Volume Title: Estimates of Residential Building, United States, 1840–1939

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Volume Publisher: NBER

Volume ISBN: 0-87014-423-5

Volume URL: http://www.nber.org/books/gott64-1

Publication Date: 1964

Chapter Title: Appendix: The Five Adjustments of the 1940 Vintage Report

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Chapter URL: http://www.nber.org/chapters/c1793

Chapter pages in book: (p. 92 - 99)

Appendix

The Five Adjustments of the 1940 Vintage Report

1. Some 3.2 million converted units were reported in the 1940 Census. Our task was to estimate how many were located in structures built after 1890. If age of structure did not affect conversion, then the proportion of converted units in structures erected after 1890 would be the same as the proportion of total standing stock (87.62 per cent). This represents the maximum conversion allowance. However, the average residential conversion rate on the 1940 standing stock (11.62 per cent) would hardly apply regardless of age. Conversion should be minimal for relatively new structures. Conversion is often thought of as concentrated in the older belt line of central city middle-class residential neighborhoods outmoded by the automobile and the suburban drift. Yet surveys of conversion indicate this is not always true.[79] Detailed surveys for two cities showed that residential age accelerated conversion only mildly in one city, markedly in the other.[80]

Since empirical testimony was inconclusive, an effort was made through multiple regression analysis to see whether age was correlated with rates of conversion, measured by percentage of standing stock converted in 1940. This percentage measured the strength of the tendency to conversion. Detailed experimentation with regression analysis conducted with both state and city returns and use of a wide variety of explanatory variables indicated that conversion was stimulated by age in some areas and for some city-size classes. The final results of the multiple regression anal-

[79] *Housing Research,* Apr. 1954, p. 11.

[80] About 65 per cent of the Baltimore conversions, compared with 62.8 per cent of all dwelling units, were made on structures built before 1920. For Norfolk, the corresponding magnitudes were 73 and 42 per cent (*Housing Research,* Nov. 1952, p. 6).

TABLE A-1

MULTIPLE REGRESSION PERCENTAGE URBAN DWELLING UNITS CONVERTED, 1939 CENSUS, STATEWIDE BASIS

Variable or Item	Mean Value of Variable Statewide Group		Regression Coefficient (Standard Error)		Beta Coefficient	
	21 States[a]	27 States[b]	21 States[a]	27 States[b]	21 States[a]	27 States[b]
X_1 Median age structure	29.8	23.9	−.034	.305	−.04	.51
			(.13)	(.12)		
X_2 Single-family structures as per cent of total	51.9	62.8	−.170	.039	−.63	.13
			(.09)	(.06)		
X_3 Nonwhite and foreign born population as per cent of total	23.8	24.4	−.475	.051	−1.27	14
			(.12)	(.06)		
Constant			34.89	2.55		
R^2			.614	.426		
Percentage dwelling units in structures built in:						
X_4 1910 - 19	18.6	21.6	.786	.103	.85	.14
			(.58)	(.16)		
X_5 1900 - 09	20.1	18.3	.376	.478	.37	.63
			(.32)	(.20)		
X_6 1890 - 99	14.0	8.2	.763	−.289	.60	−.34
			(.42)	(.24)		
X_7 1880 - 89	7.8	3.4	−.555	−.554	−.34	−.35
			(.55)	(.59)		
X_8 1860 - 79	5.7	2.2	.736	1.65	.71	1.07
			(.52)	(.57)		
Constant			−18.90	2.86		
R^2			.355	.632		

SOURCE: *Sixteenth Census of the United States,* 1940, *Reports on Housing,* II, *General Characteristics of Housing by States,* Part 1, Tables 32, 33, 57; *Population,* Vol. I, pp. 19, 30.

[a] Northern states.

[b] Southern and Pacific states.

ysis are presented for statewide returns in Table A-1 differentially for 21 northern states and 27 southern and Pacific states. The regression was based on the suppositions that older and single-family buildings would be more prone to conversion on the supply side, and that demand for converted facilities would be generated by a higher proportion of nonwhites and foreign born. Hence, in the first regression model, conversion ratios were regressed against median age of housing stock, per cent of single-family structures in housing stock, and nonwhites and foreign born as a per cent of total population.

This complex of influences "explained" 61 per cent of the variation in conversion rates in northern and central states but only 43 per cent of the variation in southern and Pacific states. Though the "fit" was more successful in the northern states' regression, the explanation was poorer. The signs are all wrong and, in any case, the age fraction showed up as an unimportant influence. The explanatory variables themselves were closely interrelated. The southern and Pacific regressions exhibit a preponderant influence of age on per cent of conversion. Each year of median age was associated with a .31 ± .12 per cent increase in the conversion rate. The relative influence of the other two forces was much smaller.

The influence of age on statewide conversion ratios was isolated in a second regression of conversion percentage on vintage patterns, i.e., the per cent of housing stock originating in periods from 1860 to 1919. Here, again, the southern and Pacific regression showed the preponderant influence, with an "explanation" of 63 per cent of the variance against 36 per cent for the northern group. Northern housing stock built in the 1910's, 1890's, and 1860-79 and southern and western stock erected in the 1900's and in 1860-79 seemed prone to conversion.

While these regressions exhibited a clear influence of age on conversion in the southern and western states, the relationship was more doubtful for the northern states. Hence, it seemed desirable to consider individual northern cities drawn from a relatively homogeneous group of eastern seaboard states. It was decided to permit the influence of age of housing stock to be measured by the per cent of stock found in structures built from 1880 to 1910. A tendency toward conversion of older buildings should be picked up by this measurement. The other factor with a significant relationship was percentage of single-family structures. Experimental regressions indicated the unimportance of minority share of population and average city size. The cities were grouped into those with population between 50,000 and 99,000, and those with more. The results are set forth in Table A-2. Both regressions were equally successful for

TABLE A-2

MULTIPLE REGRESSION PERCENTAGE URBAN DWELLING UNITS CONVERTED, 67 EASTERN SEABOARD CITIES OVER 50,000 POPULATION, 1939 CENSUS

Variable or Item	*Mean Value Variable, by Size Class* Small Cities[a]	Large Cities[b]	*Regression Coefficient (Standard Error)* 35 Cities	32 Cities	*Beta Coefficient* 35 Cities	32 Cities
X_1 Single-family structures as per cent of total units	37.1	31.8	.189 (.05)	.058 (.08)	.55	.11
X_2 Units in structures built between 1880 and 1910	44.7	46.7	.10 (.04)	.157 (.04)		.58
Constant			−1.46	−.198		
R^2			.360	.364		

SOURCE: *Sixteenth Census of the United States,* 1940, *Reports on Housing,* II, *General Characteristics of Housing by States,* Tables 74, 76.

NOTE: Eastern seaboard cities are in Mass., R. I., Conn., N. Y., N. J., Pa., Del., Md.

[a] 35 cities between 50,000 and 99,000 population.

[b] 32 cities over 100,000 population.

"fit" (R^2 of .36 and .364), but the primacy varied. Conversion ratios in small cities were preponderantly affected by the relative importance of single-family structures; the ratios in large cities were more affected by the relative share of buildings thirty- to sixty-years old.

Only tentative and guarded conclusions can be drawn from these regression runs. Clearly, there is some influence of age on conversion activity. A 1 per cent increase in the per cent of units in structures 30-60 years old in northern seaboard cities raised the conversion rate by .1 to .16 per cent; and a year of additional median age added .182 (.09) to the nationwide conversion percentage. If age were without influence on conversion activity, then 88.1 per cent of converted properties would be of recorded post-1890 vintage. The assumption here is that 76.7 per cent are actually so recorded or that an additional 362,000 units were converted solely on account of age.

2. "Other dwelling places" was defined in the 1940 Housing Census as inclusive of "tents, trailers, tourist cabins, boats, railroad cars, dugouts, and shacks when occupied by households having no other place of residence." Also included are "garages, warehouses, fruit sheds, barns, caves" when used as places of residence. All these dwelling places, totaling 147,000 units, should be excluded from the standing stock to determine the accuracy of building permit statistics. Transient hotel rooms, missions, cheap overnight lodging houses, dormitories, and institutional accommodations (religious, educational, medical, military, orphanage) are all excluded from the other dwelling places category and from the definition of dwelling units.[84] It seems unlikely that many nonhousekeeping accommodations without plumbing or permanent cooking facilities would have been classified in the 1940 Census as dwelling units, since without such facilities the accommodations would fall under the transient category. In any case, most of the nontransient nonhousekeeping accommodations would either have been converted or would have fallen under the other dwelling places category. It is true that the 1940 Census enumerated 4,712,000 units without running water. That these are bona fide dwelling units with housekeeping facilities is indicated by the fact that 79.5 per cent of these units were one-family structures with little likelihood of converted origin. They were predominantly (90.4 per cent) located out of central cities of over 50,000; some two-thirds of the units were rural nonfarm, widely distributed in the north central and southern states.

[84] See "Introductory Comments," *Sixteenth Census*, 1940, volumes on Housing.

Hence it seems fair to infer that few dwelling units enumerated as such in the 1940 Census were of the nonhousekeeping variety, aside from units placed in a "converted" or "other dwelling places" category.

3. The last minus item, farm units transferred to nonfarm stock, is difficult to track down. The numbers of farm units converted to nonfarm stock for the 1940's and 1930's are estimated at 1,250,000 and 91,000, respectively.[85] The rate of conversion increased, partly because of tendencies to urban sprawl in rural surroundings and partly because the number of farm families has declined at a rapid rate since 1940. Since the number of farm families was slowly growing from 1890 onward to 1940, our estimate of 150,000 seems acceptable.

4. The above figure is an order-of-magnitude allowance rounded to the nearest 50,000 mark. The GBW estimates for demolition and other shrinkage between 1890 and 1940 appear unaccountably low, allowing for 1,916,000 units or 9.64 per cent of estimated starts over the same period. This involves an average annual loss rate to stocks of around 0.2 per cent. The vintage report indicates that the 1890 housing stock experienced a compound annual loss rate of 2.09 per cent and an aggregate loss of around 5 million units over the fifty years (see pp. 8, 45). Even if this is cut down by 40 per cent—our maximum allowance for excess estimation —it still exceeds shrinkage allowances implicit in the GBW estimate. However, we may be able to make use of Wickens' estimate for loss by fire and demolition, which for the twenties sets this loss at 43.1 per cent of total losses for the decade, or 25,000 units per year. If we convert this into a decade rate per unit of housing stock and apply this rate to other average decade stocks, we derive an aggregate loss by fire and disaster of 1,005,000 units. This is within 20 per cent of the fire and disaster loss resulting from application of the Wickens' 43 per cent to total loss otherwise estimated by GBW. If we then use vintage aging and mortality patterns for stock of pre- and post-1890 vintage and assume that fire and disaster loss does not respect age, we accumulate a fifty-year total of fire and disaster loss of 693,000 units of stock of post-1890 vintage. If we accept this figure and add a mere token quantity of demolition at a rate of 0.06 per cent per year on the average post-1890 stock, we derive an accumulated total of 300,000 units or an average demolition loss of 6,000 units per year. This yields a total loss of a million units, which does not appear excessive considering the age distribution, rates of urban growth, and changing patterns of land use.

[85] See GBW, p. 373.

5. The above is an allocation to post-1890 production of the 7.92 per cent of housing units for which information on year built was not obtained. The 2,352,700 units involved were broadly distributed by regions and structural types. Nonreporting was more characteristic of units located in multifamily structures and possibly for that reason was more characteristic in larger cities and in regions of old settlement. There is a clear progression from 6.0 per cent for single-family detached units to 11.9 per cent for units located in structures containing twenty units or more. As expected, owner-occupied units are nonreported by only 4.5 per cent, tenant-occupied units, 10 per cent. Urban rates as a whole are, however, only slightly higher than nonurban, and there is very little progression through the urban size-class. The principal metropolitan district (PMD) rate (8.5 per cent) compares to urban outside PMD (8.3), all cities over 50,000 (7.2), rural nonfarm (6.0). The regional layout of nonreporting ratios correlates with the age layering and also with emphasis on multiunit building. Thus the six main regions have conversion rates, nonreporting rates, and median age as follows:

States	*Conversion Rate, Urban*	*Nonreporting Rate, All Units*	*Median Age, Urban*
	(per cent)		
New England (all units)	9.3	13.76	34.5
Middle Atlantic	10.6	12.70	29.2
East north central	13.1	5.42	27.6
West north central	15.2	4.67	29.8
South	14.2	5.74	21.6
West	10.7	4.40	19.5

SOURCE: 16th Census, *Housing*, II, 1943, Tables 33 and 57.

Different forces are at work in the regions, so that no clear association prevails between conversion, nonreporting, and median age. The regional patterns indicate that older buildings in New England and in the Middle Atlantic states were more likely to be unreported for vintage. But, in the four other regions, age and nonreporting did not correlate positively. We tested the aggregate correlation indicated in the Northeast by inquiry into patterns of behavior of individual cities. Scatter diagrams relate reporting percentage in eastern cities to median age and, separately, to percentage of units built between 1880 and 1910. A wide scatter was indicated with only a slight tendency for an inverse relationship of higher age with reporting percentage. It is doubtful that multiple correlation would sustain this result and, in any case, considerable experimentation would be needed to design a useful model. At least in two regions with a

wide age spectrum, these diagrams indicate that advanced age in measurable form did not correlate positively with nonreporting.

Notwithstanding this negative result in the two regions, it would be extreme to assume that 87.6 per cent of nonreporting units were of post-1890 vintage. The most recent decades can surely be recalled more easily, the more remote with difficulty. We allow for this tendency generously—in view of the evidence—by crediting the same tendency for association of age with nonreporting that we allowed for conversion. This credits 1,805,000 nonreporting units or 76.7 per cent to post-1890 vintage.