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3. SUMMARY OF ESTIMATING TECHNIQUES

MOST MAJOR attempts at estimating nonfarm residential construction from building permit data have used relationships based on some variant of population to expand data on building permit records of a sample of cities to total urban or total nonfarm estimates. David L. Wickens, whose estimates of nonfarm dwelling units started in the 1920-29 decade now form part of the official government series on dwelling unit starts, and Lowell J. Chawner, whose estimates of expenditures for housekeeping dwelling units underlie the official expenditure series for the years 1915-28, are the two most important examples of investigators who have used this general approach.[1] The urban component of the current official series on nonfarm dwelling units started and expenditures for such units, prepared jointly by the Bureau of Labor Statistics and the Department of Commerce, is similarly derived by use of population relationships applied to building permit data for reporting cities.[2]

There are two basic reasons for this dependence on population relationships. First, there is general agreement that population and its changes bear a close relationship to the volume of building. Wickens, for example, found a high correlation between dwelling unit building rates and population increase among the 257 cities in his sample for the 1920's.[3] Newman concluded that

> "there is strong statistical support for the hypothesis that the volume of building activity . . . is greatly influenced by the underlying population movements."[4]

Second, population at censal dates is the only economic indicator available for historical periods for units as small as cities.

Past estimates of aggregate building have differed in the particular characteristic of population which has been used in deriving the aggregate estimates. Chawner employed building rates based on absolute population to obtain his estimates of residential construction. The current expansion procedures used in obtaining the small nonreporting component of the urban segment in the official government series on dwelling units started and expenditures for such units essentially involve an approximation of building rates based on absolute population.

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[1] David L. Wickens, *Residential Real Estate* (National Bureau of Economic Research, 1941), Chap. V.; and Lowell J. Chawner, *Construction Activity in the United States, 1915-37* (Department of Commerce, 1938), pp. 38-45.

[2] The rural nonfarm component has been estimated in various ways over the past three decades. For a discussion of the present method of obtaining estimates of rural nonfarm dwelling units started, see Dorothy K. Newman, "Estimating National Housing Volume," *Techniques of Preparing Major BLS Statistical Series,* Bureau of Labor Statistics *Bulletin No. 993* (1950), pp. 16-17.

[3] Wickens, *op. cit.*, p. 43.

[4] William H. Newman, *The Building Industry and Business Cycles,* Studies in Business Administration,V, No. 4 (University of Chicago Libraries, 1935), 36.

Wickens, on the other hand, employed one specific measure of the decade change in population, i.e. the change in number of families (now termed "households"). He argued that "any per capita building rate computed on the basis of total population in a city or other area at a given time is essentially an average of *new* building related to 'old' population. It assumes, and imposes on the figures, a relationship that does not exist except indirectly, since over a period of years dwelling units equal to 85 to 90 per cent of all residential building have been required to house the *increase* in population, with only 10 to 15 per cent to replace losses of dwellings occupied by the 'old' population and maintain a supply of vacant units. Consequently, per capita building rates applied to the population in unreported areas produce erroneous results unless adjusted for differences in the rates of growth of the reporting cities and unreported areas."[5]

Scatter diagrams of the sample data used in this study confirm Wickens' view and indicate that population change is more closely related to residential building than is absolute population.

A second general principle of residential construction estimation has been stratification. All investigators have classified their sample data into what were considered to be homogeneous subgroups. The estimating techniques were then applied separately to each cell and the results summed to obtain estimates of total urban or nonfarm residential building. Various combinations of three criteria for stratification have been employed: regional location, city size class, and relation to metropolitan districts. Wickens classified his data by geographic divisions and, within each division, into six classes: central cities, satellite cities, nonmetropolitan district cities, both urban and rural environs within metropolitan districts, and rural nonfarm areas outside of metropolitan districts. Chawner classified by city size class and by location inside or outside metropolitan districts. The current estimates of the Bureau of Labor Statistics and Department of Commerce are based on a divisional and a city size classification.

The factors which argue for stratification, it is generally held, include differential rates of growth among size classes and divisions and differential rates of demolition and vacancy among size classes and divisions. Both of these lead to differing building rates among the various subgroups, whether these rates are calculated on the basis of absolute population or population change. To these factors can be added, for the purposes of this study, the variation among divisions and, within each division, among city size classes of the average construction expenditure per dwelling unit. It was found in the present study, for example, that the average permit valuation per dwelling unit in the Middle Atlantic division in 1915 for each of seven size classes clustered around $3,000, while the average permit valuation per dwelling unit in the South Atlantic division during the same year clustered around

[5] Wickens, *op. cit.*, p. 43n.

$2,000. Similar variations were found among size classes within a single division. For example, the average permit valuation in the New England division in 1915 ranged from about $3,000 in cities over 500,000, viz., Boston, to about $2,000 in cities of 50,000 to 100,000 population.

In general, the procedures employed in this study follow those used in the BLS-Commerce estimates. For the urban component, the estimates of residential construction were developed in two stages.[6] First, annual estimates of the number and permit valuation of housekeeping dwelling units started and of permit valuation of nonhousekeeping residential facilities started were developed for each of four city size classes in each of the nine censal divisions: 36 regional-size groups. These estimates were based on simple population relationships between reporting and nonreporting cities. Second, for three sample divisions (12 regional-size groups) similar estimates were developed based on relationships between population *changes,* corrected for annexations, in reporting and nonreporting cities. The ratios between the first and second sets of estimates for the sample divisions were applied to the original estimates for the remaining six divisions in order to allow for differential rates of growth in reporting and nonreporting cities. These corrected divisional estimates were summed to yield annual estimates of total urban housekeeping dwelling units started and of the permit valuation of urban housekeeping and nonhousekeeping facilities started.

Estimates of total nonfarm dwelling units started were derived by applying to the estimates of urban dwelling units started relationships based on population *change* of urban and rural nonfarm areas, corrected for reclassification of areas from rural to urban status. After these ratios were adjusted for the lower average construction expenditure for rural nonfarm dwelling units, the same procedure was employed to derive total construction expenditures for nonfarm housekeeping construction, again at permit valuation. Rural nonfarm expenditures for nonhousekeeping residential facilities were obtained by applying to rural nonfarm population the building rates calculated for small cities.

The series on nonfarm expenditures for both housekeeping and nonhousekeeping residential facilities were further adjusted to take account of the typical undervaluation on permit applications of final construction costs and the exclusion from the permit valuation estimates of several elements of cost included in the purchase price of the facilities. Finally, the expenditure series were converted to a work-put-in-place basis by applying ratios considered to represent the standard carry-over of construction activity from one year to the next.

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[6] The definitions of urban and rural used in this project are identical with those of the Bureau of the Census prior to the revisions for the 1950 Census of Population. Under the pre-1950 definitions, urban areas consisted primarily of cities and other incorporated places of 2,500 inhabitants or more. All territory outside of these areas was considered rural; rural population was classified into rural farm and rural nonfarm on the basis of farm residence.

These procedures accord with the view that population change is more closely related to residential building than is absolute population. The reliance upon population change, rather than change in the number of families, was conditioned by two factors. First, it would have been impossible for at least two of the four decades under study to obtain reliable family estimates in the detail required for the estimating procedure, without an expenditure of time beyond the resources of this study. Second, the advantages in using family change data, i.e. differences in the ratio of new families formed to change in population among the several divisions and city size classes, were considered matched by the stratification into regions and city size classes. The estimate for each such cell was, in general, derived independently on the basis of sample data within the cell. It can be assumed that the building permit and population data for a given cell carried implicitly within them the family and other relationships which distinguished this cell from cells in other divisions and from cells for other size classes.[7]

The detail of stratification employed in this study was about as great as that used in most other attempts at estimating aggregate residential construction volume, although one criterion of classification which has been used on occasion, viz., relation to metropolitan districts, was not utilized. In view of the long time period under investigation and the changes in definitions, coverage, and number of metropolitan districts during this period, it would have been far too cumbersome to trace the status of all the cities in the sample in respect to their inclusion in, or exclusion from, metropolitan districts.

It is believed that the estimating procedures have led to series on residential construction which are reasonably accurate with regard to both level and year-to-year movement. Because of the smaller size of the sample in early years and the use throughout the period of constant adjustment factors, derived from more recent years, the margins of error are probably greater during the first few years of the new series than for the later years. Further, the use of constant adjustment factors may result in some error in the several years in which construction activity was changing very rapidly, e.g. 1919-20, although this error can have been of only minor importance during most of the period under study. A full description of the estimating procedures is given in Section 5.

[7] Thus, the estimates derived through stratification into city size classes also partially reflected the influence of absolute population upon building rates.