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CAPITAL FORMATION IN PRIVATE NONFARM RESIDENTIAL CONSTRUCTION

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1. Residential Construction Expenditures, 1889–1950

Gross Capital Formation

As has long been known, gross capital formation in residential construction has been subject to long swings of great amplitude, usually lasting for more than a decade to more than two decades.[1] Between the beginning of the last decade of the nineteenth century and 1950, three long cycles have been traced out in gross capital formation (or four, if the submerged peak in 1941 is considered to break the last cycle into two distinct cycles).[2] An annual series of

Note: This paper presents new estimates of gross and net residential capital formation and discusses some problems of methodology and interpretation. It is an outgrowth of a forthcoming monograph, *Capital Formation in Residential Real Estate: Trends and Prospects* (Princeton University Press for National Bureau of Economic Research), by Leo Grebler and the authors of the present paper, staff members of the Institute for Urban Land Use and Housing Studies. The monograph is a joint product of the National Bureau of Economic Research and the Institute.

The present paper summarizes certain empirical findings of the monograph but makes no attempt to analyze the causal factors underlying the level and movement of capital formation in residential real estate. A comprehensive analysis of such factors, an exposition of the role of capital funds in financing residential capital formation, and a general discussion of the weaknesses and qualifications of the data will be found in the larger study.

Unless otherwise stated, all data presented in this paper are taken from the monograph, and sources and methods of derivation are described there.

[1]Gross capital formation is here defined to include expenditures for new private permanent nonfarm housekeeping dwelling units and for additions to and alterations of such units.

[2]The choice of 1950 as a tentative terminal peak was based on two considerations: first the number of dwelling units started in 1951 and 1952 was about a quarter below the 1950 high; second, it seems unlikely that the 1950 high will be reached again in the near future. This view is based largely on the declining number of young people who will reach marriageable age during the next half decade and the resulting effect on the rate of family formation, as well as the great decrease in the percentage of doubled-up families since the end of World War II.

TABLE 1

Gross Capital Formation in Housekeeping Residential Real Estate, Annual Data and Decade Averages, 1889–1950

(*millions of dollars*)

Year	Current Dollars	1929 Dollars	Year	Current Dollars	1929 Dollars
1889	891	2,284	1920	1,212	1,021
			1921	1,980	2,076
1890	875	2,232	1922	3,155	3,597
1891	694	1,831	1923	4,170	4,242
1892	843	2,290	1924	4,805	4,958
1893	662	1,804			
1894	672	1,898	1925	5,160	5,364
			1926	5,190	5,356
1895	756	2,167	1927	4,830	5,052
1896	683	1,945	1928	4,510	4,702
1897	719	2,090	1929	3,380	3,380
1898	646	1,800			
1899	679	1,763	1930	1,875	1,923
			1931	1,495	1,663
1900	503	1,239	1932	590	775
1901	683	1,703	1933	435	571
1902	648	1,561	1934	580	699
1903	691	1,607			
1904	788	1,855	1935	960	1,193
			1936	1,505	1,787
1905	1,264	2,840	1937	1,795	1,916
1906	1,281	2,620	1938	1,915	1,988
1907	1,148	2,246	1939	2,590	2,643
1908	1,148	2,319			
1909	1,390	2,705	1940	2,895	2,846
			1941	3,415	3,116
1910	1,140	2,143	1942	1,665	1,438
1911	1,109	2,113	1943	870	718
1912	1,221	2,270	1944	790	598
1913	1,214	2,339			
1914	1,187	2,274	1945	1,060	752
			1946	3,870	2,479
1915	1,300	2,430	1947	6,185	3,270
1916	1,371	2,406	1948	8,425	4,002
1917	879	1,320	1949	8,082	3,956
1918	481	608			
1919	1,398	1,518	1950	12,425	5,763

Decade Averages

Year	Current Dollars	1929 Dollars
1890–1899	723	1,982
1900–1909	954	2,070
1910–1919	1,130	1,942
1920–1929	3,839	3,975
1930–1939	1,374	1,516
1940–1950[a]	4,517	2,631

[a]Eleven-year average.

gross capital formation in both current and constant dollars is presented in Table 1; turning points in this series are given in Table 2.

Decade averages for gross capital formation in current dollars indicate a rising trend from decade to decade with the exception of the 1930's (Table 1). However, the upward trend is much less clearly marked in the decade averages of deflated capital formation. The first three decades of the sixty-year period show little variation, but the level during the 1920–1929 decade was about double that for the preceding periods. A major decline was registered in the 1930–1939 decade and a partial recovery in the 1940–1950 period. But the annual average deflated gross capital formation in 1940–1950 was still almost 34 per cent lower than that for the 1920's, although it was about a quarter above the level achieved during the 1890–1919 period.

TABLE 2

Turning Points in Long Cycles in Gross Capital Formation in Housekeeping Residential Real Estate, 1889–1950

	Current Dollars	*1929 Dollars*
Peak	1889	1892
Trough	1900	1900
Peak	1909	1905
Trough	1918	1918
Peak	1926	1925
Trough	1933	1933
Peak	*1941*	*1941*
Trough	*1944*	*1944*
Peak	1950	1950

Note: Italics indicate submerged cycle.

Five-year averages confirm the observation that the 1920's were characterized by the greatest physical volume of residential construction during the last six decades. Although average gross capital formation in current dollars in 1946–1950 was more than two-thirds higher than in 1925–1929 ($7.8 billion as against $4.6 billion), in constant dollars the post-World War II period was almost one-fifth lower ($3.9 billion as against $4.8 billion).

In the analysis of series characterized by cycles with as long a duration and as great an amplitude as those found in residential construction, the use of long-cycle averages facilitates the study of trend movements. Accordingly annual average gross capital formation, in both current and constant dollars for the construction cycles since 1889, is presented in Table 3. The cycle averages of

TABLE 3

Annual Average Gross Capital Formation in Housekeeping Residential Real Estate within Long Cycles, 1889–1950 and 1892–1950

(*millions of dollars*)

Period	*Current Dollars*	*Period*	*1929 Dollars*
1889–1909	826	1892–1905	1,846
1909–1926	2,063	1905–1925	2,465
1926–1950	3,022	1925–1950	2,495
1926–1941	2,244	1925–1941	2,546
1941–1950	4,319	1950–1950	2,406

current dollar gross capital formation show a continued rise over the sixty-year period whether the 1926–1950 period is treated as a single cycle or as two cycles. However, a very different movement is found in the cycle averages for deflated gross capital formation. The 1905–1925 cycle is characterized by a level of annual real capital formation about a third higher than the 1892–1905 cycle. But the 1925–1950 period, whether treated as a single cycle or not, showed very little change in real gross capital formation when compared with the preceding cycle.

Components of Gross Capital Formation

Gross capital formation in housekeeping residential real estate consists of expenditures for new housekeeping dwelling units and for additions to and alterations of such units. Expenditures for new units, of course, comprise the bulk of such capital formation, accounting for about 90 per cent of capital formation over the period 1915–1950. But expenditures on additions and alterations apparently play a not unimportant role in certain periods.

Expenditures for additions and alterations, although fluctuating in rough concurrence with the residential building cycle, are much more stable than expenditures for new dwelling units, and the ratio between the two therefore moves countercyclically (Table 4). This ratio declined from between 11 and 12 per cent in the half-decade 1915–1919, which included the World War I trough in residential building, to slightly less than 7 per cent in the construction boom of the 1920's. It rose to a peak of 23 or 24 per cent in the depression years of 1930–1934 and dropped steadily to 12 or 13 per cent in the post-World War II boom.

TABLE 4

Ratio of Expenditures for Additions and Alterations to Expenditures for New Private Nonfarm Housekeeping Dwelling Units, 1915–1950

(per cent)

Period	*Current Dollars*	*1929 Dollars*
1915–1919	11.6	11.2
1920–1924	6.7	6.6
1925–1929	6.8	6.8
1930–1934	23.0	23.6
1935–1939	20.3	20.7
1940–1944	15.8	15.4
1945–1950	12.0	12.5
1915–1929	7.3	7.5
1930–1950	14.5	16.1
1915–1950	11.4	11.5

Although the data in Table 4 cover less than two full construction cycles, they suggest a rising trend in additions and alterations expenditures relative to expenditures on new housekeeping dwelling units. The 1930–1950 ratio of the former to the latter was about twice the ratio for the 1915–1919 period. The same conclusion results from a comparison at successive troughs and peaks. The ratio in the trough half-decade 1915–1919 was about half the ratio in the trough period 1930–1934. Similarly the ratios of expenditures for additions and alterations to expenditures for new dwelling units in the peak periods 1920–1924 and 1925–1929 were at about half the level of the ratio in the postwar boom of 1945–1950. This apparent increase in the relative importance of additions and alterations seems to be associated in part with a similar trend in conversions, which are an important component of additions and alterations expenditures. The increase is undoubtedly also associated with the aging of the stock and with growth in the size of the stock relative to new construction.

Net Capital Formation

In this field as elsewhere, net capital formation is computed by subtracting capital consumption allowances from the estimates of gross capital formation.[3] As a result of the increasing size of the

[3]Capital consumption allowances for residential real estate are here considered to be the sum of depreciation on existing residential structures and the remaining value of demolished structures (see later sections of this paper for details).

TABLE 5

Net Capital Formation in Housekeeping Residential Real Estate, Annual Data and Decade Averages, 1889–1950

(*millions of dollars*)

Year	Current Dollars	1929 Dollars	Year	Current Dollars	1929 Dollars
1889	712	1,826	1920	−231	−195
			1921	815	854
1890	681	1,736	1922	2,052	2,340
1891	493	1,301	1923	2,879	2,929
1892	636	1,727	1924	3,462	3,573
1893	444	1,210			
1894	452	1,277	1925	3,749	3,897
			1926	3,686	3,804
1895	529	1,515	1927	3,270	3,420
1896	444	1,264	1928	2,876	2,999
1897	474	1,379	1929	1,625	1,625
1898	381	1,063			
1899	386	1,003	1930	207	212
			1931	−46	−51
1900	186	459	1932	−706	−928
1901	364	908	1933	−847	−1,111
1902	310	748	1934	−797	−961
1903	335	778			
1904	428	1,007	1935	−363	−451
			1936	124	147
1905	872	1,960	1937	255	272
1906	831	1,700	1938	324	336
1907	661	1,293	1939	958	978
1908	662	1,337			
1909	869	1,691	1940	1,162	1,143
			1941	1,519	1,386
1910	581	1,093	1942	−353	−305
1911	545	1,040	1943	−1,225	−1,011
1912	631	1,172	1944	−1,464	−1,108
1913	631	1,216			
1914	587	1,124	1945	−1,315	−933
			1946	1,246	796
1915	671	1,255	1947	2,955	1,562
1916	686	1,204	1948	4,745	2,254
1917	69	103	1949	4,415	2,161
1918	−479	−605			
1919	285	309	1950	8,417	3,904

Decade Averages

Year	Current Dollars	1929 Dollars
1890–1899	492	1,348
1900–1909	552	1,188
1910–1919	420	791
1920–1929	2,418	2,524
1930–1939	−89	−155
1940–1950[a]	1,827	895

[a]Eleven-year average.

TABLE 6

Turning Points in Long Cycles in Net Capital Formation in Housekeeping Residential Real Estate, 1887–1950

	Current Dollars	*1929 Dollars*
Peak	1887	1887
Trough	1900	1900
Peak	1905	1905
Trough	1918	1918
Peak	1925	1925
Trough	1944	1933
Peak	1950	1950
Peak	1925	1925
Trough	1933	1933
Peak	1941	1941
Trough	1944	1944
Peak	1950	1950

housing stock, capital consumption allowances have been gradually rising over the last sixty years, with declines registered only in those years in which net capital formation was negative. Subtraction of a series which shows a fairly smooth and slow increase over time from one which exhibits fluctuations of great amplitude yields a residual series with roughly coincident fluctuations of the same absolute but greater relative magnitude. Thus the net capital formation series (Tables 5 and 6) trace out the same long cycles that were found in gross capital formation.

Decade averages of net capital formation in current and constant dollars (Table 5) reveal substantial differences in movement from the corresponding averages for gross capital formation. In current dollars, the upward movement in gross capital formation during the first three decades of the sixty-year period is almost wiped out in the net capital formation series. In constant dollars, the relative stability of the decade averages for gross capital formation during the same thirty years is converted into a decline of substantial magnitude in net capital formation. The decade of the 1920's emerges as the period of greatest net additions in both current and constant dollars.

Average annual net capital formation in 1940–1950 even in current dollars was 24 per cent lower than in 1920–1929, while annual average gross capital formation was 18 per cent higher. In constant dollars, net capital formation in the 1940–1950 period was almost two-thirds lower than in the 1920's, while gross capital formation was only one-third lower.

The same pattern emerges in an analysis of the 1925–1929 and 1946–1950 periods, the two half-decades characterized by the greatest residential construction volume in the entire span of sixty years. In current dollars, annual average gross capital formation was more than two-thirds higher in 1946–1950 than in 1925–1929, but average net capital formation was only 43 per cent higher. In constant dollars, gross capital formation in 1946–1950 was almost one-fifth lower than in 1925–1929. But net capital formation was almost one-third lower.

As indicated in Table 5, net capital formation in both current and constant dollars was negative in the 1930–1939 decade. There were actually three periods of net disinvestment in housekeeping residential real estate in the last sixty years. The first and last were associated with the two World Wars, while the second coincided with the Great Depression of the 1930's (Table 5). Net disinvestment in 1918 and 1920 was relatively small. From 1931 through 1935 net capital formation in both current and constant dollars was negative, reaching a maximum of over $800 million in current dollars and over $1.1 billion in constant dollars in 1933. Again during World War II net capital formation was negative from 1942 through 1945. The maximum disinvestment occurred in 1944 when it reached almost $1.5 billion in current dollars and about $1.1 billion in constant dollars. In all, eleven years in the last six decades were characterized by negative net capital formation.

Cycle averages of net capital formation in current dollars show a constant rise when the 1925–1950 period is considered a single cycle. When it is divided into two shorter cycles, there is a slight decline from the 1905–1925 cycle to the 1925–1941 cycle, but the 1941–1950 cycle again shows an increase to a level higher than any preceding cycle (Table 7). Net capital formation in constant dol-

TABLE 7

Annual Average Net Capital Formation in Housekeeping Residential Real Estate within Long Cycles, 1887–1950

(*millions of dollars*)

Period	*Current Dollars*	*1929 Dollars*
1887–1905	479	1,252
1905–1925	926	1,318
1925–1950	1,133	805
1925–1941	898	880
1941–1950	1,552	673

lars, however, rose only slightly between the first two cycles and dropped sharply from the 1905–1925 cycle to the 1925–1950 cycle. When the latter period is considered as two cycles, both show a decline from the 1905–1925 average, with the 1941–1950 average at an even lower level than that for 1925–1941.

Ratio of Net to Gross Capital Formation

The proportion of gross capital formation which has resulted in net additions to residential capital has fluctuated in accordance with the residential building cycle. In periods of high building activity, such as the 1920–1929 and 1940–1950 decades, the ratio has been at high levels; in trough decades, such as 1910–1919 and particularly 1930–1939, the ratio has fallen to low or negative levels. Accordingly decade ratios reveal only great variability in the relationship between net and gross capital formation.

Ratios derived from net and gross capital formation within the long cycles in gross capital formation, however, indicate a long-term downward movement in the proportion of gross capital formation that resulted in net additions to residential wealth and implicitly, therefore, a long-term increase in the proportion required to offset capital consumption (Table 8). This relationship is a result of the decline in the ratio of gross capital formation to the stock of residential capital, contrasted with the relative stability in the ratio of capital consumption to the stock of residential capital.

Expenditures for Nonhousekeeping Residential Facilities

Expenditures for nonhousekeeping residential facilities[4] exhibit less evidence of long cyclical swings than do the data for housekeeping construction, although the period from the middle of the 1890's to the middle of the 1910–1919 decade might be viewed as one trough-to-trough cycle and the period from the middle of the 1910–1919 decade to sometime in the 1930's or early 1940's as another (Table 9). Disregarding short-term fluctuations, which are very pronounced in this segment of residential building, expenditures in current dollars show a gradual rise to the end of the 1910–

[4]Nonhousekeeping residential facilities comprise buildings containing nonhousekeeping quarters, e.g. transient hotels, tourist cabins, dormitories. Such expenditures are not included here in capital formation in housekeeping residential real estate.

TABLE 8

Ratio of Net Capital Formation to Gross Capital Formation within Long Cycles in Gross Capital Formation, 1889–1950 and 1892–1950

(*per cent*)

Period	*Current Dollars*	*Period*	*1929 Dollars*
1889–1909	62.7	1892–1905	60.2
1909–1926	54.8	1905–1925	53.5
1926–1950	34.0	1925–1950	32.3
1926–1941	31.6	1925–1941	34.6
1941–1950	35.9	1941–1950	28.0

TABLE 9

Expenditures for Private Nonhousekeeping Residential Facilities, 1891–1950

(*millions of dollars*)

Year	*Current Dollars*	*1929 Dollars*	*Year*	*Current Dollars*	*1929 Dollars*
			1920	130	110
1891	13	35	1921	125	131
1892	9	25	1922	205	229
1893	9	25	1923	230	233
1894	7	20	1924	255	263
1895	5	20	1925	355	363
1896	10	29	1926	410	416
1897	17	50	1927	330	339
1898	12	34	1928	260	266
1899	10	26	1929	245	245
1900	11	27	1930	200	203
1901	38	95	1931	70	77
1902	51	124	1932	40	52
1903	36	85	1933	35	44
1904	24	57	1934	45	51
1905	28	63	1935	50	58
1906	61	126	1936	60	67
1907	45	89	1937	80	80
1908	44	90	1938	75	73
1909	45	89	1939	90	86
1910	40	76	1940	90	85
1911	58	110	1941	95	85
1912	63	117	1942	50	43
1913	46	84	1943	15	12
1914	48	91	1944	25	19
1915	40	75	1945	40	29
1916	60	100	1946	145	95
1917	65	91	1947	125	70
1918	45	55	1948	155	77
1919	75	81	1949	185	91
			1950	175	83

TABLE 10

Ratio of Expenditures for Nonhousekeeping Residential Facilities to Expenditures for New Private Nonfarm Housekeeping Dwelling Units, 1891–1950

(*per cent*)

Decade	*Current Dollars*	*1929 Dollars*
1891–1899[a]	1.7	1.7
1900–1909	4.5	4.5
1910–1919	5.3	5.0
1920–1929	7.1	7.0
1930–1939	6.6	6.4
1940–1950[b]	2.5	2.7

[a]Nine years.
[b]Eleven years.

1919 decade, a more rapid rise to the middle 1920's, a decline to the early 1930's, some recovery prior to World War II, a decline during the war, and a more substantial recovery in the postwar period. Both the 1941 and 1949 peaks, however, were far below the level reached in the middle 1920's. Deflated expenditures followed essentially the same pattern, except that in the deflated series, the level in the 1910–1919 decade was somewhat lower in comparison with that in the preceding decade and the post-1945 rise was more modest. Deflated expenditures in the postwar period were at about the same level as expenditures in the late 1930's and in the 1900–1917 period and less than one-quarter of the level at the 1926 peak.

As a consequence, expenditures for such facilities since the 1920–1929 decade have declined in importance relative to expenditures for housekeeping dwelling units (Table 10). Decade averages show a rising ratio of nonhousekeeping to housekeeping expenditures over the four decades following 1890 and a declining ratio since the 1920's. The ratio for the eleven-year period 1940–1950 was lower than that for any decade in this century, and the ratio for the boom period 1946–1950 was even lower than that for the whole decade (2.2 per cent and 2.4 per cent for current and constant dollar expenditures, respectively).

2. Problems in Methodology and Interpretation

Sources and Coverage of the Gross Capital Formation Series

The data underlying the series on gross and net capital formation in housekeeping residential real estate consist of estimates of ex-

penditures for new dwelling units, expenditures for additions and alterations, and allowances for capital consumption. The estimates of expenditures for new dwelling units and for additions and alterations for the period 1889–1920 are new estimates prepared in connection with the forthcoming monograph, *Capital Formation in Residential Real Estate, Trends and Prospects;* the post–1920 estimates are official Bureau of Labor Statistics–Department of Commerce estimates. The entire series on capital consumption allowances are new estimates; these allowances are discussed later.

The derivation of the new estimates of expenditures for housekeeping dwelling units is described in detail in a recent Technical Paper of the National Bureau of Economic Research.[5] Essentially these estimates were based on data gathered in a survey of building permits issued in 417 cities over varying periods of time between 1870 and 1930. The permit values of authorized residential building in reporting cities were expanded to regional-size class totals by the use of population relationships. These regional-size class totals were summed to yield an urban series, which in turn was expandedd to a nonfarm series by the use of relationships between urban and rural nonfarm population change and an allowance for the typically lower cost of rural nonfarm dwelling units. Further adjustments were made to include those development costs (architects' and engineers' fees, land development costs, etc.) which are not recorded on applications for building permits, for the typical underestimate of building costs on permit applications, and to convert the adjusted series to a work-put-in-place basis.[6] These adjustments are quite comparable to those made in deriving the official Department of Commerce series.

The new additions and alterations estimates were derived by graphic extrapolation, both as to level and cyclical movement, by reference to the series on expenditures for new dwelling units and based on the relationship between these two series in the post–1920 period.

Housekeeping residential construction is here defined to cover new private permanent nonfarm housekeeping residential facilities. Public housing and farm housing, as well as additions and alterations to, and maintenance and repair of, existing residential structures, are excluded. Temporary structures, structures without house-

[5]David M. Blank, *The Volume of Residential Construction, 1889–1950,* National Bureau of Economic Research, Technical Paper 9, 1954.

[6]The same procedure was employed in deriving the new estimates of expenditures for nonhousekeeping residential facilities (see *ibid.*).

keeping facilities,[7] and trailers are also excluded. Living quarters for employees in warehouses and factories are excluded but the construction figures include the total cost of structures that contain both dwelling units and stores since the housing accommodations usually account for a major part of the total cost of building such structures.

Expenditures for residential facilities are further defined to include the nonstructural site improvements associated with residential building. The cost of the land underlying new structures, however, is excluded from the expenditure measures. Some discussion of the problems created in separating land from structure values is reserved for a later section of this paper.

Included in the expenditures measures also is the value of all ". . . types of immobile equipment which when installed become an integral part of the structure and are necessary to any general use of the structure. Plumbing, heating, air conditioning and lighting equipment . . . are examples of service facilities which are considered a part of construction. In general, construction does not include the procurement of special purpose equipment designed to prepare the structure for specific use. Examples of such equipment are . . . refrigerators, ranges or dishwashers in homes."[8] The exclusion of separable special-purpose equipment from the measures of expenditures for residential construction has important ramifications both in the interpretation of the capital formation figures and in the analysis of the factors determining the volume of capital formation in this field. Thus, over time an increasing proportion of what the consumer feels to be joint expenditures on the home and its equipment has probably been accounted for by the acquisition of items not captured in the construction statistics. Indeed there may well have been a significant amount of competition in the consumer's budget between outlays for the structure and for household equipment.

All official construction figures as well as the new estimates presented here are given on a work-put-in-place basis. That is, the volume of residential construction in any given period of time is defined as "cost of the materials put in place" during that period of time, "the wages of the workers who placed the materials and

[7]Essentially permanent cooking facilities.

[8]*Construction and Building Materials, Statistical Supplement* (known as *Construction and Construction Materials* through 1950), Dept. of Commerce, May 1951, p. 1.

the appropriate charges to the work for overhead and profit.'"[9] Thus, unlike the case of other producers' or consumers' durable goods, gross capital formation here is not measured by acquisitions of the goods by final purchasers and by net changes in inventory of producers of the durable goods. Rather the accounts of the construction industry and those of the purchasers of new residential structures are partially consolidated and only the gross additions to the "work in process" of the construction industry are credited to gross capital formation in residential real estate.

An interesting and, at certain times in the past, an important element of construction expenditures omitted from the historic record of residential capital formation is the amount of resources expended in the development of "premature" subdivisions. These were subdivisions laid out, usually in boom periods, in anticipation of residential building which never materialized. Substantial amounts of resources were invested in grading, building of streets and sidewalks, etc., in these subdivisions. These resources were largely wasted since the facilities either largely succumbed to the wear and tear of the elements or had become obsolete by the time residential building took place. In the present boom, however, there has been relatively little investment in land development unassociated with actual building operations.

Since the historic estimates of expenditures for residential construction are based on building permit data, expenditures for land development not accompanied by residential building are nowhere captured in the series. Nor has depreciation been charged against this form of capital.

The estimates of gross capital formation include expenditures for additions and alterations of existing residential structures but exclude expenditures for maintenance and repair of such structures. The conceptual grounds for this distinction involve the view that expenditures on existing structures which would have increased the value of such structures if they had been incurred at the time of original construction are considered increments to the capital stock of the nation and therefore part of capital formation; conversely, expenditures used simply to maintain the current value of structures are excluded.

In practice, the line of demarcation between additions and alterations expense and maintenance and repair expense is often quite

[9]Roland V. Murray and Bruce M. Fowler, "Estimating Expenditures for New Construction," *Techniques of Preparing Major BLS Statistical Series*, Bureau of Labor Statistics, Bull. 993, 1950, p. 50.

indeterminate. For example some expenditures on alterations may substitute for or include some maintenance expense. Conversely maintenance and repair expense may include some capital additions, particularly when the maintenance expenditures involve the installation of facilities of higher quality. Further, the exclusion from capital formation of maintenance expense required to maintain the current value of structures is conceived of in terms of maintaining current values after allowance for a "normal" amount of depreciation, which in turn is usually defined as the decline in value of structures over time under conditions of "normal" maintenance and repair.

Estimates of expenditures for residential additions and alterations, even for current periods, are subject to very wide margins of error and probably involve a considerable amount of underestimation. The official BLS-Commerce estimates covering the period 1915 to date are primarily based on bench-mark estimates derived from the 1935–1936 and 1941 studies of consumer expenditures. Estimates for other years are obtained by the government agencies by interpolation and extrapolation on the basis of building permit data for additions, alterations, and repairs, adjusted for changes in family income and in the number of dwelling units standing.[10]

The interindustry study for 1947, developed by the BLS, concluded on the basis of data from the Survey of Consumer Finances and other materials that nonfarm additions and alterations in 1947 probably amounted to $1.183 billion, about 60 per cent above the official estimates.[11] The divergence between the official estimates for 1947 and the estimate developed by the interindustry study may have been unusually large because of the particular characteristics of the years just following World War II. Owners during this period caught up with a great number of capital improvements deferred during the depression and war periods. Also rent control placed a premium on conversions since, under certain circumstances, converted units were exempt from control. In other words the understatement in official estimates may have been somewhat smaller in other years. But there appears to be no way to measure the absolute amount of understatement or its variation over time.

[10] *Construction and Construction Materials, Statistical Supplement,* May 1950, p. 80.

[11] David I. Siskind, "Construction, A Final Demand Sector in the 1947 Interindustry Relations Study," in "Input-Output Analysis, Technical Supplement," multilithed, National Bureau of Economic Research, 1954, Chap. 4, p. 11.

Capital Consumption Allowances

The successful passage from gross to net residential capital formation rests upon the accuracy of the annual allowance for capital consumption. Since capital consumption is a large and increasing offset to gross capital formation, wide variations in net capital formation may result from the type of depreciation formula selected and even from small differences in the annual rate of depreciation.

Although other definitions are possible, depreciation is here defined as the progressive diminution in the productive efficiency of a house as it ages, indicated by a decline in value. Since houses of various ages pass through the market, this loss in value is best determined by actual market price rather than through the adoption of accounting conventions found necessary in the case of most nonmarketable durable assets. Statistically the amount of depreciation is calculated in this paper as the difference between the current market value of a house and the estimated current cost of reproduction of an identical or nearly identical substitute. The current cost of reproduction can be ascertained alternatively (1) from the market price of an equivalent new house, or (2) since it is practically impossible to find new houses even roughly equivalent to houses fifty years old, from the estimated cost of reproduction given by competent appraisers. The market write-down of value thus calculated will, of course, reflect both the physical wear and tear of a structure and obsolescence due to style change.

The derivation of a depreciation scheme directly from value data has two advantages over the more conventional method of estimating the depreciation rate as the reciprocal of the average length of life of a structure, measured in years. In the first place, no firm longevity data exist. Not only must longevity be assumed but also a terminal value of the structure at the time of demolition. It should be realized that the value of demolished structures is far from zero; indeed since demolitions are the result, more often than not, of supersession of land use, these terminal values are often of substantial (but unknown) average size. Second, knowledge of average physical life lends itself only to the adoption of a linear depreciation method and, unlike direct value data, yields nothing about the time pattern of depreciation over the life of the structure.

Usable value data exist in the files of the Federal Housing Administration and in the work of William M. Hoad and Raymond W. Goldsmith which permit the calculation of measures of depreciation as defined above. These data support an increasingly accepted belief that official *Bulletin F* and Department of Commerce depreci-

ation formulas, linear depreciation at rates ranging from 2 to 3 per cent, overstate the amount and inadequately describe the time distribution of actual depreciation. The average residential structure seems to have a physical life substantially in excess of thirty-three to fifty years. In 1940 about 600,000 occupied, i.e. productive, dwelling units over eighty years old were still standing, a number representing a substantial proportion of all nonfarm dwelling units built before 1860; over one-third of the 1890 housing inventory was still standing in 1940. The available evidence also suggests, at least in a rapidly growing urban economy, that structure mortality other than accidental loss has been influenced much more by site obsolescence, as our urban land-use patterns have changed, than by the physical wear and tear or obsolescence of the structures themselves. With average maintenance and repairs, relatively few dwelling units are unable to attract occupancy at some rental sufficient to cover at least operating costs. In 1950 the number of dwelling units reported dilapidated and vacant constituted only 0.7 per cent of the nonfarm inventory, and even of this number many were undoubtedly still on the market.

Hoad's study[12] reveals that houses fifty years old have experienced a loss in value averaging 0.6 per cent per year. His work is based on two samples of single-family houses of different ages: bungalows and 1½–2 story frame houses sold on the open market and for which bona fide market prices could be obtained. The average market price of each age class, expressed as a ratio to the price of a comparable new house, indicates that fifty-year-old bungalows had suffered a 35 per cent loss in value and fifty-year-old frame houses a smaller loss of 26 per cent, equivalent to average linear rates of 0.7 and 0.5 per cent respectively. The depreciation curve for bungalows in particular was nonlinear and showed a relatively greater value decline in early compared to later life.

The rates derived by Hoad are strikingly low and for a number of reasons somewhat understate the probable rate of depreciation. His market price ratios are based on values inclusive of land and tend to yield a lower schedule of depreciation than for structure alone. Second, the price ratio of old to new houses understates the decline in value from actual reproduction cost. No matter how careful the

[12]William M. Hoad, "Real Estate Prices—A Study of Residential Real Estate in Lucas County, Ohio," unpublished dissertation, University of Michigan, 1942. Hoad's study covers the years 1917–1938 but the market price data from which his depreciation curves are drawn are restricted to the period of the 1920's.

efforts to maintain sample homogeneity may be, in an empirical study of market sales it is exceedingly difficult to obtain structure comparability. Older houses, especially those coming into the market, tend to be larger than newer structures.[13] The price of a new house may be considerably lower therefore than the cost of reproducing its older counterpart. A third element of bias arises from the fact that those older houses which are actually sold may be subject to less than average obsolescence and more than an average amount of maintenance, repairs, additions, and alterations.

TABLE 11

Selected Characteristics of a Sample of Existing Single-Family Houses Securing Mortgages Insured by FHA, September-December 1939

Year Built	*Total FHA Property Valuation* (1)	*FHA Value Main Building* (2)	*Estimated Current Replacement Cost of Main Building* (3)	*FHA Land Value* (4)	*Age in Years* (5)	*Current Value as Per Cent of Value Replacement Cost* (6)	*Average Per Cent Annual Decline in Value* (7)	*Land Ratio* (8)
1938	$5,851	$4,703	$4,935	$ 849	1	95.3	4.7	14.5
1937	5,543	4,505	4,766	779	2	94.5	2.8	14.0
1936	6,440	4,989	5,640	1,107	3	88.5	3.8	17.2
1935	6,452	5,089	6,187	1,070	4	82.3	4.4	16.6
1930–1934	5,518	4,368	5,506	904	7	79.3	2.9	16.4
1925–1929	5,024	3,864	5,321	946	12	72.6	2.3	18.8
1920–1924	4,846	3,596	5,492	1,029	17	65.5	2.0	21.2
1915–1919	4,608	3,427	5,992	994	22	57.2	1.9	21.6
1910–1914	4,698	3,393	6,002	1,085	27	56.5	1.6	23.1
1900–1909	4,212	3,127	5,978	929	34	52.3	1.4	22.1
Pre–1900	4,033	2,788	7,766	1,063	52	35.9	1.2	26.4

The first two biases can be illustrated by the FHA data shown in Table 11. The decline in value of fifty-year-old structures, when measured inclusive of land, is 0.65 per cent per year compared to 0.82 per cent per year when land is excluded.[14] Second, when the average value of the oldest houses, $2,788, is compared with its estimated replacement cost of $7,766 (column 4), a 64 per cent value decline is noted, while the ratio of old to new house values without regard to the comparability obtainable by reproduction cost estimates yields only a 42 per cent decline (column 3). The larger

[13]George Katona, *Relevant Considerations in Recent Home Purchases*, Housing and Home Finance Agency, 1953.

[14]Thus the oldest houses (inclusive of land) show about a one-third decline in value relative to the newest houses, $4,033 compared to a 1935–1938 average of $6,072 (Table 11, col. 2). Exclusive of land the value decline is 42 per cent, $2,788 compared to $4,822 (col. 3).

size of these older structures can be inferred from their relatively high replacement costs.

Goldsmith found from value and age of structure data published in the *Financial Survey of Urban Housing*[15] a 50 per cent value decline for houses forty-five years old, implying an average annual (linear) rate of 1.1 per cent.[16] While owner estimates of value or age of structure may not be completely trustworthy, the results are nevertheless useful both because the data were not restricted to houses coming into the market and because of the wide geographic coverage. The fact that these data could not be adjusted for site value or for structure homogeneity probably operated toward understating the depreciation rate as it has been defined here.

According to the value data collected by the FHA from a sample of 1,500 single-family houses, structures with an average age of fifty-two years are worth about 36 per cent of their estimated cost of reproduction, implying a decline in value of about 1.2 per cent per year on a linear basis (Table 11). These data, which are in many ways the most usable of all, since structure values are distinguished from land values and both reproduction costs and current values are estimated by experienced appraisers, further indicate a pronounced curvilinear pattern in the form of a convex (to the origin) curve. But even in connection with these data, a number of factors have to be considered before establishing a final rate:

1. A depreciation rate derived from 1939 value data is likely to be higher than would be found in a period of high or even "normal" housing market activity. The market rate of depreciation is not likely to be cyclically stable since the value discount for age applied by buyers and sellers probably varies with conditions in the housing market. Hoad's results derived from the 1920's implied a much lower rate of depreciation even after giving consideration to the biases held to be inherent in his data.

2. Eligibility requirements imposed by the FHA may result in the same "marketability" bias discussed earlier, namely that the sample structures may have experienced less than average obsolescence and that such structures have received better than average maintenance, additions, and alterations. Since additions and alterations are included in gross capital formation, any depreciation rate derived from actual value data requires some enlargement. The

[15] *Financial Survey of Urban Housing*, Dept. of Commerce, 1937.

[16] Raymond W. Goldsmith, "A Perpetual Inventory of National Wealth," *Studies in Income and Wealth, Volume Fourteen*, National Bureau of Economic Research, 1951, pp. 21–24.

data on additions and alterations are so poor that some writers (Goldsmith, for example) speak of omitting them entirely from gross capital formation, compensating for the omission by using a relatively lower depreciation rate.[17] If done with care, the estimates of net capital formation would remain the same irrespective of which of the two procedures was adopted. The understatement in gross capital formation would be matched by a corresponding understatement in capital consumption.[18]

3. The derived rate refers to single-family houses. Consideration must therefore be given to multifamily structures, which are generally thought to decline more rapidly in value than single-family units.

4. A depreciation curve derived from market data, dealing only as it must with surviving houses, does not make allowances for houses actually demolished. An adjustment for this factor is discussed below.

On the basis of scanty available data, a compound rate of 2 per cent annually was thought to yield the best results if a separate allowance were made for demolitions. A 2 per cent rate applied to remaining balances not only approximates the magnitude of decline suggested by the empirical data but also permits a convex decline in value.[19] Had the same data and adjustments been used to derive

[17] *Ibid.*, pp. 22–24.

[18] There are, however, some objections to the second procedure. First, it is obvious that the ratios of net to gross capital formation would be significantly altered. For example under the first procedure if gross capital formation in a given year is estimated at $500 million ($450 million outlay on housekeeping units and $50 million on additions and alterations) and capital consumption is estimated at $200 million, the ratio of net to gross is 60 per cent. Under the second procedure gross capital formation would be taken at $450 million and capital consumption at $150 million, yielding a net-to-gross ratio of 67 per cent. Furthermore neither the scope of gross capital formation nor capital consumption would be equivalent to other economic sectors and thus limit both comparison and summation into more comprehensive totals. Another objection is the fact that the series on additions and alterations are, in effect, brought in by the back door with annual implied magnitudes equal to the annual understatement in both the gross capital formation and capital consumption accounts. Such estimates might better be made explicit rather than burried within a pair of self-canceling errors.

[19] A declining balance method of depreciation offers a further advantage in that it does not depend upon the original costs of existing capital. There was no need therefore to make estimates of residential construction and price changes for the early part of the nineteenth century, an extremely hazardous undertaking, in order to compute capital consumption of the inventory standing in 1889. Instead the wealth estimate prepared for that year could be directly employed. The annual depreciation charge is

a linear rate, a level of about 1.4 per cent would have been selected. In comparison with the 2 per cent compound rate, such a linear rate produces about the same amount of total depreciation over the first forty years of structure life, except that it is distributed more heavily during the second two and less during the first two decades. Under the linear rate there is complete extinction of value at the end of approximately seventy years; under the compound rate 25 per cent of value remains at the end of such a period and some value remains as long as the structure stays in existence.

No depreciation formula is likely to be completely satisfactory. Even the adopted rate results in lower depreciation charges during early life than the FHA data imply. It is quite possible that a curvilinear method based on a varying rather than constant rate would offer the most realistic description of value decline. Such a schedule of rates could then be varied with cyclical changes, with a trend factor for the increasing proportion of structures containing wiring, plumbing, and other special equipment subject to relatively high rates of depreciation and for such special circumstances as undermaintenance of real estate during periods of rent control. Refinements of this kind must await superior data. The constant rate method at least avoids some of the pitfalls of the linear method. Moreover it is at least as easy to use and comprehend, traditionally the main commendation of linear depreciation.

Allowance for Demolitions

The allowance for demolitions made here (Table 12) is so small in relation to total depreciation that it might have been totally ignored or dealt with by a slight increase in the depreciation rate. Separate estimation is justified less by a dubious gain in precision than by a desire to distinguish between the two very different kinds of capital consumption. The demolition of an occupied or inhabitable residential structure to make way for an office building, public improvement, or even an apartment house does not represent the same kind of accelerated depreciation that occurs when a usable machine tool is rendered obsolete by the introduction of a newer type. In the latter case the relative efficiency of the existing tool

made by charging 2 per cent of the value of residential capital at the beginning of the year against each year's gross capital formation. The resulting net capital formation for the year is then added to beginning-year value and the process is repeated in each succeeding year. To take account of depreciation on houses built during any given year, the assumption is made that all such housing has undergone six months' depreciation by year-end.

TABLE 12

Annual Capital Consumption, Nonfarm Housing, 1889–1950

(*millions of dollars*)

Year	Depreciation (current dollars) (1)	Demolition (current dollars) (2)	Total Capital Consumption (current dollars) (3)	Depreciation (1929 dollars) (4)	Demolition (1929 dollars) (5)	Total Capital Consumption (1929 dollars) (6)
1889	167	12	179	427	31	458
1890	181	13	194	463	33	496
1891	187	14	201	494	36	530
1892	193	14	207	525	38	563
1893	203	15	218	554	40	594
1894	205	15	220	579	42	621
1895	212	15	228	608	44	652
1896	223	16	239	635	46	681
1897	228	17	245	663	48	711
1898	247	18	265	687	50	737
1899	273	20	293	708	52	760
1900	294	23	317	723	57	780
1901	296	23	318	737	58	795
1902	313	24	337	754	59	813
1903	331	26	356	769	60	829
1904	334	26	360	787	61	848
1905	364	28	392	817	63	880
1906	418	32	450	854	66	920
1907	452	35	487	884	69	953
1908	451	35	486	911	71	982
1909	484	38	521	941	73	1,014
1910	516	43	559	969	81	1,050
1911	520	43	563	991	82	1,073
1912	546	45	591	1,014	84	1,098
1913	538	45	583	1,037	86	1,123
1914	554	46	600	1,062	88	1,150
1915	580	48	629	1,085	90	1,175
1916	633	52	685	1,110	92	1,202
1917	748	63	811	1,123	94	1,217
1918	885	75	961	1,118	95	1,213
1919	1,027	87	1,113	1,115	94	1,209
1920	1,325	119	1,443	1,116	100	1,216
1921	1,071	94	1,166	1,123	99	1,222
1922	1,014	89	1,102	1,156	101	1,257
1923	1,187	103	1,291	1,208	105	1,313
1924	1,235	107	1,342	1,275	110	1,385
1925	1,299	113	1,411	1,350	117	1,467
1926	1,384	120	1,504	1,428	124	1,552
1927	1,435	125	1,560	1,501	131	1,632
1928	1,502	131	1,633	1,566	137	1,703
1929	1,613	142	1,755	1,613	142	1,755

(continued on next page)

TABLE 12 (continued)

(*millions of dollars*)

Year	*Depreciation* (1)	*Demolition* (2)	*Total Capital Consumption* (3)	*Depreciation* (4)	*Demolition* (5)	*Total Capital Consumption* (6)
	(*current dollars*)			(*1929 dollars*)		
1930	1,589	79	1,668	1,630	81	1,711
1931	1,468	73	1,541	1,633	81	1,714
1932	1,234	62	1,296	1,622	81	1,703
1933	1,221	61	1,282	1,602	80	1,682
1934	1,311	65	1,376	1,581	79	1,660
1935	1,261	63	1,323	1,566	78	1,644
1936	1,316	65	1,381	1,563	77	1,640
1937	1,468	72	1,540	1,567	77	1,644
1938	1,516	75	1,591	1,574	78	1,652
1939	1,555	76	1,632	1,587	78	1,665
1940	1,635	97	1,732	1,608	95	1,703
1941	1,791	105	1,896	1,634	96	1,730
1942	1,905	113	2,018	1,645	98	1,743
1943	1,978	118	2,096	1,632	97	1,729
1944	2,127	127	2,254	1,610	96	1,703
1945	2,240	134	2,374	1,590	95	1,685
1946	2,480	147	2,627	1,589	94	1,683
1947	3,050	180	3,230	1,612	95	1,707
1948	3,475	204	3,680	1,651	97	1,748
1949	3,465	202	3,667	1,696	99	1,795
1950	3,790	220	4,008	1,758	102	1,859

is so sharply reduced as to give it zero (or scrap) value. In the case of site supersession the relative efficiency of the structure itself is not reduced; the demolition is occasioned by the inability to transport the structure elsewhere. Moreover while a depreciation charge is viewed as a continuous and regular consumption of capital, demolitions are probably quite irregular and related to causes which cannot be impounded within the phrase, "the passage of time."

Demolitions caused by casualty are more closely related to the concept of depreciation since most of this destruction can largely be attributed to the perhaps actuarily stable action of the elements. Yet for a number of reasons even this form of capital consumption ought to be clearly distinguished from ordinary depreciation. First some writers prefer to treat catastrophic destruction as an item of capital adjustment rather than capital consumption.[20] Second the

[20]Solomon Fabricant, *Capital Consumption and Adjustment*, National Bureau of Economic Research, 1938, p. 19.

assumption of "natural" causation is valid only in the absence of war. In the social accounting system of other and less fortunate nations, the destruction of residential capital in wartime can hardly constitute an item of ordinary depreciation.

The statistical data available for making allowances for demolitions are notoriously weak even for recent years. Decade estimates of the total number of dwelling units demolished have been made by David L. Wickens for the period 1890–1929[21] and by BLS for the period 1930–1949.[22] These estimates are the starting point of the demolitions allowance.

A ratio was derived of annual demolitions (taken as one-tenth of the total in each decade) to the average annual size of the inventory (taken as the average of the opening and closing inventories of each decade). These ratios were then converted to value ratios on the assumption that demolished dwelling units have a somewhat lower than average value since (1) structures demolished because of supersession are probably older than the average structure and, (2) a large proportion of losses due to storm, flood, and fire occur in rural nonfarm areas, where dwelling units are typically lower in value. Such assumptions are obviously crude but since the total demolition allowance accounts for only 10 per cent of the full annual capital consumption charge, even wide errors cannot affect the results greatly.

Comparison of Residential Capital Formation with Residential Wealth Estimates

Estimates of net capital formation both for totals and for individual sectors have in the past years been subject to test by wealth data.[23] One might add that until very recent years this has been virtually the only purpose for which wealth data have been introduced into the mainstream of economic research. But as Simon Kuznets has pointed out,[24] there are severe limitations on the usefulness of such tests—limitations which were brought sharply into focus when the residential capital formation estimates were cumu-

[21]David L. Wickens, *Residential Real Estate*, National Bureau of Economic Research, 1941, p. 54.

[22]For 1930–1939, M. H. Naigles, "Housing and the Increase in Population," *Monthly Labor Review*, March 1942. The estimates for 1940–1949, still unofficial, are contained in a BLS release entitled "Changes in the Nonfarm Housing Inventory, 1940–1950," February 28, 1952.

[23]Simon Kuznets, *National Product since 1869*, National Bureau of Economic Research, 1946, Part IV; Goldsmith, *op. cit.*

[24]*Op. cit.*, p. 198.

lated and compared with census-type residential wealth totals at bench-mark dates.

Existing bench-mark residential wealth data fall into two categories, depending upon the type of census from which they are derived. Since housing is a form of real property, it is subject to frequent censuses conducted by tax-assessing officials. Since these officials, because of the public records to which they have access and the nature of their responsibilities and even temperaments, are hardly likely to overlook any houses, the coverage of such a census is practically complete. Assessment data, therefore, on the grounds of coverage, reliability, and frequency of collection would appear to offer an ideal potential source for residential wealth estimates.

Unfortunately this potential has been far from realized in the past. In the first place a major effort is required to gather the assessment data of every county in the United States and to process them into usable form. Although periodic collections of tax assessment data have been made by the Bureau of the Census, the extremely wide diversity of assessing practices requires enormously detailed adjustments to reduce the data to a common basis of valuation such as market value. It is notoriously difficult to obtain accurate ratios of assessed to market value for even a single county and a herculean task to achieve, in effect, a countrywide adjustment factor.

A second weakness is the fact that data have not been broken down by type of real estate. As a result the value of residential real estate has traditionally been derived as a residual by subtracting estimated amounts for various classes of nonresidential real estate from the total value of real estate. Like all residuals, a residential wealth estimate obtained in this manner fully reflects and even magnifies not only all the errors present in the total but errors in each of the subtrahends. Clearly such an estimate can be used only with diffidence.

The other type of residential wealth estimate is based upon the residential rent and value data reported by the Census of Population in 1930 and the Census of Housing in 1940 and 1950. Since nearly every dwelling unit is visited (including vacant units in 1940 and 1950), the coverage of such a census is nearly as good as the coverage obtainable from assessment records and, in addition, has the inestimable advantage of yielding data directly related to nonfarm residential real estate.

This type of census, however, falls short in a number of respects from fulfilling the conditions of an ideal residential wealth census.

In the first place direct value data are obtained only for owner-occupied dwelling units. As far as the tenant-occupied portion of the housing inventory is concerned, only rent data are solicited. Average rent is then transformed into average value by means of a so-called gross rent multiplier; these transformations may involve significant errors because of the difficulties of ascertaining an accurate multiplier. Second, the value data are obtained directly from the occupants themselves. It is possible that these reported values tend to lag behind changes in actual market value, particularly during periods of rapid fluctuations. It is also likely that varying amounts of consumer capital normally transferred with a house, such as screens, garden equipment, stoves, refrigerators, etc., are often included in the value report. The 1940 value data are further weakened by the fact that they are reported on a dwelling unit rather than on a structure basis; the 1930 value data, as will be shown later, are quite ambiguous in this respect. Dwelling units and structures are equivalent only in the case of a single-family house. While there are a substantial number of houses occupied jointly by the owner and one or more tenants, such houses are not valued as an entity. The owner reports the value of his own quarters, not an easy task for the inexperienced, while the value of the tenant-occupied portion of the structure is obtained by the aforementioned transformation method. On the other hand data on a dwelling unit rather than structure basis have one advantage—the exclusion of the nonresidential portion of a building, such as stores and offices.

The Testing Procedure

The foregoing discussion indicates that existing residential wealth estimates undoubtedly contain varying degrees of error which restrict the usefulness of the capital formation check. In addition to actual errors, the check is further weakened by the steps necessary to convert the capital formation estimates into the requisite form for testing and by a number of incomparabilities in the coverage of the two sets of data:

1. In a number of instances the census wealth estimates represent combined land and structure values. It is obvious therefore that some estimated value for the sites underlying residential real estate must be added to the cumulated capital formation estimates or subtracted from the census wealth totals. Reliable information on site value and its changes over time are exceedingly difficult to obtain. In the absence of data on the physical quantity and

average price per unit of land, site values are most readily obtainable by means of a ratio of site value to total value. Annual data on these ratios since the middle 1930's are provided by the FHA for a large number of areas. This series was here augmented by some scattered bench-mark data for the early 1930's, the 1920's, and the turn of the century. These data pointed to the existence of a fairly regular declining trend in the share of land in the total value of residential real estate—from about 40 per cent in 1890 to 18 per cent in 1950. Annual ratios between bench-mark years were formed by interpolation (Table 13, column 3). As far as both level and trend are concerned, this series of land ratios produced more satisfactory results in separating land from structure values than those given by other wealth estimators.[25] No attempt was made to adjust these land ratios for the fact that an allowance for outlays in preparing residential sites has been included in the capital formation estimate. The possible double counting error would appear to be small.

Even if it is granted that the land ratios used in our wealth check are tolerably good, it is difficult to maintain that so artificially interpolated a series does not contain wide margins of error in individual years. Such errors will of course produce corresponding errors in structure values and reduce the usefulness of the wealth data.

2. Other problems arise because the census wealth data appear in the form of current dollar totals, based in one way or another on market values. The capital formation estimates cumulated to any bench-mark data require revaluation into the bench-mark year's price level. This revaluation, which was accomplished by means of the construction cost index discussed below, is, of course, fraught with peril. Waiving the possibility of purely statistical deficiencies, there are sufficient short-run differences between the movement of costs and prices to produce substantial differences in any bench-mark year. Indeed it is no exaggeration to say that the knotty problem of valuation is probably the single most important drawback to wealth checks.

3. Finally there are a number of problems arising from differences in coverage. First, the wealth estimates include public housing and

[25]The explanation for the sharp decline in land ratios lies primarily in the growing use of automobiles, which opened up vast new areas of residential land. Another factor is the spread of the apartment house in relatively expensive central urban sites, which causes land ratios to fall even in the older settled part of the city.

TABLE 13

Cumulated Estimates of Nonfarm Residential Wealth, 1889–1950

(*dollars in millions*)

End of Year	Structures		Land		Total Residential Wealth
	1929 Dollars (1)	Current Dollars (2)	Proportion of Total Value (per cent) (3)	Current Dollars (4)	Current Dollars (5)
1889	22,050	8,600	40.0	5,733	14,333
1890[a]	22,918	8,984	40.0	5,989	14,973
1890	23,786	9,324	40.0	6,216	15,540
1891	25,087	9,508	39.6	6,234	15,742
1892	26,814	9,868	39.3	6,389	16,257
1893	28,024	10,285	38.9	6,548	16,833
1894	29,301	10,373	38.5	6,494	16,867
1895	30,816	10,755	38.2	6,648	17,403
1896	32,080	11,260	37.8	6,843	18,103
1897	33,459	11,510	37.4	6,877	18,387
1898	34,522	12,393	37.1	7,310	19,703
1899	35,525	13,677	36.1	7,930	21,607
1900	35,984	14,610	36.3	8,326	22,936
1901	36,892	14,794	36.0	8,322	23,116
1902	37,640	15,621	35.6	8,635	24,256
1903	38,418	16,520	35.2	8,974	25,494
1904	39,425	16,756	34.9	8,983	25,739
1905	41,385	18,416	34.5	9,702	28,118
1906	43,085	21,069	34.1	10,902	31,971
1907	44,378	22,677	33.8	11,578	34,255
1908	45,715	22,629	33.4	11,348	33,977
1909	47,406	24,367	33.0	12,002	36,369
1910	48,499	25,801	32.7	12,536	38,337
1911	49,539	26,008	32.3	12,409	38,417
1912	50,711	27,283	31.9	12,780	40,063
1913	51,927	26,950	31.6	12,451	39,401
1914	53,051	27,693	31.2	12,558	40,251
1915	54,306	29,054	30.8	12,932	41,986
1916	55,510	31,641	30.5	13,886	45,527
1917	55,613	37,038	30.1	15,949	52,987
1918	55,008	43,566	29.7	18,406	61,972
1919	55,317	50,947	29.4	21,216	72,163
1920	55,122	65,430	29.0	26,715	92,155
1921	55,976	53,401	28.6	21,390	74,791
1922	58,316	51,143	28.3	20,186	71,329
1923	61,245	60,204	27.9	23,297	83,501
1924	64,818	62,809	27.5	23,824	86,633
1925	68,715	66,104	27.2	24,698	90,802
1926	72,519	70,271	26.8	25,728	95,999
1927	75,939	72,598	26.4	26,041	98,639
1928	78,938	75,702	26.1	26,736	102,438
1929	80,563	80,563	25.7	27,866	108,429

(continued on next page)

TABLE 13 (continued)

(*dollars in millions*)

End of Year	Structures		Land		Total Residential Wealth
	1929 Dollars (1)	Current Dollars (2)	Proportion of Total Value (per cent) (3)	Current Dollars (4)	Current Dollars (5)
1930	80,775	78,756	25.3	26,674	105,430
1931	80,724	72,571	25.0	24,190	96,761
1932	79,796	60,725	24.6	19,812	80,537
1933	78,685	59,958	24.2	19,142	79,100
1934	77,724	64,433	23.9	20,236	84,669
1935	77,273	62,205	23.5	19,109	81,314
1936	77,420	65,188	23.1	19,582	84,770
1937	77,692	72,797	22.8	21,500	94,297
1938	78,028	75,140	22.4	21,690	96,831
1939	79,006	77,426	22.0	21,838	99,264
1940	80,149	81,512	21.7	22,590	104,102
1941	81,535	89,362	21.3	24,186	113,548
1942	81,230	94,064	20.9	24,858	118,922
1943	80,219	97,225	20.6	25,225	122,450
1944	79,111	104,506	20.2	26,454	130,960
1945	78,178	110,153	19.8	27,195	137,348
1946	78,974	123,278	19.5	29,862	153,140
1947	80,536	152,412	19.1	35,984	188,396
1948	82,790	174,273	18.7	40,085	214,358
1949	84,951	173,555	18.3	38,875	212,430
1950	88,855	191,571	18.0	42,052	233,623

[a]June 1, 1890.

certain types of marginal dwelling units, trailers, temporary houses, etc., which are specifically excluded from the capital formation series. The capital formation estimates capture, however, the value of the incidental nonresidential portions of residential structures which are, as stated earlier, excluded from the later wealth estimate but are probably included in the earlier estimate based on assessment data.

Second, the increment to wealth for any single sector between two points in time is not simply a function of gross capital formation and capital consumption. Intersector *transfers* of wealth are constantly in process. The entry of farm houses into the nonfarm residential category between two bench-mark dates because of change in use (or even change in census definitions) will be reflected in the census wealth estimate but not in the cumulation series since obviously no capital formation has taken place. Likewise when a residential structure is partially or wholly converted

to nonresidential use, the transfer remains unrecorded in the cumulated capital formation series since there has been no capital consumption, but will presumably diminish the census wealth total. An accurate wealth check would require a reasonably complete series of transfers of this kind, but unfortunately there are little or no data except for recent years which measure shifts of wealth to and from the private residential sector. Certainly one major type of transfer, the occupancy of former farm houses by nonfarm families, has served to enlarge residential wealth, while a second type, shifts between residential and nonresidential, has caused it to shrink. There is no way of knowing, however, what the size or sign of the net balance may be.

The inevitable consequence of the incomparabilities between residential wealth estimates and cumulated net residential capital formation arising from dissimilarities in coverage and valuation is the inability to interpret with any degree of confidence the differences in bench-mark estimates. Clearly a 10 per cent or even a 20 per cent discrepancy in any one year could easily be attributable to inherent differences in the data. Yet a difference of this magnitude can utterly destroy the usefulness of wealth data for checking capital formation over short periods of time. For testing time series covering long periods of time, wealth data are more serviceable since any errors present in either the initial or terminal wealth estimates are relatively small compared to the total increment to wealth.

The Checks at Bench-mark Dates

The check is carried out in two stages. First, the cumulated net capital formation estimates, augmented by estimated allowances for land, are compared in terms of current dollar totals because the underlying differences in data are best examined in this form (Table 14). Second, the census-type wealth estimates are reduced to structure values by removal of land value and then deflated, permitting a direct check on capital formation in constant dollars.

As a base for the cumulation of capital formation, a residential wealth estimate for 1890 was formed by multiplying the number of dwelling units by an estimated average value per dwelling unit. This resulted in a residential wealth total of $15 billion, quite close to Kuznets' estimate of $14.4 billion, derived from assessment data (Table 14). Since the starting estimates are so similar, they are practically removed as sources of discrepancy in subsequent bench-mark years.

TABLE 14

Comparison of Cumulative and Independent Residential Wealth Estimates, 1890–1950

(*billions of current dollars*)

Cumulated Wealth Estimates[a]				*Bench-mark Wealth Estimates*			
Date	*Structures*	*Land*	*Total*	*Date*	*Structures*	*Land*	*Total*
1890	9.0	6.0	15.0	1890[b]	6.7	7.7	14.5
1900	14.6	8.3	22.9	1900[b]	9.5	10.5	20.0
1912	27.3	12.8	40.1	1912[b]	20.7	18.4	39.1
1922	51.1	20.2	71.3	1922[c]	30.0	34.9	65.0
				1930[d]	98.1	24.5	122.6
1929	80.6	27.9	108.4	1930[e]	46.8	52.2	99.0
				1930[c]	51.6	56.1	107.7
1938	75.1	21.7	96.8	1938[c]	44.0	48.0	92.0
1939	77.4	21.8	99.3	1940[f]	....	....	87.4
1949	173.6	38.9	212.4	1950[g]	....	....	260.0

Note: Cumulated wealth estimates are for June 1 in 1890 and for December 31 in succeeding years. Bench-mark wealth estimates are for June 1 through 1912 and for April 1 in succeeding years, except in 1922, Doane's entry for 1930, and 1938 where the month and day were not available.

[a]From Table 13.

[b]Simon Kuznets, *National Product since 1869*, National Bureau of Economic Research, 1946, pp. 201–207.

[c]Robert R. Doane, *The Anatomy of American Wealth*, Harper, 1940, pp. 213, 224, and 251. Doane's procedure is essentially similar to that of Kuznets. Apparently as a result of a typographical error, a 1922 estimate of $67 billion is given on p. 116. Subsequent discussion indicates that $65 billion is the total actually intended.

[d]David Wickens, *Residential Real Estate*, National Bureau of Economic Research, 1941, p. 3 ff. His assumed land ratio is given on p. 4.

[e]E. A. Keller, *A Study of the Physical Assets, Sometimes Called Wealth, of the United States, 1922–1933*, University of Notre Dame, 1939, pp. 116–120.

[f]1940 Census of Housing, Series H-1943, No. 1.

[g]As estimated in Leo Grebler, David M. Blank, and Louis Winnick, *Capital Formation in Residential Real Estate: Trends and Prospects*, Princeton University Press for National Bureau of Economic Research, 1956.

On December 31, 1900, the next bench-mark, cumulated capital formation amounts to $22.9 billion, compared to Kuznets' estimate of $20.0 billion for June 1. In view of the small difference in the 1890 estimate and seven months' difference in dates, such a discrepancy appears small and quite reconcilable. Yet when comparison is made later in terms of net capital formation for the decade, even this small difference can be seen to vitiate the check.

In 1912 the agreement is quite good. The $0.9 billion difference between the cumulation estimate of $40.1 billion and Kuznets' esti-

mate of $39.2 billion is again explainable by the seven months' difference in dates.

At the next bench-mark date, 1922, the cumulation wealth estimate of $71.3 billion is about 10 per cent higher than Doane's estimate of $65.0 billion,[26] also based on assessment data. The difference appears to be, in large part at least, accounted for by valuation. The movement of construction costs in the postwar period was quite erratic, rising by about 29 per cent between 1919 and 1920 and dropping by about 25 per cent between 1920 and 1922. Market prices of real estate, upon which Doane's estimate is based, appear to have been more stable, though characterized by a fairly rapid postwar rise. It is in such periods of sharply fluctuating price levels that the problem of differences in valuation becomes most acute, leaving the investigator without a firm basis for interpreting his results.

In 1930 comparison can be made with at least three separate wealth estimates. The cumulated wealth estimate at the end of 1929 is $108.5 billion. Doane's 1930 estimate of $107.7 billion, derived from assessment data, lies very close to the cumulated total and is in no need of reconciliation. The Wickens and Keller estimates, both based on the April 1, 1930 Census of Population, of $122.6 billion and $99.0 billion, respectively, diverge substantially in opposite directions from the former and obviously require explanation.

The $23.6 billion difference between Keller and Wickens can be explained as follows:

1. The 1930 census returned the median value of owner-occupied houses and the median rent of tenant-occupied dwelling units. Keller accepted these medians as being equivalent to the mean value and rent. Wickens, on the other hand, was able to obtain average value and rent through a special census tabulation. The average value of an owner-occupied house in 1930, $5,833, was 21 per cent higher than the $4,828 median employed by Keller. Similarly the average monthly rent of $30.34 was somewhat (8 per cent) higher than median rent. These differences between average and median account for about two-thirds of the total difference between Wickens and Keller.

[26]Kuznets' 1922 estimate, though in close agreement with the cumulation estimate, was not used in this comparison since it is essentially derived from and dependent upon the 1930 Census of Population data, which are discussed later.

2. Nearly all of the remaining difference is explained by Keller's omission of 1.5 million vacant and nonreporting dwelling units from his value total.

3. The remaining difference is caused by the slight difference in gross rent multipliers used by these investigators in transferring rent estimates of the tenant-occupied inventory into value estimates.

On the face of the evidence, Wickens' estimate appears to have been made more carefully than Keller's and therefore is preferable for purposes of wealth checking. How can the $14.1 billion difference between the Wickens' and the cumulative totals be reconciled? It is believed that Wickens was led into an overstatement of residential wealth because of (1) an actual error in the census reports and (2) the use of an excessive gross rent multiplier in converting average rent into average value.

There has been more than a little confusion in the interpretation of 1930 census data on owner-occupied multifamily structures (constituting, in 1940, 16 per cent of the owner-occupied inventory) as to whether the values refer to the entire property or merely to the dwelling unit in which the owner resides. The value of the former will obviously be greater than the latter. While Wickens was led to believe that dwelling unit rather than structure values were reported and based his wealth estimate on this assumption, internal evidence in the census reports strongly indicates this cannot have been true. In a special tabulation of 139 cities giving both the average value for owner-occupied single-family houses and all owner-occupied dwelling units, the value of the latter turns out to be, in the vast majority of cases, larger than the former. This result is quite contrary to all available evidence found in FHA and 1940 census data and even to common sense. It seems almost certain that the "all owner-occupied" average was unduly enlarged because the value of the entire structure was returned. If this be true, the overstatement in Wickens' wealth estimate on this account is estimated in the order of $6 billion.

The second source of error seems to be even more important. To obtain a value figure for the tenant-occupied inventory, Wickens multiplied average annual rent by a factor of 11.9. Independent data on actual market relations between rent and value indicate that this multiplier is substantially overstated. Wickens apparently went astray by utilizing 1933 rent and value data drawn from his *Financial Survey of Urban Housing*, a notably poor base year for obtaining reliable value reports. While the contract rent reported by tenants accurately reflected depression levels, the value reports

of owners, unwilling to concede the severe drop in real estate values, did not; any ratio formed between these two figures was bound to be too high. Judging from independent estimates of the gross rent multiplier in 1929, a factor of 10 would appear to be ample, further reducing Wickens' wealth estimate by $9 billion. A total reduction of $15 billion produces a 1930 wealth estimate which is in good accord with the cumulation.

In 1938 Doane's estimate of $92.0 billion is about 5 per cent below the cumulation estimate of $96.8 billion and does not warrant extended discussion. More serious is the discrepancy between the $99.2 billion cumulation estimate at the end of 1939 and the $87.4 billion estimate made by the Census Bureau for April 1, 1940. In this case no significant part of the difference can be explained by errors in reporting since the census was quite explicit in reporting average values on a dwelling unit basis; nor does their choice of a gross rent multiplier of 8.3 give any cause for suspicion in the light of the independent findings for this year. Probably a large part of the difference is accounted for by valuation. Judging from both Wickens' experience and evidence for the late 1940's (presented later), there is some tendency for owners' estimates of market value to lag behind actual market prices; in 1940 these estimates were probably still influenced by bitter depression experience. In addition there is some evidence that construction costs had made a better recovery by 1940 than had market prices. It is difficult to say, however, whether these observations are sufficient to permit a full reconciliation between the two estimates.

In 1950 the cumulation falls considerably short of a rough wealth estimate prepared from Census of Housing data—$212.5 billion compared to $260.0 billion.

The problems of intersector shifts in wealth and general problems of coverage are best illustrated in this decade. There was a movement of an estimated 900,000 farmhouses into the nonfarm housing inventory in the 1940's, resulting from actual change in use and from a change in census definition. In addition by 1950 the housing inventory included over 300,000 permanent and about 600,000 temporary publicly financed dwelling units. Furthermore an estimated 1.75 million units were added by conversion; it is doubtful that the estimates for additions and alterations fully reflect this enormous gain.

The excess in the wealth total over the cumulation total is also due in part to valuation. The construction cost index in 1949 (used to revalue the cumulation) showed a 6 per cent decline from 1948

levels, causing the first decrease in current dollar wealth since 1935. It is dubious whether owners' estimates of value were affected by the interruption in the rise of market prices in 1949; it is more likely that they were still reporting values at the higher 1948 level. The problem of dealing with owners' estimates can be illustrated by the following: at the beginning of 1949 the Survey of Consumer Finances reported the value of an owner-occupied house, according to owners' estimates, to be $9,100; according to the 1950 census sample the average value of an owner-occupied single-family house was $10,800, or nearly 19 per cent higher. It is unlikely that sampling errors alone could account for such a difference. Market prices between the survey and census periods did not rise, according to most observers. Nor could the additions to inventory during the interim produce a rise in the average since the average value of new units built was below the average in the standing inventory. The presumption is strong that owners' estimates are not completely reliable and are perhaps unduly influenced by the prices prevailing two or more years in the past.

Comparison in Terms of Net Capital Formation

A re-examination of the wealth and cumulation totals at bench-mark dates in terms of current dollar totals inclusive of land shows a fair degree of correspondence in the light of formidable statistical difference between them. This correspondence is deceptive, however. A 10 per cent difference at a bench-mark date might not seem large enough to be worrisome. But because the increment to residential capital over a decade is a relatively small fraction of total capital, small differences in stock estimates may result in large differences in estimates of increments to stock and the test becomes too difficult to interpret. The wealth test is probably better for twenty-, thirty-, or even fifty-year periods, but even here large elements of uncertainty remain (see Table 15).

Before the check of the periodic increments to capital was undertaken, two of the census estimates were adjusted (a $15 billion reduction in Wickens' estimate of 1930 and a $20 billion reduction in the 1950 estimate) to allow for excess coverage. The land component of all wealth estimates was removed, as stated earlier, by means of independently calculated ratios of site to total value.

Between June 1890 and April 1950 the increase in value of residential structures implied in the wealth estimates amounts to $73.9 billion. Net capital formation, according to the estimate of this study, totaled $62.0 billion to the end of 1949 or about 16 per cent

TABLE 15

Comparison of Net Nonfarm Residential Capital Formation Estimates with Net Capital Formation Derived from Independent Wealth Estimates for Various Subperiods, 1890–1950

(*billions of 1929 dollars*)

Period	*Residential Capital Study* (1)	*Period*	*Independent Wealth Estimate* (2)	*Net Difference* (1) – (2) (3)
6/1/90–12/31/00	13.1	6/1/90–6/1/00	9.3	3.8
12/31/00–12/31/12	14.7	6/1/00–6/1/12	18.3	−3.6
12/31/12–12/31/22	7.6	6/1/12–n.a./22	3.5	4.1
12/31/22–12/31/29	22.2	n.a./22–4/1/30	26.8	−4.6
12/31/29–12/31/39	−1.6	4/1/30–4/1/40	−10.4	8.8
12/31/39–12/31/49	5.9	4/1/40–4/1/50	26.4	−20.5
6/1/90–12/31/22	35.4	6/1/90–n.a./22	31.1	4.3
6/1/90–12/31/29	57.6	6/1/90–4/1/30	57.9	−0.3
12/31/29–12/31/49	4.4	4/1/30–4/1/50	16.0	−11.6
6/1/90–12/31/49	62.0	6/1/90–4/1/50	73.9	−11.0

n.a. = not available.

less. The short fall for the six decades as a whole does not appear to be too great and to the extent that the wealth data have some reliability for a sixty-year check, an error approaching this size might have been caused by the unsatisfactory estimates of additions and alterations. The check against wealth data is useful to the extent that it is capable of revealing some systematic error in net capital formation, that is if the discrepancies between capital formation and wealth become wider and wider at each successive bench-mark. This is not the case. The differences at bench-mark dates, while sometimes large, are in opposite directions and do not tend to cumulate.

Between 1890 and 1900 net capital formation of $13.1 billion appears to be some 40 per cent higher than implied by the wealth totals. Between 1900 and 1912 the estimates deviate in the opposite direction, $14.7 billion in the cumulation total compared with $18.3 billion in the wealth estimates. In the next period, 1912–1922, the net capital formation estimates are more than double the amount of capital formation inferred from the wealth totals, $7.6 billion compared to $3.5 (and note that the comparison in terms of current dollar wealth revealed less than a 10 per cent difference in both 1912 and 1922). For the period 1890–1922 as a whole, the years which the new construction expenditure series cover, total

net capital formation of $35.4 billion is about 14 per cent higher than the estimate of $31.1 billion based on bench-mark data.

In the period 1922–1930 the estimated $22.2 billion of net capital formation falls about 17 per cent short of the wealth data. For the four decades 1890–1930, because of offsetting subperiod discrepancies, the agreement is quite close—the two sets of estimates differing by less than 1 per cent.

The wealth check fails most drastically in the next two decades. While the wealth data between 1930 and 1940 imply $10.4 billion of disinvestment, net capital formation is −$1.6 billion. In the next decade the comparison yields equally poor results. Even after adjustment of the 1950 wealth estimate, a total of $26.4 billion is implied by the census data compared to only $5.9 billion by the estimate of this study. For both decades taken together, census data imply $16.0 billion compared to $4.4 billion in the study. It is obvious that differences as wide as these make a mockery of wealth checks. While it is quite conceivable and even probable that the estimates of net capital formation between 1940 and 1950 are understated, it can hardly ever approach the shortage suggested by the wealth totals, which incidentally are drawn from as good a source as any wealth data currently in existence. The lesson to be drawn is not merely the limitations provided by wealth checks but, more importantly, that any investigator who lacks direct data for this decade must proceed with caution before he uses differences in wealth as a measure of capital formation.

The Deflation Problem

Deflation of residential capital formation estimates to constant dollar levels for most purposes requires in principle the use of a price index of residential construction. However, no national market price index covering a reasonably long period of time exists although house price indexes have been constructed for several cities, usually covering relatively few years. Consequently, in this paper as in other studies, a construction cost index is used as a substitute on the usual assumption that the movement of such an index is a reasonable reflection of changes in new house prices.

For various technical reasons, one might expect divergences to arise between construction cost indexes as presently derived and a valid index of the market price of homes. Further, although the interconnection between markets for new and old homes undoubtedly insures close conformity of their price movements at most times, differences in price movements in these two markets could appear

at several cycle stages and could persist for as long as several years.

To determine the importance of such divergences between indexes of construction cost and house prices, and thus to test the validity of the deflator used in this paper, a house price index for 1890–1934 was developed and compared with the cost index used here (Table 16).

The data for the house price index were derived from the *Financial Survey of Urban Housing*, which presented the results of a survey of financial and other information for a sample of residential structures in sixty-one cities in 1934. Detailed information in the survey is available only for twenty-two widely scattered cities. One set of questions asked of each owner of a residential structure related to (1) value of the property in 1934, (2) year of acquisition by the then-present owner, and (3) original cost to owner at time of acquisition. This information was summarized for each city and a table presented for each of the twenty-two cities, listing the number of properties included in the 1934 sample which were acquired in each year from 1890 to 1933, the total acquisition cost of properties acquired in each year, and the value of each group of such properties in 1934. Separate data for all owner-occupied, all tenant-occupied, all single-family owner-occupied, and all single-family tenant-occupied structures were given.

The data selected for analysis were those relating to single-family owner-occupied dwellings on the view that this relatively homogeneous group, which comprises a major portion of the nonfarm housing stock, would show a more consistent pattern than the other categories. Relatives for each year 1890–1933 were calculated for each city based on the ratio of the total acquisition cost of the single-family owner-occupied houses acquired in each given year to their value in 1934. The median relative for each year was then determined[27] and the relatives were chained and converted to a 1929 base (Table 16, column 1). It is assumed that the movement of median relatives between successive years approximates the movement in prices of a single sample between the two years.

It must be remembered that the price and value estimates on each property relate to land and buildings combined. It has been necessary to assume that land and structure values share proportionately in any movement of the combined land-structure value. While this

[27]Individual city relatives based on less than four properties were disregarded in the computation of the median.

TABLE 16

Price Index of Single-Family Owner-Occupied Houses, 22 Cities, 1890–1934, and Residential Construction Cost Index, 1890–1950

(*1929 = 100*)

Year	*Unadjusted House Price Index* (1)	*Adjusted House Price Index*[a] (2)	*Construction Cost Index* (3)	Year	*Unadjusted House Price Index* (1)	*Adjusted Price Index*[a] (2)	*Construction Cost Index* (3)
1890	61.3	36.0	39.2	1920	102.7	90.8	118.7
1891	55.3	32.9	37.9	1921	100.4	90.0	95.4
1892	56.3	34.0	36.8	1922	101.8	92.5	87.7
1893	58.7	35.9	36.7	1923	103.3	95.2	98.3
1894	68.4	42.4	35.4	1924	103.5	96.7	96.9
1895	62.1	39.0	34.9	1925	108.9	103.1	96.2
1896	53.8	34.3	35.1	1926	104.5	100.4	96.9
1897	55.5	35.9	34.4	1927	100.6	97.9	95.6
1898	59.1	38.7	35.9	1928	102.1	100.7	95.9
1899	56.5	37.5	38.5	1929	100.0	100.0	100.0
1900	64.6	43.5	40.6	1930	95.7	97.1	97.5
1901	54.2	37.0	40.1	1931	87.9	90.4	89.9
1902	63.9	42.4	41.5	1932	78.7	82.0	76.1
1903	64.9	45.5	43.0	1933	75.7	80.0	76.2
1904	67.9	48.3	42.5	1934	77.9	78.3	82.9
1905	59.5	42.9	44.5	1935			80.5
1906	70.6	51.6	48.9	1936			84.2
1907	77.9	57.7	51.1	1937			93.7
1908	70.3	52.8	49.5	1938			96.3
1909	68.7	52.3	51.4	1939			98.0
1910	74.2	57.3	53.2	1940			101.7
1911	72.5	56.7	52.5	1941			109.6
1912	75.3	59.7	53.8	1942			115.8
1913	75.3	60.5	51.9	1943			121.2
1914	78.1	63.7	52.2	1944			132.1
1915	71.7	59.2	53.5	1945			140.9
1916	78.5	65.8	57.0	1946			156.1
1917	80.1	68.0	66.6	1947			189.2
1918	85.2	73.3	79.2	1948			210.5
1919	93.7	81.7	92.1	1949			204.3
				1950			215.6

[a]Corrected for $1\frac{3}{8}$ per cent compound annual depreciation.

is not a wholly satisfactory assumption, it does permit one to operate with data in their present form.

A comparison of the construction cost index for 1890–1934 and the unadjusted house price index for the same period, drawn from

Table 16, suggests general conformity between the two series. In both there is an upward secular drift from 1890 to 1921, a more or less stable level from 1922 to about 1929, and a sharp drop to 1933.

There are, however, several important differences between the two series. Except for the period 1916–1922, the price index shows considerably more short-run variability than the cost index. Between 1905 and 1909, for example, the price index had a rise of more than 30 per cent and a fall of more than 10 per cent as compared with the cost index, which rose less than 15 per cent between 1905 and 1907 and declined only 3 per cent between 1907 and 1908. The same relationship holds for the period after 1922; the price index fell almost 8 per cent between 1925 and 1927 while the cost index remained almost unchanged. Thus it seems likely that in most periods the market price of homes fluctuates more widely over the short run than do construction costs as measured by a standard construction cost index.

A second difference between the two series is that the unadjusted cost index rises to a much sharper peak in 1920 than does the price index. This sharp rise in 1920, associated with a unique set of transportation difficulties in the winter and spring of that year, is found in all construction cost indexes and probably reflects a real difference between construction costs and house prices.

The final and, for the purposes of this analysis, the most important divergence between the two series is the difference in long-term rise over the entire period. The average level of the cost index from 1921 to 1929 was almost 2.5 times the average level from 1895 to 1905. The unadjusted price index rose only about 70 per cent between the two periods.

Is this discrepancy an indication that there is a real divergence between the long-term movement of standard construction cost indexes and house prices, or is the discrepancy due to biases in the price index? Although there are a number of possible biases in the price series, only two appear serious enough to warrant adjustment of the index: (1) value losses due to depreciation and obsolescence and (2) value increments in the form of structural additions and alterations. The price relative for 1904, for example, before conversion to a 1929 base, measures the change in price of a given set of properties between 1904 and 1934; this change is affected by thirty years of depreciation operating on these properties and is somewhat smaller than the change in price which would be measured if this group of properties in 1934 had the same age structure that they had in 1904. Conversely any structural additions or alterations

to the property between 1904 and 1934 would tend to make the price rise between these two years larger than the theoretically correct price movement.

The level of depreciation rates on single-family houses as determined in the market place was analyzed earlier. The FHA data, from which the depreciation rate for the housing inventory used in calculating net capital formation was derived, suggested that the decline in value of single-family dwellings over the first fifty-two years of life, after taking account of additions and alterations, approximated that resulting from a 1.2 per cent linear rate of depreciation. Since the twenty-two-city index is based on movements in the prices of structures plus land, the depreciation correction for this index also requires a rate based on structures plus land. The corresponding linear rate, derived from the same data, is about 1.0 per cent.

For reasons described earlier, a curvilinear rate of depreciation is more appropriate for residential structures than a linear rate. The compound rate of depreciation, which yields about the same remaining value after fifty-two years as a 1.0 per cent linear rate, but which approximates more closely the path of declining value of residential structures as they age, is about $1\frac{3}{8}$ per cent. Accordingly; a $1\frac{3}{8}$ per cent compound rate of depreciation was applied to the original twenty-two-city index. The series so calculated, after adjustment so that 1929 equals 100, is presented in Table 16, column 2.

A comparison of the construction cost index with the adjusted price index indicates that the correction for net depreciation has approximately eliminated the discrepancy between the long-term rises in the two series. The construction cost index in 1921–1929 was about 245 per cent of its level in 1895–1905; the adjusted price index in 1921–1929 is about 238 per cent of its level in 1895–1929. It would appear therefore that the long-run movement of the construction cost index measures with reasonable accuracy the long-run movement of house prices.

A Note on the Measurement of Savings in Residential Real Estate

Other investigators have pointed out earlier that the cumulated net savings (net investment) in the form of nonfarm residential real estate since the 1890's have not been greatly in excess of the increment in the residential mortgage debt. This finding is confirmed by

the data in our study. Thus between 1890 and 1950 the increase in the value of structures (in 1929 dollars and net of depreciation) has been about $62 billion while the increase in mortgage indebtedness has been about $53 billion.

One could proceed to draw an inference from such statistical results that capital formation in residential structures was financed not by the savings of owners of residential real estate but by the savings of the mortgagee, in spite of the fact that (1) considerable amounts of equity financing go into each year's new residential construction, (2) net residential capital formation has been positive in all but a few years, and (3) the aggregate debt-to-value ratio has, at all times, been substantially smaller than the aggregate equity-to-value ratio.

Such an inference would definitely be misleading and tend to underestimate significantly the role of equity finance in residential real estate. The finding that residential real estate owners have made only negligible savings is a direct result of the definition that has sometimes been adopted for measuring savings in the form of real estate. On the justification that the savings transaction (the acquisition of residential structures) is so closely associated with a dissavings transaction (the incurrence of mortgage indebtedness), the two transactions have been considered offsetting. Annual net savings are treated as the difference between the year's net residential capital formation and the year's increment to the residential mortgage debt.

But the annual increment to the mortgage debt is the result not only of the financing of new construction during the year but also of (1) the refinancing of debt on existing real estate facilities (which have had a marked long-run price rise) and (2) the financing of the acquisition of the underlying sites of both new and existing structures. Though neither the capital gains nor the value of land are permitted to enter the savings column, both are implicitly entered in the dissavings column; no theoretically justifiable method or statistical data exist for excluding from the increment in the mortgage debt the proportion due to land and capital gains.

While residential capital formation depends heavily upon external financing in the form of mortgage loans, this kind of offsetting treatment minimizes the role of individual savings by permitting individuals to dissave that which they have not been allowed to save in the first place. One might better say that the "savings" of mortgagees financed not only true savings in residential real estate but capital gains and land values as well, thereby reducing somewhat

the savings role of the creditor group and increasing that of real estate owners.

If mortgage debt increments are treated as an offset to savings, a difficult deflation problem is created, arising from the fact that one form of savings (residential structures) is in the form of real resources and the other form (mortgage debt) represents a paper claim. The summation of annual net (after deduction of the increase in debt) savings over a fifty-year period in current dollars renders a total that is difficult to interpret because of the differences in price levels at which these savings were made.

For many purposes a deflated savings figure is required. While it is possible to deflate savings in the form of residential structures by a construction cost index to yield a meaningful total, the choice of index becomes quite difficult if such savings have been reduced by mortgage indebtedness. To deflate net residential savings by the same index is to deflate, implicitly, mortgage debt by the changes in construction costs. The deflation of a series which represents a claim to a fixed number of dollars has always been a difficult problem; it is not at all clear that a construction cost index is the most appropriate deflator. This is particularly true when it is realized that the bulk of the mortgage debt is held by financial intermediaries who do not themselves directly constitute a savings group. The assets on the balance sheets of financial intermediaries are imputed to the savings groups who hold claims against these institutions in the form of deposits, insurance reserves, saving and loan shares, etc. Deflation of the mortgage holdings of financial institutions by a construction cost index would imply an indirect deflation of these claims by the same index, hardly a tenable proposition.

It might be argued that the current dollar mortgage increment could be deducted from a deflated series of annual net residential capital formation. But it is quickly seen that an aggregate of such annual figures would be quite ambiguous since the size of the aggregate would vary with every choice of base year. A similar deficiency would result if one decided to deflate net investment and mortgage debt by separate indexes, such as a construction cost index for the annual investment series and a cost of living index for the mortgage debt. Again the aggregate sum would depend on the relationship between the two indexes during the base year selected.