	31.26	33.57	69.54	46.81	33.90	52.57	67.27
E.S.C.	22.94	25.52	51.98	36.17	29.13	43.68	58.49
W.S.C.	28.59	30.68	54.14	42.19	29.51	48.08	68.96
Mountain	31.41	29.90	40.47	23.65	16.09	28.72	39.51
Pacific	51.83	90.59	118.27	121.55	70.80	137.22	162.64
NATIONAL	41.04	47.40	77.42	49.10	31.80	50.99	70.12
%cap.gain	7.48	2.93	10.31	-4.45	-4.25	9.91	6.58

	1960	1970	1980	1986
N.England	116.53	277.03	898.34	1514.12
M. Atl.	155.01	357.91	1320.67	1381.61
E.N.C.	206.02	345.59	1581.04	964.32
W.N.C.	97.29	164.43	750.20	444.90
S. Atl.	162.73	306.32	1251.75	1248.65
E.S.C.	110.51	240.49	1036.40	996.14
W.S.C.	137.31	256.96	839.68	878.86
Mountain	77.07	129.39	532.55	469.99
Pacific	343.21	472.31	1429.48	1546.58
NATIONAL	134.84	233.76	935.56	761.71
%US cap.gain	6.76	5.66	14.88	-3.37

Table D.5. Real Value per Improved Farm Acre, Adjusted for Interstate Farming Drift, by Region, 1850-1986.

(In 1960 New England consumer dollars per acre)

	1850	1860	1870	1880	1890	1900
N. England	41.26	46.22	33.54	49.07	54.04	71.04
M. Atl.	78.00	98.61	82.23	102.41	112.32	113.83
E.N.C.	57.37	92.66	77.96	99.44	121.53	141.64
W.N.C.	19.03	31.67	30.39	34.01	51.29	67.50
S. Atl.	20.23	29.28	14.98	26.34	41.35	45.30
E.S.C.	32.47	58.85	26.31	30.93	37.96	41.44
W.S.C.	21.73	26.89	16.75	23.43	35.39	38.90
Mountain						
Pacific						
NATIONAL	34.06	49.08	34.78	47.43	59.82	70.86
US % real capital gain:		3.72	-3.38	3.15	2.35	1.71

	1910	1915	1920	1930	1940	1945	1950
N. England	91.57	90.39	74.90	72.19	65.54	83.29	72.92
M. Atl.	126.66	115.94	86.81	91.46	79.54	93.84	97.49
E.N.C.	233.35	232.29	205.20	116.37	104.54	129.01	137.77
W.N.C.	136.22	147.60	146.63	89.71	57.64	67.78	75.24
S. Atl.	87.31	91.24	109.00	87.51	75.02	90.97	87.35
E.S.C.	65.00	70.49	83.04	73.74	67.71	78.01	77.08
W.S.C.	86.12	87.53	89.19	83.91	68.83	87.28	93.55
Mountain		69.22	54.11	43.09	34.67	48.36	49.90
Pacific		241.57	181.95	213.04	148.60	226.44	202.54
NATIONAL	128.19	137.95	114.35	86.98	67.19	83.86	86.26
	6.10	1.48	-3.68	-2.70	-2.55	4.53	0.57

	1960	1970	1980	1986
N. England	116.53	205.66	323.14	409.22
M. Atl.	163.00	279.40	475.06	373.41
E.N.C.	217.55	271.05	568.72	260.63
W.N.C.	102.41	128.46	269.86	120.24
S. Atl.	184.71	258.06	450.27	337.47
E.S.C.	127.76	206.25	372.80	269.23
W.S.C.	160.78	223.44	302.04	237.53
Mountain	81.90	102.12	191.56	127.03
Pacific	354.92	362.48	514.20	417.99
NATIONAL	134.84	178.28	336.53	205.87
	4.57	2.83	6.56	-7.86

(For 1960-1986, all regional deflators were assumed to rise in fixed proportion to the U.S. consumer price deflator.)

Table D.6. Farmland "Quality" per Acre, Adjusted for Interstate Farming Drift, by Regions, 1850-1986.

	1850	1860	1870	1880	1890	1900	1910	1915	1920
N.England	0.752	0.756	0.755	0.752	0.707	0.606	0.592	0.584	0.576
M.Atl.	0.744	0.765	0.780	0.805	0.820	0.792	0.786	0.779	0.772
E.N.C.	0.682	0.739	0.821	0.824	0.846	0.849	0.856	0.855	0.853
W.N.C.	0.639	0.651	0.728	0.822	0.858	0.867	0.880	0.875	0.871
S.Atl.	0.507	0.509	0.531	0.543	0.581	0.600	0.618	0.628	0.637
E.S.C.	0.538	0.555	0.569	0.600	0.635	0.666	0.694	0.701	0.707
W.S.C.	0.474	0.475	0.488	0.556	0.590	0.496	0.568	0.576	0.583
Mountain	0.609	0.531	0.573	0.682	0.577	0.478	0.544	0.546	0.544
Pacific	0.327	0.487	0.621	0.676	0.640	0.550	0.565	0.619	0.613
NATIONAL	0.565	0.588	0.613	0.650	0.667	0.655	0.674	0.682	0.681

	1930	1940	1945	1950	1960	1970	1980 and 1986	
N.England	0.703	0.710	0.700	0.700	0.727	0.771	0.831	0.831
M.Atl.	0.702	0.711	0.701	0.700	0.711	0.745	0.769	0.769
E.N.C.	0.851	0.837	0.841	0.845	0.873	0.904	0.930	0.930
W.N.C.	0.877	0.863	0.863	0.867	0.881	0.920	0.952	0.952
S.Atl.	0.682	0.684	0.669	0.644	0.687	0.767	0.836	0.836
E.S.C.	0.692	0.699	0.685	0.664	0.646	0.667	0.709	0.709
W.S.C.	0.630	0.600	0.575	0.564	0.589	0.614	0.625	0.625
Mountain	0.530	0.472	0.453	0.462	0.459	0.471	0.497	0.497
Pacific	0.599	0.589	0.571	0.575	0.604	0.642	0.708	0.708
NATIONAL	0.687	0.672	0.662	0.660	0.680	0.713	0.752	0.752

Note: some of the changes from 1920 to 1930 are artifacts of switching from state data on improved acreage (1920 census) to Tostlebe's regional coverage for 1930-1950. In particular, New England and the Mid Atlantic states are aggregated in a single Northeast region for 1930-1950. Values for 1980-1986 are spliced to those for 1950 using the land quality indices of Peterson[1986].

APPENDIX E.

CASH RENTS ON MIDWESTERN FARMS, 1900-1986.

America has kept less track of farm rents than of farm purchase prices, as noted in the text. Only within this century have usable time series been produced. The available series are disappointly disjoint, with different data-gathering procedures in different periods with no convenient overlap for splicing.

The Rent Series Themselves. Three different series cover three different periods since 1900. First, there is Chambers's [1924] excellent study of farm rents and values, 1900-1920, with emphasis on the Midwest. Chambers gives us time series covering seven states, five of them fairly well. His data seem to refer to fixed sets of farms that were repeatedly rented. Table E.1 begins with a summary of his rent series, splicing thinner-sample series from the early years onto the well-sampled series for the final years 1916-1920.

The official censuses of agriculture published farm rental data by state from 1930 through 1964. The official definitions sound correct and comparable to Chambers, though one would prefer some temporal overlap with Chambers in order to test the consistency of the two sets of numbers. Unfortunately, the census cash-rent series atrophied over time. The 1959 and 1964 series switched to including unknown shares of cash rents paid by "share-cash" tenants as well as true all-cash rents. A share-cash tenant generally paid only about half the revenue in cash, with payment in kind making up the rest of the rent. The census recorded only the cash part, greatly depressing the average rental payment per acre. The 1959 and 1964 figures must be set aside, and later censuses did not try to report cash rents.

The task of measuring rents fell to the USDA in the 1960s and later. First the Statistical Reporting Service and then (from 1984 on) the Economic Research Service followed three kinds of annual rents: those on wholly-rented farms, those on crop land and those on pasture land. Of the three kinds, the rent on wholly-rented farms seems to offer the best comparability with earlier series. Yet it may have a higher share of building value in total value than the earlier series, because it is specific to wholly-rented farms and omits the crop and pasture parcels that lacked buildings.

Thus Figure 2, Table 1 and Table E.1 might overstate the rise in rents from 1954 to 1962, though not by more than 10 percent.

The Rent/Value Ratio. The gaps in series, 1920-1930 and 1954-1962, also seem to confound attempts to read a long-run single series on the rent/value ratio, as suggested in Table E.2 and Figure E.1. Most suspicious is the jump in rent/value ratios between the Census of 1954 and the onset of the USDA series in 1962. It is hard to come up with reasons why the average rent/value ratio for four states should have jumped from 4.96 percent to 7.25 percent in eight years that saw no great jump in interest rates or taxes, and no speculative crash in land prices. Even if government support payments became more generous between 1954 and 1962, it seems likely that they would have raised both rents and values, with little effect on the rent/value ratio.

It is nonetheless possible to study the time patterns of the rent/value ratio *within* each data series, to see if there is a pattern of behavior that might hold over the long run. Our evidence is strongest for the well-researched period since 1962. A voluminous literature, much of it econometric, has explored the postwar behavior of the rent-value relationship. There is a pattern to the literature, one easily grasped by glancing at Figure E.1. Studies in the late 1970s and early 1980s tended to find an orderly land market, one in which rising land values look like fair capitalizations of rising rents [Melichar, 1979; Reinsel and Reinsel, 1979; Barry, 1980; Scott, 1983]. The authors did note the decline in the rent/value ratio reflected in Figure E.1, but did not find it inconsistent with accelerating rents. More recent studies, with hindsight on the farm crisis of the 1980s, tend to raise anew the specter of unstable land markets, using the oscillation of the rent-value relationship as a central clue. Thus Moore and Meyers [1986] find econometric evidence rejecting the rational expectations hypothesis even in time series ending at the 1981 peak. Burt [1986] finds a land market that responds to revalations of its mistakes with dampened swings. Featherstone and Baker [1987] find overshooting and bubbles in US data (on all farm assets, not just land) for 1910-1985, a longer and more troubled history than the usual postwar samples. Alston [1986] and Pongtanakorn and Tweeten [1986], on the other hand, argue that land values reasonably reflected expectations about rents, but their

data again stopped with 1982 and the Pongtanakorn-Tweeten conclusion that the markets were efficient is unpersuasive.

The best inference about the rent/value ratio is suggested by Figure E.1 itself: the ratio is subject to wide swings that fit an adaptive expectations model: investors expect any recent farm trend to continue. More specifically, the market makes prediction errors that vary positively with the departure of land value from its prior long-run trend.

Some basic asset-market theory and some data suggest why this might be so, and offer clues about how the unrecorded farm rents of the nineteenth century probably moved. The rates of return on land and another asset e.g. a bond paying nominal interest rate i, can be usefully linked by the identity

expected return on land, adjusted	=	expected return on alternative asset,

or $(R/P) + \hat{P}_{exp} - tx - \delta = i,$

where

(R/P) = gross rent/value ratio;

$\hat{P}_{exp}$ = expected nominal rate of land price appreciation;

tx = share of real estate taken by tax flow;

δ = rate of depreciation, maintenance and asset disamenity entailed by land ownership, including any risk premium;

and i = the interest rate on alternative lending (or mortgage borrowing).

The definition of δ assures that the equation is an identity. If we re-express the expected capital gain ($\hat{P}_{exp}$) as the sum of the actual ex-post gain ($\hat{P}_{actual}$) and an expectational error (e), then we can regroup terms and break the observed gross rent/value ratio into measureable and unmeasureable parts:

$$(R/P) = [i - \hat{P}_{actual} + tx] \quad + \quad [\delta - e]$$

measureables — unmeasureables (largely subjective)

The formula, when combined with historical observation, underlines just how perverse the expectational errors in farm land values have been in each of the three data-covered periods in this century. Consider first the decline in the (R/P) ratio from the turn of the century to 1920. (R/P) dropped even though nominal interest rates (i) rose and nominal $\hat{P}_{actual}$ fell, with no lowering of tax rates. The measureable part of the rent/value ratio thus rose, yet the ratio itself fell. Only a perverse rise in $(\delta - e)$, basically a subjective shift toward land owership not justified by subsequent price movements (i.e. by $\hat{P}_{actual}$) could explain the fall in (R/P). The best guess is that the expectations error e is tied to the current level of P itself, accentuating swings in land values until other forces reverse the trend.

In the era covered by census rent data, 1930-1954, there is again a suggestion of perverse movements in the largely-subjective term $(\delta - e)$. The peak rent/value ratio came at the real-price trough in 1940. That was a year in which nominal interest rates were particularly low, taxes were moderate, and $\hat{P}_{actual}$ was to prove high, so that the measureable part of (R/P) was at a trough. The observed peak level of (R/P) means that $(\delta - e)$ must have been particularly high -- i.e. investors were too pessimistic about land ownership.

Finally, the same perversity shows up in the years since 1962. The USDA-measured rent/value ratio dropped while real land prices rose, up to 1981, and then both movements reversed, as already noted. Here again, consistent with the econometric literature since 1984, there is the look of systematic forecasting errors. The higher the price level, the more investors overestimate the upcoming trend.

Predicting Rents for 1850-1900. The pattern of forecast errors from this century helps us "predict" those unmeasured rents per acre across the latter half of the nineteenth century. Seeing how the error e tended to behave since 1900 suggests that it might have been procyclical in the nineteenth-century as well, with overoptimism (overpessimism) coinciding with cyclical peaks (troughs) in real land values.

We can therefore predict changes in land rents backwards from 1900 to 1850 in two steps. The first step is to ignore the subjective and unmeasureable term $(\delta - e)$ and assume that changes from any nineteenth-century census year to 1900 were due solely to changes in the objective and observable component $(i - \hat{P}_{actual} + tx)$. Since tax on property were low and stable throughout the second half of the nineteenth century, we need follow only changes in Midwestern mortgage interest rates, documented by Bogue,[1] and changes in the actual land price appreciation over each subsequent decade.

Figure E.2 shows the resulting index of "predicted" real rental values over the second half of the nineteenth century. The points graphed are the real rental values per acre that would have been historical truth if (a) the asset market had behaved according to the equation above, (b) the rate δ had been unchanging, and (c) the expectations error e had been zero. Such was not the case, of course. Here we must take the second step, invoking the pattern of errors observed for the twentieth century. The 1900 figure should have been much higher relative to all others

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[1] Bogue [1976, pp. 86-87], citing several earlier studies. The calculations underlying Figure E.2 make use of the following slight geographic mismatches:

State for land values (census)		Region for rental values (Chambers)		Region for mortgage interest rates (Bogue)
Wisconsin	=	Southern Wisconsin	=	Newton Twp., Wisc.
Minnesota	=	Southern Minnesota	=	Story County, Iowa
Ohio	=	Ohio	=	Portage County, Ohio
Illinois	=	Northern Illinois	=	Walnut Grove Twp., Ill.
Iowa	=	Iowa	=	Story County, Iowa

because in 1900 the land market seriously underpredicted what was to happen to land values between 1900 and 1910 -- or so I infer from the high rent/value ratios for 1900 and the above reasoning about the pattern in twentieth-century market errors. That is, the prediction error e was very negative in 1900, artificially raising rent/value ratios in that year. Such errors were probably not made in earlier years, with the possible exception of the pessimistic trough of 1870. In 1860, by contrast, with land values having grown rapidly and Civil War in the offing, the market's error e was probably positive (too optimistic), implying a lower rent/value ratio than the perfect-foresight model predicts. Figure E.2 notes these likely departures from the model of equilibrium and perfect foresight.[2]

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[2]For visual convenience, Figure E.2 portrays departures as "relative to 1850," since 1850 was a year of probably-accurate expectations, with land prices near their long-run trend value. The absolute real values on the vertical axis, however, are probably too high for 1850-1890 if the reasoning about too little optimism in 1900 is correct. Figure E.2 is better viewed as showing an index, rather than absolute real levels, of rent per acre in the second half of the nineteenth century.

Figure E.2, with its caveats, predicts the following movements in farm rents in five Midwestern states in the second half of the nineteenth century:

1850s -- rents up, though probably less than the doubling (annual rise of 7.1%) implied by the five-state curve;

1860s -- no clear change in rents, unlike the drop in land values;

1870s -- no clear trend in rents;

1880s -- rents up, perhaps by the predicted 1.6% a year;

1890s -- no clear trend in rents.

In Section III's discussion of possible determinants of farmland rents and values, the 1850s rise will be attributed to the whole period 1839-1859, and no trend will be assumed for 1869-1899, though the estimates suggest a slight net rise (for 1870s-1890s).

The Realized Rate of Return on Farm Real Estate since 1900. The data just used to follow the rent/value ratio and to backcast rents can also be used to measure the realized rate of return on farm real estate:

Realized rate of return	=	rent/value ratio	+	Realized (ex post) rate of capital gains	-	rate of depreciation	-	property tax rate
r	=	(R/P)	+	$\hat{P}_{actual}$	-	δ	-	tx

Using this relationship, Tables E.3 and E.4 calculate the nominal and real single-year rates of return on farm real estate. Figure 5 in the main text compares the real rate of return with the real short-term interest rate and the rate of current income from all productive farm assets, to support inferences about twentieth-century swings in the speculative aspect of owning farm land.

Table E.1. Nominal Cash Rents per Farm Acre, Five Midwestern States, 1900-1986.

Nominal cash rents per acre: Spliced Series from Chambers [1924]:

	Southern Wisconsin	Southern Minnesota	Ohio	Northern Illinois	Iowa	Five states: Nominal	Real(1960$)
1900	3.36	2.19	3.24	4.30	3.43	3.30	11.74
1901	3.36	2.19	3.35	4.30	3.44	3.32	11.81
1902	3.39	2.20	3.33	4.33	3.45	3.34	11.46
1903	3.39	2.25	3.35	4.33	3.53	3.37	11.21
1904	3.51	2.34	3.36	4.48	3.67	3.48	11.57
1905	3.51	2.37	3.40	4.48	3.72	3.51	11.66
1906	3.57	2.37	3.46	4.64	3.78	3.57	11.52
1907	3.66	2.46	3.52	4.77	3.88	3.67	11.47
1908	3.67	2.63	3.53	4.81	4.03	3.76	12.12
1909	3.70	2.63	3.58	5.08	4.23	3.88	12.51
1910	3.76	2.75	3.69	5.13	4.37	3.98	12.44
1911	3.79	2.92	3.76	5.20	4.49	4.08	12.75
1912	3.91	2.97	3.83	5.30	4.68	4.19	12.71
1913	3.99	3.12	3.85	5.47	4.75	4.29	12.83
1914	4.09	3.23	3.90	5.53	5.13	4.45	13.12
1915	4.20	3.36	3.99	5.83	5.29	4.62	13.45
1916	4.32	3.44	4.12	5.99	5.62	4.79	13.01
1917	4.39	3.59	4.24	6.43	5.92	5.03	11.60
1918	4.59	3.91	4.62	6.87	6.34	5.39	10.61
1919	4.87	4.24	4.82	7.20	6.98	5.77	9.87
1920	5.16	4.58	5.11	7.79	7.89	6.30	9.31

Nominal cash rents per acre from the US Censuses of Agriculture:

	Wisconsin	Minnesota	Ohio	Illinois	Iowa	Five states: Nominal	Real(1960$)
1930	4.08	3.86	4.28	5.91	6.93	5.19	9.19
1940	2.70	2.69	3.44	4.42	5.13	3.80	8.03
1950	5.82	4.88	4.98	9.07	8.51	6.90	8.49
1954	7.06	6.45	6.99	10.60	9.92	8.43	9.28

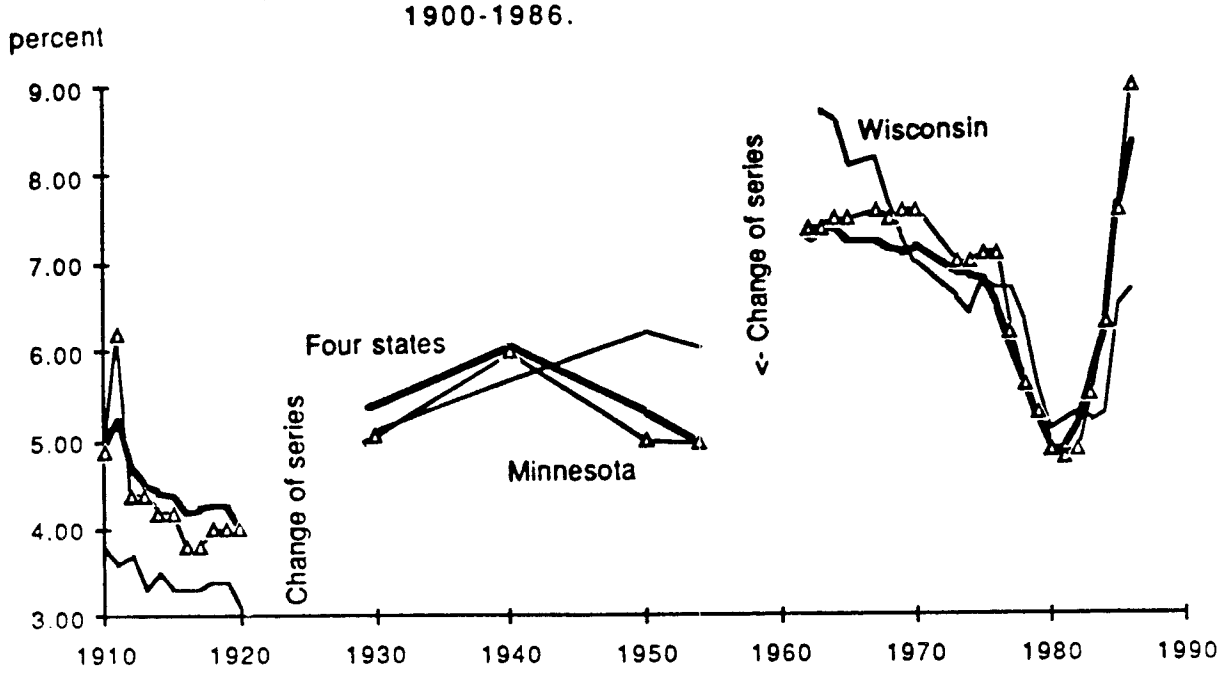
(The 1959 and 1964 Census figures are distrusted because they include partial cash rents by share-cash tenants.)

Nominal cash rents per acre for whole farms (USDA):

	Wisconsin	Minnesota	Ohio	Illinois	Iowa	Five states: Nominal	Real(1960$)
1962	13.20	13.95	13.20	20.65	18.30	16.33	15.99
1963	14.80	14.15	14.40	22.15	18.85	17.27	16.71
1964	14.45	15.20	15.20	22.85	19.50	17.89	17.08
1965	16.29	15.83	18.03	28.24	19.73	19.98	18.76
1966	16.85	16.90	19.31	31.77	21.74	21.79	19.89
1967	18.34	18.07	19.74	35.04	24.37	23.75	21.07
1969	18.88	20.84	20.87	38.95	28.34	26.51	21.41
1970	19.69	21.48	22.92	37.84	30.49	27.35	20.86
1973	22.00	23.30	25.10	40.90	38.50	31.14	20.75
1974	24.80	31.10	29.00	51.00	53.00	39.82	23.91
1975	29.90	39.00	33.20	61.00	60.00	47.02	25.87
1976	30.20	42.70	45.60	68.00	68.60	53.36	27.76
1977	36.50	47.30	53.00	81.00	78.00	61.72	30.16
1978	39.60	48.50	59.60	85.00	82.00	65.29	29.64
1979	42.00	53.80	69.00	92.00	89.00	71.51	29.18
1980	45.00	59.50	72.00	99.00	96.00	77.04	27.69
1981	49.10	63.30	78.60	105.80	101.80	82.45	26.85
1982	53.30	68.30	80.80	112.80	106.10	87.22	26.76
1983	56.60	68.10	77.80	111.40	105.60	86.83	25.81
1984	56.14	64.15	71.78	119.95	109.17	87.85	25.05
1985	53.24	60.04	72.18	103.78	98.40	80.16	22.07
1986	43.69	52.85	65.88	100.07	82.98	71.44	19.23
m.acres:	21	30.8	18.5	30.3	33.8	134.4	

(Land in farms in 1960, used as fixed weights for five-state average.)

Figure E.1. Gross Rent/Value Ratios for Midwestern Farm . · Land, 1900-1986.



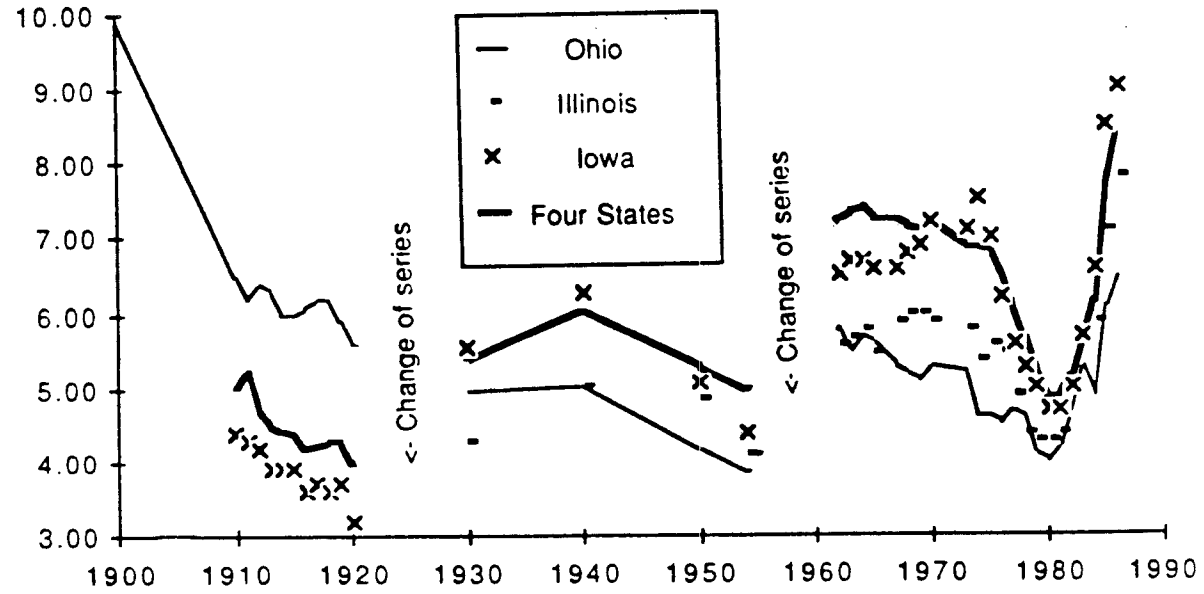


Table E.2. Gross Rent/Price Ratios on Farms Rented for Cash, 5 Midwestern States, 1900-1986.
(percent per annum)

Year	Wisc.	Minn.	Ohio	Illinois	Iowa	Four States
1900			9.90			
1910	3.80	4.90	6.50		4.40	4.97
1911	3.60	6.20	6.20			
1912	3.70	4.40	6.40		4.20	4.71
1913	3.30	4.40	6.30		3.90	4.50
1914	3.50	4.20	6.00		3.90	4.43
1915	3.30	4.20	6.00		3.90	4.39
1916	3.30	3.80	6.10		3.60	4.18
1917	3.30	3.80	6.20		3.70	4.24
1918	3.40	4.00	6.20		3.60	4.28
1919	3.40	4.00	5.90		3.70	4.26
1920	3.10	4.00	5.60		3.20	3.98
1930	5.10	5.05	4.97	4.30	5.56	5.39
1940	5.66	5.98	5.04	5.04	6.28	6.05
1950	6.20	4.99	4.18	4.86	5.08	5.30
1954	6.02	4.96	3.85	4.13	4.39	4.96
1962	8.30	7.40	5.80	5.60	6.50	7.25
1963	8.70	7.40	5.50	5.70	6.70	7.34
1964	8.60	7.50	5.70	5.80	6.70	7.39
1965	8.10	7.50	5.60	5.50	6.60	7.23
1967	8.20	7.60	5.30	5.90	6.60	7.23
1968	7.70	7.50	5.20	6.00	6.80	7.14
1969	7.30	7.60	5.10	6.00	6.90	7.11
1970	7.00	7.60	5.30	5.90	7.20	7.18
1973	6.60	7.00	5.20	5.80	7.10	6.86
1974	6.40	7.00	4.60	5.40	7.50	6.84
1975	6.80	7.10	4.60	5.60	7.00	6.79
1976	6.70	7.10	4.50	5.50	6.20	6.48
1977	6.70	6.20	4.70	4.90	5.60	6.04
1978	6.30	5.60	4.60	4.40	5.30	5.66
1979	5.60	5.30	4.10	4.30	5.00	5.23
1980	5.10	4.90	4.00	4.30	4.70	4.88
1981	5.20	4.80	4.20	4.40	4.70	4.91
1982	5.30	4.90	4.70	5.00	5.00	5.15
1983	5.20	5.50	5.30	5.60	5.70	5.66
1984	5.30	6.30	4.90	5.90	6.60	6.15
1985	6.50	7.60	6.10	7.10	8.50	7.66
1986	6.70	9.00	6.50	7.80	9.00	8.37

Sources and notes: 1900-1920: Chambers [1924, pp. 21,38]; 1930-1954: US agricultural censuses; 1962-1983: USDA, Statistical Reporting Service, various titles; 1984-1986: USDA Economic Research Service, various titles. Changes in series are underlined here. Four-state average of Wis., Minn., Ohio, and Iowa is weighted by total farmland acres in 1960.

Figure E.2. Real Rents on Improved Farm Land Predicted By Assuming Asset-Market Equilibrium and Perfect Foresight, Five Midwestern States, 1850-1900.

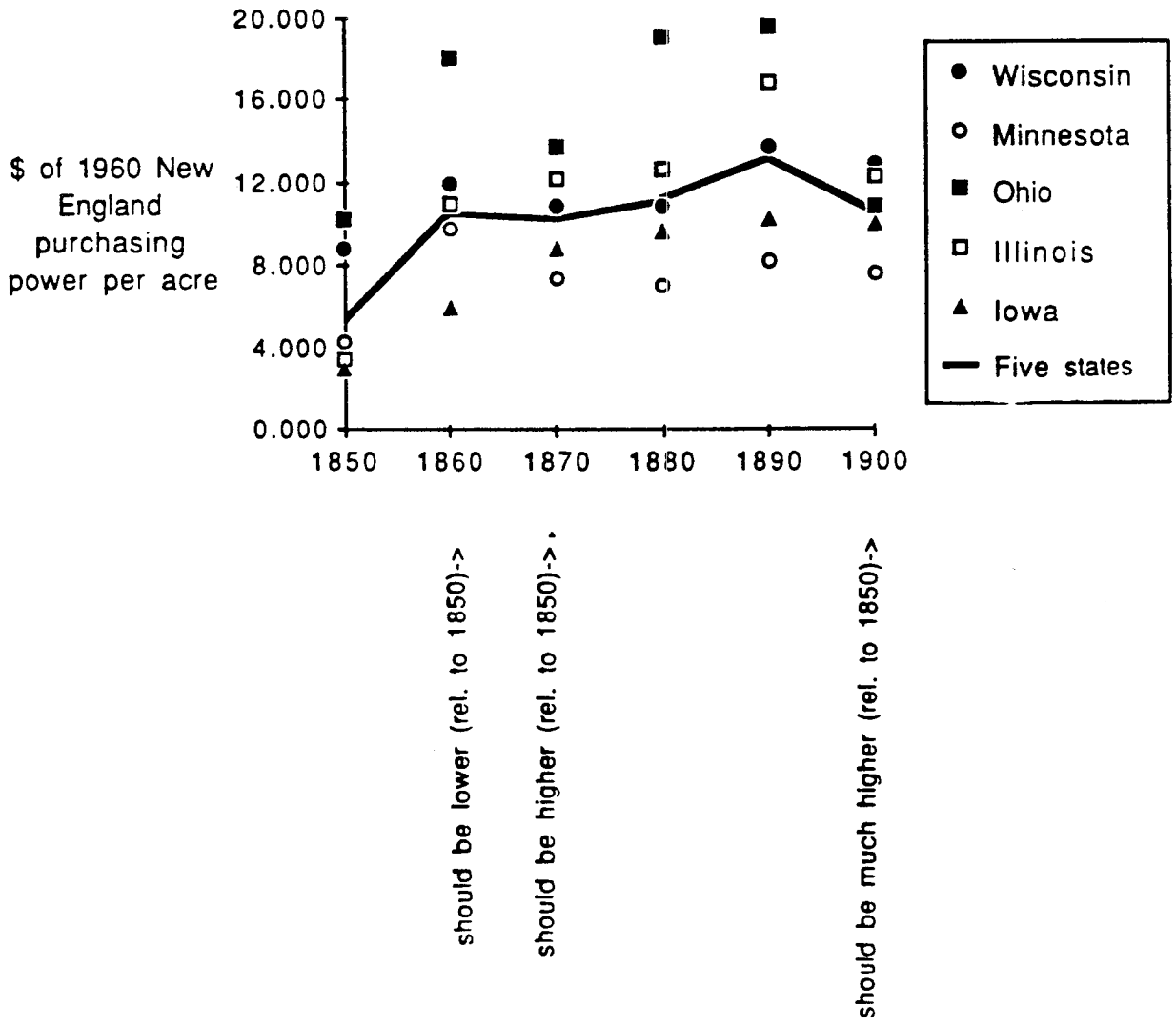


Table E.3. Nominal Annual Rates of Net Return on Farm Real Estate, Five Midwestern States, 1900-1985.

Year	Wisc.	Minn.	Ohio	Illinois	Iowa	5 States	
			(% per annum)				
1900	14.00	12.14	10.51	13.73	12.37	12.62	1900-1920:
1905	10.68	14.27	11.52	13.13	17.19	13.81	Chambers,
1910	4.56	8.34	6.82	2.90	7.75	6.17	Holmes and
1911	4.31	9.44	6.51	1.86	7.44	6.02	census
1912	6.02	9.45	8.10	2.65	7.18	6.62	
1913	3.69	7.14	5.09	2.47	7.54	5.37	
1914	2.29	4.92	10.33	-2.50	10.03	4.87	
1915	13.39	15.66	9.96	1.57	16.19	11.48	
1916	7.88	15.46	9.77	4.70	7.04	8.95	
1917	8.92	15.41	15.57	5.90	11.12	11.19	
1918	8.57	10.45	7.08	8.38	12.99	9.86	
1919	21.29	29.66	22.38	21.96	35.55	27.09	
1920	2.58	1.89	-11.04	-4.76	-5.30	-3.09	
1930	-8.27	-9.93	-6.27	-9.32	-8.17	-8.59	Census
1940	1.71	4.00	6.57	4.59	4.53	4.26	
1950	15.17	19.63	22.02	20.42	20.16	19.57	
1954	3.68	7.90	8.70	4.18	8.43	6.64	
1962	4.51	5.92	6.31	8.39	5.90	6.31	USDA
1963	10.44	7.12	11.59	8.24	7.58	8.62	
1964	0.20	0.32	2.33	4.00	2.63	1.99	
1965	11.87	10.06	10.20	16.13	15.20	13.02	
1967	10.86	11.73	8.97	7.65	9.65	9.77	
1968	15.14	12.31	7.00	8.13	8.76	10.19	
1969	13.21	9.30	8.55	2.70	6.75	7.68	
1970	16.08	10.56	11.05	8.22	10.09	10.84	
1973	22.88	30.80	27.23	30.13	32.91	29.45	
1974	15.47	31.57	15.70	20.90	25.42	22.92	
1975	16.47	26.33	23.79	27.41	30.96	25.85	
1976	22.97	30.17	33.56	39.43	39.91	34.05	
1977	22.32	17.24	15.27	13.96	8.31	14.78	
1978	28.13	27.74	20.19	20.44	25.92	24.66	
1979	21.06	24.37	19.45	12.32	22.18	19.91	
1980	17.81	21.57	8.19	9.60	11.85	14.00	
1981	1.85	2.52	-8.76	-5.15	-2.58	-2.15	
1982	-0.07	-5.35	-5.29	-6.75	-7.88	-5.47	
1983	-3.47	-3.99	-1.20	0.96	-7.80	-3.37	
1984	-16.56	-20.33	-18.57	-23.38	-25.14	-21.40	
1985	-13.50	-21.52	-6.99	-9.09	-16.18	-14.12	

Note: Each rate equals the rent/value ratio plus the net value appreciation minus estimated depreciation and taxes. Tax rates for 1900-05 and 1985 were borrowed from 1910 and 1984, respectively. Depreciation rate = 0.49% for 1900-1954 (Chambers for 1920) and 1.25% for 1962-85 (USDA for 1967-70).

Table E.4. Real Annual Rates of Net Return on Farm Real Estate, Five Midwestern States, 1900-1985.

Year	Wisc.	Minn.	Ohio	Illinois	Iowa	5 States
1900	12.66	10.79	9.17	12.39	11.03	11.28
1905	9.43	13.02	10.27	11.88	15.94	12.56
1910	4.56	8.34	6.82	2.90	7.75	6.17
1911	1.19	6.31	3.38	-1.27	4.32	2.90
1912	4.63	8.06	6.70	1.25	5.78	5.23
1913	2.23	5.69	3.63	1.02	6.08	3.91
1914	1.14	3.77	9.18	-3.64	8.88	3.72
1915	6.05	8.32	2.62	-5.77	8.85	4.14
1916	-9.76	-2.17	-7.86	-12.94	-10.59	-8.69
1917	-8.30	-1.81	-1.65	-11.32	-6.09	-6.02
1918	-6.52	-4.64	-8.01	-6.71	-2.09	-5.22
1919	5.53	13.91	6.63	6.20	19.80	11.34
1920	13.32	12.64	-0.30	5.98	5.44	7.65
1930	0.66	-1.00	2.66	-0.38	0.77	0.35
1940	-3.42	-1.13	1.44	-0.54	-0.60	-0.87
1950	7.17	11.63	14.02	12.43	12.16	11.58
1954	4.00	8.22	9.01	4.50	8.75	6.96
1962	3.29	4.71	5.10	7.17	4.69	5.09
1963	9.12	5.81	10.28	6.92	6.26	7.31
1964	-1.52	-1.40	0.61	2.28	0.91	0.27
1965	9.02	7.21	7.34	13.28	12.35	10.17
1967	6.66	7.53	4.76	3.44	5.45	5.57
1968	9.76	6.93	1.62	2.75	3.38	4.81
1969	7.29	3.38	2.62	-3.22	0.83	1.76
1970	11.48	5.96	6.45	3.62	5.49	6.24
1973	8.43	16.36	12.78	15.69	18.47	15.01
1974	4.50	20.60	4.73	9.93	14.45	11.95
1975	7.33	17.19	14.65	18.27	21.82	16.71
1976	17.20	24.41	27.79	33.66	34.15	28.28
1977	15.87	10.79	8.82	7.51	1.86	8.33
1978	20.47	20.09	12.53	12.78	18.26	17.00
1979	9.80	13.11	8.18	1.06	10.92	8.65
1980	4.29	8.04	-5.33	-3.92	-1.67	0.48
1981	-8.53	-7.85	-19.13	-15.52	-12.96	-12.52
1982	-6.20	-11.48	-11.42	-12.89	-14.01	-11.60
1983	-6.69	-7.20	-4.41	-2.26	-11.01	-6.58
1984	-20.82	-24.58	-22.83	-27.64	-29.40	-25.65
1985	-17.07	-25.09	-10.56	-12.66	-19.75	-17.69

Note: Each rate equals the nominal rate from Table E.3 deflated by the inflation of the consumer price index from the year's annual average price level to the next year's annual average.

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