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PART VI

THE VOLUME OF CONSTRUCTION

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PREFACE

1 PROBLEMS OF DEFINITION AND MEASUREMENT

THE statistical analysis in the preceding Parts dealt chiefly with the flow of finished movable commodities from their producers to their ultimate recipients and consumers. It failed to measure the volume of an activity that is an important element of the process of capital formation, viz., construction. To this task, made difficult by lack of adequate data, Part VI is devoted.

Construction, in the broadest sense of the word, includes all work performed in erecting buildings or other structures (such as bridges, subways, roads) which upon completion become integral parts of the landscape, i.e., cannot be detached from it except at a great loss in their value. It embraces not only the construction of new residential, industrial, or other structural units, but also repairs, alterations, remodeling, and renovation of the already existing construction units. And it covers not only work done by construction companies or firms specializing in repairs and alterations, but also work by other enterprises whose main activity is quite distinct from construction proper.

Whether the field is defined broadly or narrowly, there are few inclusive and reliable measurements of construction activity. The first census that attempted to report data for construction companies (since 1900) was that of 1929. Close analysis of its results suggests that its coverage is somewhat deficient even in the field it proposed to cover, and it omits, by intent, the very substantial volume of construction carried on by business enterprises on force account. A new census of construction has been taken for 1935, with results that again indicate incomplete coverage. Meanwhile, the obvious importance of the industry in the changing economic conditions of the country has directed to it the attention of statisticians and economists who, utilizing various sources of information, have attempted to arrive at comprehensive estimates of all construction. Such efforts are still being made, and with the continuous accretion of information and increasing ingenuity of the methods applied, this field of statistical measurement is in unceasing flux. Any estimates, no matter how thoroughly and ingeniously worked out today, will be open to revision within a short time. This qualification attaches to the results of the statistical analysis in this Part of the study to an extent much greater than it does to the estimates presented in the other Parts.

For purposes of measuring construction activity which, with its durable results, constitutes properly a part of the process of capital formation, the estimates should include not only the work of construction companies but also that of other business or public enterprises on force account. Because of the partial character of the various types of data in the field, the first task was conceived to be that of measuring in the most comprehensive fashion all construction activity. This conception was strengthened by the possibility of measuring, in the study of the commodity classification of manufactured products which was undertaken as the first and basic step in our measurement of the flow of movable commodities, the volume of construction materials produced. Since almost no construction activity fails to utilize some construction materials, data on their production provide both a basis and a convenient starting point for estimating total construction activity. Consequently, the first section of the ensuing statistical analysis is devoted to deriving a comprehensive estimate of annual construction activity based largely upon the flow of construction materials into consumption.

As will be shown presently, this comprehensive estimate of total construction could be derived only by commitment to numerous subsidiary assumptions and by recourse to information exceed-

ingly fragmentary in its coverage. With the resulting qualifications attached to the estimates, it became important to check them by measures based upon independent data. Furthermore, even on the assumption that the comprehensive total of construction derived from the consumption of construction materials is accurate, it is unsatisfactory for our purposes in two respects. First, the methods do not make possible an allocation of total construction by the characteristics of the ultimate user, i.e., a distinction between construction of residential units, business construction, or public works. Since a classification of capital formation by the type of user for whom it is destined is of great analytical value, it would in any event have been advisable to supplement the global estimates of total construction by an estimated apportionment of the total among various types of user. Second, a most important drawback from the viewpoint of this study, estimates based upon the consumption of construction materials naturally cover not only new construction and substantial additions and alterations but also the minor activities of renovating and repairing. Inasmuch as by definition capital formation should include only those activities that result in durable products, it should exclude construction work whose results do not last more than three years. The global estimates of construction, which include what might be called non-durable construction products, are obviously too comprehensive for the purposes of this study; and would have to be adjusted in order to fit our definition of capital formation.

For these reasons, the second section of the statistical analysis is devoted to an estimate of construction by type, based upon data independent of those on construction materials produced or consumed. In the attempt to arrive at this second estimate reliance was placed upon the results of work by other investigators in the field, these results being supplemented only at points at which the accession of new data and the unsuitability of the estimate to the particular purpose at hand made such additional work possible and necessary. The annual estimates of construction by type, thus derived, can claim a fair degree of completeness so far as new construction is concerned. They cover some of the more extensive repairs and alterations, as well as almost all maintenance in public utilities and some maintenance in public works; but omit most maintenance and all minor repairs and alterations in the other fields of construction work.

In the third section of the analysis the two estimates are compared, account being taken of th difference in the scope of their coverage. Th global estimates, based on the consumption c construction materials, are naturally larger tha those resulting from the measurement of construc tion by type. But it is important to determin whether the excess is approximately of the magni tude that is likely to characterize the value o construction omitted in the estimate of construc tion by type. While data on the amount of thes omitted activities (minor repairs and alteration maintenance, etc.) are almost completely lacking scattered samples indirectly shed light on the ap proximate magnitudes involved.

According to our definition capital forma tion should include durable construction alone Consequently, the estimate of new construc tion and of major repairs and alterations is ac cepted finally as a measure of the construction element in capital formation. The global estimat of all construction, too comprehensive for ou purposes, is not used after it has been studied a an approximate check upon new construction b type. It retains, however, independent value; and may be utilized, fully or with some scaling down by those investigators who are interested in a meas urement of construction activity broader than tha finally chosen in this study.

Both estimates measure construction at the cos of work done. For alterations, repairs, or construc tion done directly by the producing unit for th ultimate recipient or consumer, this is an appro priate basis of measurement, since it reflects th cost of the product to the ultimate consumer o recipient. But in new construction, particularl residential and especially during boom years, ther may be extensive building undertaken by con struction or real estate firms not on order but fo stock, and in the expectation of selling it upo completion for a price significantly higher tha the cost of construction. In other words, there ma be margins added to the value of construction, be yond the production cost covered in our estimates

This addition to the value of construction be yond the actual production cost may be appreci able; and only a minor fraction of it, if any, i likely to be covered in the construction estimate below, as is clearly demonstrated in the more de tailed account of the procedures. It is doubtful however, that such a discrepancy between th value of new construction at the point of comple tion and its cost to ultimate consumers should b included in our estimates. First, the sales value in cludes the value of land, whose appreciation o

depreciation is no proper part of capital formation. In fact, straining the point, one might say that the margins in question could all be attributed to changes in the value of land rather than to those in the cost of the construction work. Second, there is a general question whether the value discrepancies can be conceived as payment for productive services, as they are in distributive margins in trade, or whether they should be conceived as speculative gains or losses on already existing capital units. The latter interpretation is plausible, and, if adopted, would bar the inclusion of these value discrepancies in capital formation. In any event, lack of appropriate data makes it impossible to measure construction except on a cost of production basis; and hence the estimates of construction presented below omit all discrepancies between the cost and the price charged to ultimate consumers. The only reflection of such discrepancies would be in the gross profits of construction firms, an item utilized directly in the global estimates of construction based on the consumption of materials and included also in most of the component parts in the estimate of construction by type.

The order of statistical analysis has already been indicated. By separating the lengthy series of steps leading to the global estimate of construction into two divisions we obtain the following rough outline: (a) derivation of the value of construction materials consumed; (b) determination of the ratio of the value of construction materials consumed to the total value of construction, and of a comprehensive estimate of the latter; (c) derivation of the value of construction by type; (d) comparison of the estimates obtained under (b) and (c), with an attempt to reconcile them, and choice of the measure to be used subsequently in striking the total of capital formation.

2 VALUE OF CONSTRUCTION MATERIALS CONSUMED

The derivation of the annual value of construction materials consumed repeats the successive steps in estimating the flow of movable finished commodities to ultimate consumers: the measurement of production in census years, the interpolation for intercensal years, the distribution of sales, the addition of transportation and distributive margins, the adjustment for imports and exports, and the correction for changes in inventories needed in order to pass from production to sales totals or from purchase to consumption totals. The only difference from the analysis developed in Parts I through V is that we deal here with construction materials, instead of finished commodities.

As for finished commodities, the basic step is to segregate construction materials from other manufactured commodities. This segregation was carried through in Part I in the general commodity classification; and its trustworthiness can be verified only from a careful inspection of the various decisions made (see Tables I–1, I–2, I–3, and I–5, especially Tables I–1 and I–3). In characterizing some of the commodities as construction materials we were guided partly by the list in the Census of Construction for 1929 and partly by general knowledge. As in other commodity classes, commodities were considered as belonging fully to the group, when only an insignificant fraction was utilized for other purposes. When this fraction was of significant magnitude, i.e., exceeding 3 to 5 per cent, the commodity was classified as mixed and a special effort was made to divide it between construction materials and that used for other purposes. In almost all such cases the breakdown of the mixed commodity total had to be based on special information, rather than on the distribution of sales or data on consumption of materials in manufactures. The value of construction materials obtained by such a breakdown of mixed commodity totals accounts in 1929 for 31 per cent of total construction materials, 69 per cent being accounted for by commodities that could be directly classified as being almost wholly construction materials.

As a base for measuring all construction activity such segregation of construction materials contains, on the face of it, some elements of exaggeration. First, the classification of some commodities as wholly construction materials, even though some small share of them is consumed in other uses, leads to an overestimate of the amount of construction materials produced. On the other hand, such exaggeration is perhaps offset by a failure to include small shares of other commodities used in construction that are being utilized almost wholly in other fields. For example, tar was considered as a construction material, even though a small share of it might be used otherwise, while linseed oil was considered as a completely unfinished commodity, even though a small share of it may be used by house and other construction job painters for mixing with dry lead to prepare the paints used in construction work. Nevertheless, the extent of exaggeration may still possibly be in excess of the omissions although, at its highest,

it is not likely to be more than 3 per cent of the grand total.

The second element of possible exaggeration lies in the fact that in most construction materials included, the values cover consumption by household consumers, in addition to that by construction enterprises or other business and public units. That the activity of a household consumer in painting the porch of his house or in using lumber to build a partition can properly be characterized as construction activity is open to doubt. But it is equally to be doubted that the amount of construction materials thus consumed is significant in comparison with the amount consumed in construction activity proper.

After the value of materials produced by manufacturing enterprises in each census year has been established, several sequential steps lead to the measurement of the annual flow of construction materials from their producers into the various distributive channels. The several columns in Table VI–1 and the notes to it reveal these steps and indicate the magnitudes appearing at the successive links of this chain of estimates.

First, the value of manufactured construction materials must be supplemented by that of non-manufactured materials (Note A).[1] Second, the values for intercensal years must be obtained, the interpolation being carried through with the help of a special index of production of construction materials compiled upon the basis of currently available series (Note B). Third, the movement of inventories of construction materials held by producers must be estimated so that production can be translated into flow to distributors and consumers. Since the stocks and production data currently available are in quantity units, production of all construction materials must be expressed in similar units, i.e., in terms of a constant price level. The indexes of prices utilized for this purpose as well as for the subsequent translation of changes in inventories back into current prices are assembled in Note C. Note D describes the derivation of the inventory-production ratios for 1929 and of the index of estimated changes in this ratio for the other years in the period. Fourth, the transportation charges must be measured at this stage, in accordance with the usual assumption that most of the transportation occurs at the point of flow from the producers of the commodities. Here we utilize again the basic information on steam railroad freight charges for 1928, interpolating the values for the other years in the period on the basis of an index of over-all freight rates (see Note E). Finally, the flow of commodities from producers, at producers' values, is apportioned among the various channels of immediate destination, i.e., among direct sales to consumers, sales to wholesalers, and sales to retailers. This apportionment is based on the distribution of products of manufacturing plants for 1929 (Census data), and is held constant for the other years in the period.

Each of these steps entails one or more assumptions concerning the changes introduced into the flow by the successive links from production to sales flowing into various channels. Two of these assumptions seem of particular importance. First, the utilization of the freight rates data to measure transportation charges implies that other methods of transporting construction materials are relatively unimportant, or, if significant, are not materially different in respect of cost from railroad transportation. In view of the possibly extensive use of water transport for the bulkier construction materials, and the lower cost of this method of transportation, this assumption, forced upon us by lack of data, may serve to exaggerate the cost of construction materials to purchasers, and would eventually lead to an exaggerated estimate of construction. But some fragmentary data indicate that the probable extent of such exaggeration is narrowly restricted. First, of the important construction materials, only sand, gravel, stone, and lumber are transported extensively by water. Second, the freight rate per ton transported by water is only about 20 per cent lower than that for railroad transportation (although the average haul is appreciably longer). Third, we do not allow for any transportation charges at later stages in the movement of the materials except that by wholesaler or retailers (the cost of transportation by them would then be included under the distributive charges)—an omission that tends to offset partly any exaggerations in estimated transportation charges.

The second important assumption is that implied in holding the proportionate allocation of 1929 sales constant throughout the period. Such constancy is not likely, and its effects on the resulting estimates might make for a significant deviation from the truth, because of the large share of production sold directly to ultimate consumer

[1] Neither non-manufactured fuel, such as coal, nor manufactured types, such as gasoline, have been included among construction materials. Whether or not this omission reduces the final estimates of total construction depends upon the treatment of these materials in the Census of Construction. If fuels were included among 'other construction materials' then their omission here leads to an underestimate.

see in this connection the different situation in ne case of movable commodities, as was empha- zed in the Preface to Part V). One would expect nat the share of direct sales to ultimate consumers as on the whole increased over the period, at the xpense of the share of sales to retailers and to holesalers. If it has, a correct measure would show ss of an upward trend in the cost of construction naterials toward 1929 and less of a decline after 929. But as will be seen in Table VI–10, the lobal estimates even as derived now, rise less be- ore 1929 and decline less after 1929 than the esti- nates of construction by type. Thus the removal f this assumption would only accentuate the dif- erence in movement already existing between the stimates based upon consumption of construc- ion materials and those based upon other, less omprehensive data.

The flow of construction materials to and from holesalers is set forth in Table VI–2. In accord- nce with our usual assumption we take account f imports and exports at the wholesale trade link n the distributive system. In addition to this ad- ustment for imports and exports, tracing the flow hrough the hands of wholesalers involves the con- ideration of possible changes in inventories held y them, of the mark-up received by them, and of he division of their sales between sales to retailers nd direct sales to ultimate consumers.

The details of the adjustment for imports and xports appear in Note A to Table VI–2. Since the et balance of foreign trade in construction mate- ials is but a small percentage of total production, he ratio of 1929 was applied in the adjustment for ther years. Inasmuch as exports exceed imports, his correction results in lowering slightly the alue of materials consumed within the country, nd hence the value of domestic construction.

The measurement of changes in inventories is ased largely upon the ratio for 1929 and 1933 of nventories to cost of goods sold (from the Census f Distribution and the Census of American Busi- ess), and an index of this ratio for other years ased partly upon sample data, partly upon its ovement in the case of producers of construction naterials (Note B). The inventories thus esti- nated are in current valuation and can be utilized ithout conversion to a constant price basis, since ne distributive margins are also defined upon the asis of considering beginning and year-end in- entories at current valuation.

For measuring these distributive margins and ne allocation of sales by wholesalers among re- ailers and ultimate consumers the Census of Dis- tribution for 1929 again provides the basic mate- rials (Note C). The movement of the margins for years other than 1929 is assumed to follow the gen- eral changes in distributive margins established from the survey in Part IV for trade as a whole. The allocation of sales is assumed to be constant throughout the period in the proportions that can be established for 1929; with effects on the final estimates similar to those implied in holding con- stant the allocation of sales by the producers of construction materials.

These procedures parallel clearly and rigidly those followed for the various groups of finished movable commodities in Parts II, III, and V, the problem and the materials at hand being similar in all. The same is naturally true of the tracing of the flow of construction materials beyond whole- sale trade, i.e., to and from retailers (Table VI–3). Here, in order to pass from the flow of commodi- ties to retailers (whose volume is taken directly from Tables VI–1 and VI–2) to sales by them, two adjustments must be made: one for inventories, in their current valuations, the other for the dis- tributive margins. The basis for both these adjust- ments is largely information derived from the Census of Distribution, as well as from some frag- mentary sample data (see Notes A and B to Table VI–3).

The preceding analysis traced the flow of con- struction materials to their consumers; the value of the flow at that point can now be obtained by summation of direct sales to consumers by pro- ducers (Table VI–1), by wholesalers (Table VI–2), and by retailers (Table VI–3). At a similar junc- ture in the flow of finished movable commodities our analysis was complete, for what happened to these commodities once they reached their ulti- mate consumers or holders was no part of the measurable process of capital formation. But the flow of construction materials to consumers is of interest only as an indication of the value of con- struction. Consequently, the analysis must be pushed further, and a transition made from the flow to consumers to the actual consumption of construction materials in the process of construc- tion.

This step involves a correction for changes in commodity stocks in the hands of consumers of construction materials, so measured as to reveal actual net drafts from current flow into stocks or from stocks into consumption. The adjustment is presented in Table VI–4, and the basis for it de- scribed in Note A to that table. The inventories of construction materials in the hands of their con-

sumers are estimated for the years since 1926 on the basis of data on inventories held by construction corporations; and for earlier years are extrapolated from the 1926 level by an index reflecting the inventory-production ratio for producers of construction materials. When the relevant price adjustments are made, we arrive at the estimated annual consumption of construction materials, and are ready for the next important step in the procedure, viz., the passing from the consumption of materials to the total value of construction.

3 RATIO OF VALUE OF CONSTRUCTION MATERIALS TO VALUE OF CONSTRUCTION, AND DERIVATION OF THE GLOBAL ESTIMATE OF TOTAL CONSTRUCTION

The annual estimate of the final cost of construction materials consumed having been derived, the analysis reaches the most difficult step in obtaining the global estimate of total construction, that of ascertaining the ratio of the value of construction materials to the value of total construction. The difficulty arises from the extreme paucity of data bearing directly upon this ratio. With such data scarce, one might consider the possibility of using information available on similar ratios in other branches of industrial activity. But construction differs so distinctly from either extractive or manufacturing industries for which such data are available that there seems little justification for attempting to estimate by analogy. It is thus necessary to confine the analysis, at least at first, to the scant data that bear directly upon construction activity.

The ratio of materials to the total value of construction is different for various types of construction activity and may vary for each type from year to year. The statistical problem is thus to estimate the changing magnitude of the ratio in total construction whose variations may arise from two sources: changes in the ratio within each of the specific types of construction, and shifts in the relative importance of these types within total construction. Moreover, some of the data for years other than 1929 bear upon the ratio of construction materials, not to the total value of construction, but to the amount spent on materials and on wages and salaries (i.e., on the ratio largely to prime costs). Accordingly, it is advisable to distinguish in the present analysis three stages: (a) measurement of the ratio of the value of construction materials to the combined total of materials plus salaries and wages; (b) estimate of the ratio of the value of construction materials plus salaries and wages to the total value of construction activity and since the analysis under both (a) and (b) i for the distinct types of construction activity, ther follows (c) measurement of changes in relativ importance of various types of construction activ ity in the total, as a basis for applying changing weights to the results obtained under (a) and (b)

For the first two stages of this analysis the Cen sus of Construction provides the basic data fo 1929. The information available in the Censu makes it possible to compute for 1929 the ratio o the value of construction materials consumed t the combined total of materials plus wages an salaries; and the ratio of the latter combined tota to total value of construction, i.e., the relative gros profits (see detailed account in Note A to Tabl VI–5). Of course, the Census covers only wor done by construction firms, and excludes wor either by repair and maintenance firms or by othe units whose main activity is distinct from con struction proper. For lack of further information it is assumed that the cost ratios in these omitte types of construction activity are identical wit those established for the contract constructio firms. The eventual effect of this assumption o the final estimates is discussed below.

The next task is to estimate changes during th period in the ratio of the value of constructio materials to prime costs. The materials availabl for this purpose are for the State of Pennsylvani for the first three years in the period, and data o construction payrolls since 1929.[2] Such a scarcit of data imposes two limitations on the task as orig inally formulated. First, it is impossible to estimat changes in the ratio for each type of constructio activity separately; and we proceed upon th assumption that, at least before 1929, relativ changes in the ratio are uniform throughout th whole field of construction activity. Second, for th years for which no direct evidence is availabl (1922–28), the analysis uses subsidiary data o prices of construction materials and labor, whic make it possible to interpolate the values of th ratio index for the missing years.

The details of this rather tenuous procedure ma be seen in Notes A and B to Table VI–5. Takin the ratio for 1929 as the base for the index, we firs compute the relative standing of the ratio for thos few years in the period for which there are direc data on the share of construction materials in th total of materials plus wages and salaries. For th

[2] There are scattered samples for some years since 1929, bu they are so narrow in scope as to be unsuitable for direct u in the present connection.

other years before 1929 we assume that the relative magnitude of the year-to-year changes in the wholesale prices of construction materials and in the wage rates for construction labor provide some reasonable indication of how the ratio in question changes from year to year; and the interpolation for the missing years before 1929 is carried through accordingly. For the years since 1929 an estimate is available of total payrolls for construction, based largely on employment indexes for several states and data on per capita wages and salaries. But this estimate, based on data for private construction firms only, is hardly indicative of payrolls in all construction, including public works. It was, therefore, decided to apply it in combination with only that part of construction materials which could be segregated as consumed in private and public utility construction. This meant a separate estimate of public works construction; and it was at this point that we were forced to accept measures of public works construction derived from other data as guides in the estimate of the ratio of materials to materials plus salaries and wages for the years since 1929 (see Table VI–5 and Note B). The weaknesses of the index of the ratio of the cost of materials to materials and labor thus obtained for 1919–33 are obvious, though it utilizes all the information apparently available. But while it is hardly a precise guide to the year-to-year changes in the ratio, its general indication, viz., that the share of construction materials in the combined total of materials plus wages and salaries did not change appreciably over the period, has some weight.

In the next step, establishing changes in the relative gross profits (i.e., ratio of the combined total of materials plus wages and salaries to total cost of construction), we attempted first to use the data on cost of goods sold and sales appearing annually in *Statistics of Income* for corporations classified under the construction division. However, the resulting index showed curious changes, apparently inexplicable by any substantive factors; and analysis of their possible causes suggested that the data suffer from lack of homogeneity. The inclusion of shipbuilding corporations produced a marked effect during 1919, 1920, and 1921, exactly the years in which changes in the ratio would be especially important; and it proved difficult to adjust for this inclusion satisfactorily. Moreover, the reporting of sales in the industrial division of construction appeared to be erratic, varying proportions of activity being treated as incomparable with sales and its result reported under 'gross income from sources other than sale of goods'.

For this reason it was considered best to disregard these data and to estimate the movement of the ratio of gross profits to total construction on the basis of similar ratios in some other line of industrial activity for which the data were more reliable and more comparable during the period. *Statistics of Income* gave us the ratio of cost of goods sold to the value of sales in the two branches of manufacturing most closely related to construction, viz., lumber and stone, clay and glass. The index of changes in relative gross profits in construction, thus derived, was applied, for the years before 1929, to the 1929 level as shown by the Census of Construction (see Note C to Table VI–5). For the years since 1929 the estimate allows changing gross profit ratios only for private and public utility construction; for public works construction this ratio, like the materials and payrolls ratios, was assumed to be constant through the depression.

The estimates derived from this analysis of the cost ratios in construction activity are little more than reasonable guesses. It was, therefore, considered advisable to see what results would be obtained if no effort were made to allow for changes in the ratio of construction materials to total value of construction. Either of two assumptions can then be followed. First, it may be assumed that the ratio of value of construction materials to total value of construction is constant when both are measured in fluctuating current prices. The implication is then either that both prices and quantities of materials, as compared with those of labor and of other production elements, change from year to year in exactly the same fashion; or that if changes in prices and in quantities of the two groups of production elements are divergent, they are equally divergent in opposite directions. The latter implication is reasonable if it is assumed that the two groups of productive elements can be easily substituted for each other. Under such conditions a rise in the price of construction labor relative to the price of materials would mean a proportionally reduced use of labor relative to materials.

The other possible assumption is that the ratio of construction materials to total value of construction is constant when both are expressed in terms of a constant price level. This assumption, a direct opposite of that suggested above, implies that the technical conditions of construction activity are quite rigid with respect to the relative

amounts of materials consumed as over against the amounts of the other groups of production goods used; and the variation of the ratio of the value of materials to the total value of construction, when both are expressed in current prices, results exclusively from divergent changes in prices of these two groups of production goods.[3]

In order to make possible comparison of the measures obtained from these various assumptions, three sets of global estimates are presented in Table VI–5: that based on an approximation to a varying ratio of current cost of construction materials to total value of construction (derived from the analysis in Notes A through C); and those based upon constant ratios in terms of current or of 1929 prices. The third method yields at first a measure of total construction in 1929 prices; to obtain the corresponding estimate in current prices, a comprehensive index of construction costs is needed. Such an index has been compiled from the several specific construction cost indexes available (for the details see Note D to Table VI–5).

Before comparing the three global estimates of total construction assembled in Table VI–5, we should discuss the final step in their derivation, common to all: the weighting of the ratios for specific types of construction in combining them into a single ratio. As noted above, even when the ratios are allowed to vary from year to year, we are forced to assume that the relative variations are the same for the different types of construction; and similarly, the constancy of the ratios over time, in whatever form assumed, is considered to hold good not only for construction as a whole but also for the different types of construction activity. But this does not obviate the necessity of measuring the changing importance in the total of various types of construction, which, as the figures of the 1929 Census indicate, are distinguished by different ratios of the value of construction materials to the total value of construction.

The only possible source from which such variation in weights and the weights themselves could be studied would, of course, be estimates of construction by type; at this point the global estimates of construction use again information contained in the estimate of construction by type. The latter estimates, whose derivation is described in Tables VI–7 to VI–9 and their respective notes, and is discussed in the next section of this Preface, provide the weights as used in Table VI–5 in combining the ratios for the several types of construction activity into a single ratio which could be applied to total construction materials consumed.

One important consequence of such weighting should be noted: that it leads to an underestimate of total construction. The reason is that the cost ratios derived from the Census of Construction represent construction in which the relative weight of repairs or alterations is much smaller than in our global estimates. At the same time the Census data indicate that in such types of construction activity as repairs, alterations, and renovations, the ratio of materials to total cost of work done is appreciably lower than a similar ratio in new construction.[4] Hence, the assignment to repair and alteration work which, by implication, is included fully in the global estimate of construction, of a ratio of materials value to total value similar to that in new construction, results in the ratio computed in Table VI–5 being somewhat too high. If this ratio is too high, obviously the resulting global estimate of total construction is correspondingly too low. There is no way of remedying this bias, unless data on the annual volume of small repairs and alterations were available. But the underestimate just described goes far to offset any overestimate in the global estimate of total construction that may have resulted from the assumptions implied in any preceding phase of the analysis.

We may now compare the three global estimates in Table VI–5 (lines 5, 18, and 23). For 1929 they are naturally identical, and the differences are, on the whole, fairly small for 1925–28. But for 1919–21 the estimate based on a varying cost ratio is larger than those based on constant ratios, while for 1922–24 the first is lower than the other two. This suggests that in 1919–20 the relative share of materials was lower than in other years, and during 1922–24 it was relatively higher; and that these fluctuations in the relative shares were due primarily to the divergent movement of prices of the two groups of production goods, rather than to any divergence in the movement of the quantities.

These results appear easily accountable for in

[3] Both assumptions can also be varied by having the constancy of the ratio apply to the share of construction materials in the combined total of materials plus wages and salaries. A comparison of lines 4, 8, and 16 of Table VI–5 would then show the difference introduced into lines 5 and 18 by this variation in the assumptions. The result would obviously be to raise the values in lines 5 and 23 for 1919–22, and lower them for 1930–33.

[4] For painting and decorating, and plastering and lathing, two forms of construction activity that may be indicative of repair work, the ratios of materials to work done were 21 and 28 per cent, respectively.

the light of the changing economic conditions during the post-War period. In the first two years of this period construction materials shared, although not fully, in the extraordinary rise in prices that developed shortly after the armistice. But cost of labor and relative gross profits were exceptionally high, the latter especially so as compared with the subsequent years; as a result, the share of materials in total costs was lower in 1919 and 1920 than subsequently. More doubt attaches perhaps to the rapid rise of the ratio in line 6 of Table VI–5 from 1921 to 1923 and the subsequent decline to 1924, which resulted in the global estimates in line 18 being smaller than the other two estimates for 1922–24. But the rapid rise in prices of construction materials from 1921 to 1923 is not surprising, in view of the general recovery of prices in 1922 and 1923; and the lag of wage rates and wage costs is not an exceptional phenomenon during cyclical expansions. Only after building strikes in 1923 were wage rates raised, and, accompanying as it did, a developing weakness in commodity prices in general (and hence also in construction materials prices), the rise was reflected in a decline of the materials ratio from 1923 to 1924. There was a tendency toward a similar movement in the cycle of 1924–27; and in the depression of 1921 the ratio of materials costs also declined. Only in the drastic contraction that followed 1929 did wage costs decline more relatively than costs of materials.

It is not possible to account fully for the year-to-year variations in the global estimates in line 18 of Table VI–5. To point out that the variations in the ratio upon which these estimates are based seem to be in reasonable consonance with what we know of the general behavior during business cycles of labor costs, of prices of materials several of which are fixed in semi-monopolistic markets, and of gross profits in a highly competitive industry, does not necessarily mean that the exact magnitude of the changes has been tested; or that the factors mentioned could not be offset by others that may have been omitted from our account. But it does appear that of the three estimates in Table VI–5, the one in line 18, based on varying costs ratios, is to be preferred; and that it offers, within the limitations of the data, a rough description of the total value of construction activity, comprehensively defined.

4 ESTIMATES OF CONSTRUCTION BY TYPE

Among the data available on the value of construction by type three groups may be distinguished: (a) Reports on the number of building permits and on the value of construction that they represent, for a varying number of the larger cities in the country. These data include both residential and non-residential construction; and cover not only new construction but also substantial repairs and alterations. (b) Data on construction contracts awarded, of which the most comprehensive series is that collected by the F. W. Dodge Corporation. These data relate to construction of different types, and cover primarily work on contract, although they include some small, but indeterminable, amount of force account work. (c) Data on construction activity by business and public enterprises, which can be obtained from their accounts. Most of the enterprises for which such information is available are in the field of public utilities and public works construction; and the information usually covers both work done by contract construction firms and that carried through on force account. These data cover, in addition to new construction, repairs and maintenance work.

This brief synopsis of the three bodies of the available data indicates their deficiencies for the purpose of a comprehensive estimate of construction by type, even if the estimate is confined to new construction and such substantial repairs and alterations as are durable and hence properly a part of the capital formation total. Each group of data mentioned covers only a part of the field; and what is omitted in one is not necessarily covered adequately in the others. Moreover, the information is defective even for the specific fields that it is presumed to cover. Building permits, disregarding the fact that they are available for a few cities only, do not necessarily measure actual construction since some of the permits issued are allowed to lapse without eventuating in any construction. Furthermore, they refer only to the corporate limits of the cities covered, and hence omit construction outside city limits. Moreover, even the values given may be underestimates, because of the tendency on the part of applicants for permits to consider the values given as a basis for future assessments. The published data on contracts awarded are available for only 27 states prior to 1923, 36 states in 1924, and for 37 states subsequently; cover contracts only above a certain size, the minimum limit varying from one part of the period to another; and there are some grounds for assuming that the adequacy of the coverage, even within the varying limits indicated, has been continually improving with the passage of time.

Added to these difficulties is the lack of consistency in the classification of contracts by type. The data on construction activity by various groups of private and public enterprises vary in completeness and detail from group to group. They are best for such enterprises as steam railroads, whose annual accounting is closely supervised and standardized by the Interstate Commerce Commission; and become poorer until the information is so scanty that the resulting estimates are necessarily not much more than reasonable guesses.

Obviously, with such inadequate data, a great deal of labor and ingenuity must be spent in order to arrive at acceptable estimates of construction by type; even then, such estimates would be subject to frequent revisions as new information becomes available and new estimating procedures are devised. Fortunately, it was possible here to utilize the work of various investigators in the field; this was supplemented by new efforts only where it seemed both possible and advisable. The work of the Federal Employment Stabilization Board provided some valuable clues; and we have used directly the results, kindly made available to us, of the work of David Wickens, Arthur Gayer, and Peter Stone.

The specific estimates are presented in Tables VI–7, VI–8, and VI–9; the sources of the data and the details of the procedures are described in the notes appended to these tables. It would be of little use to repeat the description here, but it is useful to comment briefly upon the alternatives open and the decisions made in connection with measuring the value of the basic types of construction work.

a *Non-farm residential construction*

On this most important type of construction, both available bodies of data—building permits and contracts awarded—are deficient in respect of total value, and yield divergent results concerning year-to-year movements. Our problem was thus twofold: first, to devise a method that would correct for the deficiency; second, to decide how the adjusted value should be made to vary annually within the period under study. Fortunately, both aspects of the problem were solved satisfactorily by D. L. Wickens and Ray R. Foster; and it was possible to utilize their estimates without change. A description of the estimates sufficiently detailed to indicate their derivation is given in *Bulletin 65,* National Bureau of Economic Research (September 15, 1937).

b *Other private construction*

In addition to new non-farm residential construction, private construction includes new farm construction on both residential and other units, new non-residential construction in private and semi-public business, excluding public utilities, and major repairs and alterations. Construction for public utilities, both because of its importance and the existence of a distinct body of data covering it, is treated separately.

For farm construction the basic data are those provided by the Bureau of Agricultural Economics on construction work carried through on productive farm assets, i.e., on structural units other than farm dwellings. These estimates were extrapolated for years not covered in the B.A.E. figures; and were utilized to evaluate construction on farm dwellings, largely by comparing the value of farm dwellings with that of buildings other than dwellings and the approximate depreciation for these two types of fixed assets (see Note B to Table VI–7). Farm construction totals include some non-segregable maintenance and repair work, but the preponderant part of the total is probably new construction or durable alterations; and the total is thus fully included in the estimate of construction used in deriving total capital formation.

For other private construction, excluding public utilities, the main data are contracts awarded. These had to be adjusted for the changing area of coverage, and somewhat refined in classification to avoid duplication with public utility and public works construction (see Note C to Table VI–7). No attempt was made here to adjust for the possible shortage of the contracts data, similar to the adjustment made for residential construction, except that implied in adding major repairs and alterations in line 6. Undoubtedly, the limitation of contract reporting to those above $5,000 (for most years in the period) has resulted in the omission of some new construction in these fields; but the allowance for major repairs and alterations should contribute towards offsetting any such shortage in coverage.[5]

The estimates of major repairs and alterations are determined largely by new construction, residential and other, and by the ratio of repairs and alterations to it, a ratio shown by the building permit data (see details in Note D to Table VI–7). Such repairs and alterations, because of their sub-

[5] Some duplication with construction covered by the Dodge data may be involved in this allowance. But it is doubtful that such duplication is at all significant.

stantial character, which is indicated by the necessity of obtaining a permit for them, are classified by us as durable construction, and hence as properly a part of the capital formation total.

c *Public utility construction*

In this field data are relatively abundant for recent years, on both new construction and maintenance work. The difficulty lies primarily in carrying the estimates back in time, especially for the first three years in the period, for which the data become much sparser.

The final estimates appear in Table VI–8; Note A presents a detailed description of the sources of the data used. We were again fortunate in being able to use here the results obtained by other investigators. Areas that were still unrepresented in the available data were allowed for by assuming that their value changed in a fashion similar to that of the value covered by the data. While this procedure is not without dangers, the changes in the coverage were not too abrupt. The break in 1922 involves an increase in the area of coverage of about 13 per cent; that in 1925, of between 8 and 9 per cent; and that in 1929, of about 8 per cent.

As will be seen from Table VI–8, estimated construction in public utility fields is reduced for duplication, the total reduction varying from about 580 million dollars in 1929 to 87 million in 1933. This duplication arises from the inclusion in the specific data on public utility construction of some durable, fixed equipment, whose installation requires a considerable amount of construction work. Since all such equipment was already measured by us under producers' durable commodities, and since they are not properly a part of construction activity, the construction values in question should be reduced by excluding the values of this durable equipment. The basis of this deduction is described in Note A to Table VI–8. It need only be indicated here that some part of this total deduction applied to construction work in private and public fields. However, there is no way of allocating the duplication among the various types of construction activity; and since the preponderant part is in the data on public utility construction, it seemed advisable to apply the deduction fully there. This means that our classification of construction by type is not quite clear-cut—an observation also strengthened by the circumstances that our public utility estimates include none for publicly owned electric light and power plants, gas plants and electric railways.

The durability of the maintenance work in the public utilities field is unknown. Such work may include not only minor repairs and alterations, whose results are short-lived, but also some more substantial construction activities of more durable consequence. However, from the strict accounting viewpoint, the item of maintenance charges should cover only expenditures whose results are fully amortized within the current year. We assumed, therefore, that the maintenance work in public utilities is largely nondurable; and have excluded the corresponding total from the construction item as it appears in the total of capital formation.

d *Public works construction*

The basic data for our measure of construction in this field are A. D. Gayer's estimates published in *Public Works in Prosperity and Depression,* estimates that are based partly upon the Dodge data and partly upon independent information for one important item of governmental construction. Our task was to carry these estimates back of 1923, the year with which the Gayer series begins; to substitute for one item in the Gayer estimate, that relating to city streets, another estimate that appeared more reliable as a gauge of changes in this field; and to segregate, so far as possible, maintenance items. This segregation could not be carried through completely, since only the maintenance of rural highways and city streets could be measured separately. Although the residual thus includes an indeterminate, but probably small, amount of maintenance work, it still falls somewhat short of the total of new public construction: the Gayer estimates adjust the contract series for possible shortages in only two types of public works construction. It would have been possible, with considerable time and effort, to revise the Gayer estimates in the light of newly available data, but the potential effect of such revision seemed small, and certainly not to warrant the labor.

The grand total of these estimates of construction by type, including maintenance work where it could be measured, appears in Table VI–6.

5 COMPARISON OF GLOBAL ESTIMATES WITH ESTIMATES OF CONSTRUCTION BY TYPE

Table VI–10 presents the two groups of estimates of total construction, one consisting of three variants based on the consumption of construction ma-

terials, the other on the estimate of total construction compounded of the measures of construction by type. The comparison shows, as could be expected, that the global estimates are significantly larger than the estimates of construction by type; and that both the absolute and relative magnitudes of the difference vary from year to year. The task before us now is to account as much as possible for: (a) the approximate magnitude of the difference; (b) changes in the magnitude of the difference over the period.

(a) If we include in the estimate of construction by type whatever repairs and maintenance items have already been measured, viz., maintenance in public utilities and of highways and streets, the excess of the global estimates over those by type range for the different variants from as low as 1.1 billion dollars to as high as 5.7 billion. Differences between the two estimates for single years should not be assigned much weight, if only because the timing of the estimates by type is somewhat different from that of measures based on the consumption of materials. We may, therefore, consider now only the approximate magnitude of the difference over the period as a whole, and see whether in the areas covered by the global estimates and omitted in the estimates by type, construction activity can reach the approximate magnitudes suggested by the differences in Table VI–10.

The global estimates include, and those by type exclude, all minor repairs and maintenance in the following fields: (a) residential construction; (b) all other private construction, except on farms and public utilities; (c) public construction, except maintenance of highways and streets since 1923. For public works construction no estimate of the omitted items can be made, not even a reasonable guess. But for the other two fields it is possible to obtain a rough idea of the activity, either on the basis of the approximate ratio of cost of repairs and maintenance to gross rent paid, or by using some direct information on repair and maintenance expenditures.

The most important item, minor repairs and maintenance construction in connection with residential real estate, can be gauged indirectly by approximating the gross rental bill and then applying to it the ratio that expenditures on this type of construction work constitute of it; the same procedure can be carried through also for buildings and other structural units occupied by retail and wholesale trade establishments. Table VI–a presents an estimate of the gross rental bill for all residential and trade units in the United States for 1929, a year for which our information is most abundant, owing to the Census of Populatio (which contains data on rents paid and value c houses owned) and the Census of Distributio (which provides data on rents paid by trading e tablishments). The estimates include both ren actually paid and the imputed rent for residence or premises owned and used by the owner. Th derivation is indicated briefly in Table VI–a, th estimates having been prepared as a subsidiar part of the National Bureau's study of nationa income.

The gross rental bill in Table VI–a is quit large, but when it is considered that the 9 billio dollars of residential rent were paid by or imputed to 22,698,535 non-farm families, thus yielding a annual average rent of $402; and that the 2.88 bi lion dollars were paid by 1,712,860 retail an wholesale units, thus averaging $1,683 per uni the total does not seem excessive. Accepting it, w inquire what proportion of the rental bill migh have been spent on repairs, painting, etc., activ ties whose value accounts probably for a large pa of the discrepancy between the two constructio estimates in Table VI–10.

Table VI–a

RENTAL BILL IN 1929, CASH AND IMPUTED RESIDENTIAL PROPERTY AND PROPERTY OCCUPIED BY RETAIL AND WHOLESALE TRADE

TYPE OF RENT	RENTAL BILL (*millions of dollars*)	METHOD OF ESTIMATING
Residental, cash	4,531	Estimated on basis of number c rented homes interpolated between 1920 and 1930 Census, an average rental for 1929 derived from 1930 median Census value adjusted to average and extrap olated back on basis of rent index
Residential, imputed	4,592	Estimated on basis of number c owned homes and average rent value derived from Census m dian values and Financial Surve of Urban Housing ratio of ren to value
Wholesale trade, cash	272	Census of Distribution, special tabulation
Wholesale trade, imputed	563	Estimated on basis of Dun and Bradstreet's ratio of rent to sal applied to sales in 1933. Relationship of imputed rent to cas rent in 1933 applied to 1929 cas rent
Retail trade, cash	1,478	Census of Distribution
Retail trade, imputed	569	Estimated on basis of ratio of rent paid to sales from leased premises and estimated sales from owned stores
Total	12,005	

Unfortunately, on this subject the data are extremely scanty. However, a sample of expenditure studies is available for 51 apartment houses for 1934, published in the *Real Estate Record*. From the detailed expenditure items given there we compiled the total expenses per room that definitely referred to repairs, renovations, maintenance, and other activities consuming construction materials. For each building a ratio of these expenditures to rent was then computed. Of the various factors that might have affected variations in this ratio, age of building (none in the sample was built after 1930), assessed value, and number of rooms in the apartment building did not seem to have been important. But it was obvious that within each group of buildings, distinguished by type, the cost of repair and maintenance construction did not increase *pari passu* with the increase in rent collections per room—so that when rent collections per room were large, the ratio of expenditures to rent was small. The data for this sample are summarized in Table VI–b.

Table VI–b

RATIO OF EXPENSES ON PAINTING AND REPAIRS TO RENT FOR A SAMPLE OF APARTMENT HOUSES IN 1934 [1]

1 Ratio to Rent Collections

CLASSES BY SIZE OF ANNUAL RENTAL PER ROOM IN DOLLARS	GROUP I SIXTEEN 5 AND 6 STORY NON-ELEVATOR BUILDINGS		GROUP II TWENTY-FIVE 6 STORY ELEVATOR BUILDINGS		GROUP III TEN 9 TO 16 STORY ELEVATOR BUILDINGS	
	NUMBER	ARITHMETIC MEAN OF RATIOS	NUMBER	ARITHMETIC MEAN OF RATIOS	NUMBER	ARITHMETIC MEAN OF RATIOS
0– 59.9	1	21.2	0	..	0	..
60– 99.9	3	14.2	0	..	0	..
100–124.9	5	14.5	3	15.3	0	..
125–149.9	7	11.9	14	14.0	0	..
150–174.9	0	..	5	10.8	0	..
175–199.9	0	..	3	8.5	0	..
200–224.9	0	..	0	..	3	13.1
225–249.9	0	..	0	..	2	9.3
250–299.9	0	..	0	..	4	8.6
300–349.9	0	..	0	..	1	6.5
Total	16	13.7	25	12.8	10	9.9

2 Ratio to Gross Rent (on the assumption of complete occupancy, no bad debts and no concessions)

0– 59.9	0	..	0	..	0	..
60– 99.9	2	14.4	0	..	0	..
100–124.9	2	14.0	0	..	0	..
125–149.9	8	11.4	2	13.8	0	..
150–174.9	4	9.5	18	11.8	0	..
175–199.9	0	..	4	9.0	0	..
200–224.9	0	..	1	8.1	0	..
225–249.9	0	..	0	..	1	13.3
250–299.9	0	..	0	..	5	8.2
300–349.9	0	..	0	..	4	7.0
Total	16	11.6	25	11.4	10	8.2

3 Other Information on the Sample

	GROUP I			GROUP II			GROUP III		
	LOWEST	HIGHEST	ARITHMETIC MEAN	LOWEST	HIGHEST	ARITHMETIC MEAN	LOWEST	HIGHEST	ARITHMETIC MEAN
Age of building (years)	6	16	9.6	5	9	6.2	4	9	6.5
Number of rooms	124	310	195	71	321	194	178	428	292
Assessment value in 1934 (thousands of dollars)	77	270	168	75	530	208	460	1175	760
Rent collection per room (dollars)	57	146	113	119	180	147	202	331	256
Bad debts, vacancies, concessions (per cent)	1.5	28.3	14.1	4.0	23.1	10.8	5.4	31.5	16.0
Rent per room adjusted for vacancies, etc. (dollars)	71	158	133	135	203	165	249	350	304
Painting and repairing charges per room (dollars)	8.9	24.1	15.1	12.2	35.9	18.6	21.1	33.1	24.6

[1] *Real Estate Record*, April 20 and August 17, 1935.

The average ratio to rent collections for the sample as a whole was 12.54 per cent.[6] The evidence of two other samples may be considered. The first is for apartment houses constructed under the auspices of the New York State Board of Housing, in which the ratio in the various buildings for 1934 ranged from 5.7 to 10.4 per cent of rent collections.[7] The unweighted arithmetic mean for the eight buildings was 7.9 per cent, a ratio appreciably lower than for the sample summarized in Table VI–6. But it must be noted, first, that most of the eight buildings in the Board of Housing study were recently constructed, and that the three older buildings all showed higher ratios than the others (9.1, 10.4, and 9.6). Second, the attractively low rentals of these buildings made perhaps for a stability of tenancy and less need of renovations and repairs than is typical of apartment houses run on strictly business principles.

The other sample has been collected by the Federal Housing Administration and some of the results have been published recently (see Paul M. Green, The FHA Study of Apartment Operating Experience, *Real Estate Record,* June 19, 1937, pp. 9–12). The information published so far refers to average repairs and maintenance cost per room in a number of apartment houses in several large cities, but only total expenses (exclusive of depreciation and financial expenses) are shown, no information being provided on rents. However, for one city, St. Louis, both total expenses and total income are given for 1935, the ratio of the former to the latter being 1.05. If we assume that total income represents largely income from rent and that the ratio of total income to total expenses in other cities in 1934 was approximately the same as in St. Louis in 1935, then the percentages for 1934 of median expenses on repairs and maintenance to median rental income are, in the FHA sample, as follows: New York City (42 walk-up and 15 elevator apartment buildings)—12; Chicago (15 walk-up and 3 elevator)—20; Washington, D. C. (9 walk-up and 7 elevator)—21; San Francisco (8 walk-up and 12 elevator)—9; St. Louis (1935, 19 walk-up)—28. On the whole this sample indicates even a higher ratio of repairs and maintenance expenses to rental income than that analyzed in Table VI–b.

It thus seems reasonable to assume that a ratio of expenditures on repairs, maintenance, and renovation construction to rent of from 10 to 20 per cent was more or less common for apartment houses in 1934, the ratio, on the whole, decreasing as rent per room increased. But what would be the ratio for all the residential units whose rent was covered in Table VI–a, and for 1929, a year in which both rents and construction costs were higher than in 1934? The answer to the first part of the question can be merely a conjecture. The bulk of small residential units which account for the larger part of the total in Table VI–a may not need as extensive annual repairs and renovations as would apartment buildings with their greater turnover of residents. On the other hand, Table VI–b indicates that the lower the average rental the higher its ratio to the cost of repair and maintenance construction. A ratio of 12.5 per cent of the total rental bill is perhaps not unreasonable. It would allow a ratio in residential units other than apartment houses significantly lower. The over-all percentage is certainly not appreciably lower and may be somewhat higher.

The same ratio, if not a higher, is likely to have prevailed in 1929. The Board of Housing data indicate a relatively small change in the ratio from year to year; and the data for similar expenses in office buildings (see below) indicate about the same ratio to rent collections in 1934 as in 1929. In the FHA sample, the percentage of repairs and maintenance expenses to *total expenses* was in New York City, 12.3 in 1934 and 19.8 in 1929; and in Washington, D. C., 21.6 in 1934 and 23.9 in 1929. We may, therefore, assume 12.5 per cent of gross rental bills as the most likely ratio for 1929 of expenses on repair and maintenance construction, an under- rather than an overestimate. Applying this ratio to the gross residential rental bill for 1929 we obtain a value of construction activity amounting to 1.14 billion dollars.

For expenditures on repairs and maintenance of premises occupied by wholesale and retail trade establishments, the most reasonable ratio is perhaps that to rents for office buildings. It can be computed for a substantial sample of office buildings annually from 1923 through 1935 from data provided by the National Association of Building Owners and Managers (see *Office Building Experience Reports*). The average ratio for 1929 is 5.0 per cent of rent collections (4.9 per cent for 1934). Applying this ratio to the gross rental bill for trade, as shown in Table VI–a, we obtain a value of construction activity of 144 million dollars. This amount, added to that established for

[6] The ratio obtained from this sample is a minimum since it excludes supply items such as glass, awnings, and shades, a part of which should probably be included in any measure of repair and maintenance expenditures.

[7] *Report of the State Board of Housing,* Leg. Doc. (1935), No. 41.

residential repairs and maintenance, yields a total of 1.28 billion dollars.

Turning now to mining and manufacturing we find some data on maintenance and repair expenditures given by corporations submitting reports to the Securities and Exchange Commission. For a sample of 367 companies (about 20 per cent of the total depreciation and depletion bill) the percentage in 1934 of maintenance and repair expenditures to the depreciation and depletion charges for 1933 was 85.4 in mining and 78.2 in manufacturing.[8] It can be reasonably assumed that the percentage in 1929 was about the same, since the depreciation and depletion charges in mining and manufacturing declined some 24 per cent from 1929 to 1933 (see *Bulletin 60,* National Bureau of Economic Research, Appendix Table 1, p. 14); while the general index of construction costs, an important element in the repair and maintenance activity, declined 20 per cent (see Note D to Table VI–5). This ratio yields an estimated total expenditure for mining of 420 million, and for manufacturing of 1,686 million—or a total for 1929 of 2,106 million dollars.

This total covers repairs and maintenance on all fixed assets, and therefore includes not only construction activity but also repairs and maintenance of equipment. At the time of writing there are no data that would make possible a division of expenditures between those applied to structures and other construction units and those applied to equipment. Until such data become available we can merely guess at the apportionment of total repairs and maintenance expenditures; and provisionally may assume that at least half is for activities that consume construction materials. On this assumption, the cost of minor repairs and maintenance construction in the two fields of mining and manufacturing was 1,053 million dollars in 1929; this amount added to the total for the same type of construction activity on residential and trade units yields a combined total of 2.33 billion dollars.

To this total may be added the cost of development work in mines, a type of activity largely of a construction character not accounted for so far. According to Solomon Fabricant's estimate this item was 321 million dollars in 1929, and its inclusion raises the total to 2.65 billion dollars. The latter figure still fails to include repairs and maintenance construction done in connection with premises occupied by all business units in finance, service, construction, and miscellaneous, as well as that part of minor repairs and maintenance construction in public works that has not been covered by estimates in Table VI–9. What the omitted volume amounts to is a matter for guessing. For construction and service corporations alone the sample data on the ratio of repairs and maintenance expenditures to depreciation and depletion charges (cited above for mining and manufacturing) would suggest a value of construction activity in 1929 not much less than 200 million dollars. The construction activity omitted so far may well have amounted in 1929 to at least 500 million dollars, and was perhaps more.

Thus, with the help of various conjectures, a reasonable guess of the value in 1929 of minor repair and maintenance construction, not accounted for in estimates of construction by type, would be 3.15 billion dollars, and could well be more. By inference, activity in most years before 1929, when construction costs were at least as high as in 1929, and the rental bills and maintenance expenditures not much lower, would have been similar. If we compare this figure with the entries in line 5b of Table VI–10, taking the latter not for single years but rather as a two-year moving average (to allow for disparity in timing between estimates of construction by type and the global estimates), it will be seen that these entries for years before 1931 exceed 3.15 billion dollars, on the average, by some 600 million; and at their highest are not above 4.4 billion dollars. Only for the years before 1922 is the excess greater, a circumstance subject to a specific explanation advanced below.

It would then appear that if there is any exaggeration in the global estimates, or any underestimate in the total of construction by type, it does not exceed a billion dollars at its highest; and is likely to be much smaller, when it is considered that the 3.15 billion dollars of the residual maintenance and repair construction arrived at above are a minimum estimate. The data published recently in the 1935 Census of Construction lend some support to this statement. This Census segregates for the first time new construction and additions from remodeling, repairs, and maintenance work. Taking this classification as largely identical with our distinction between new construction and repair and maintenance work, we may observe the ratios for 1935 (see *Census of Business: 1935, Construction Industry,* Vol. I, p. 81).

[8] Preliminary figures from a sample compiled by Solomon Fabricant. More detailed data will appear in his *Capital Consumption.*

Percentage of Remodeling, Repairs, and Maintenance Work to New Construction and Additions, Contract Construction Firms, 1935

	PRIVATE CONSTRUCTION	PUBLIC CONSTRUCTION	ALL CONSTRUCTION
General contractors	38.3	6.0	16.1
Special trade contractors	133.1	19.2	103.0
All contractors	80.8	7.6	38.5

All these ratios underestimate the importance of repair and maintenance work as compared with new construction and additions, for two reasons: (a) The Census covers the activity of construction firms alone, omitting force account work. Obviously among all fields of construction work, but especially in public works and public utilities, a larger proportion of repair and maintenance work than of new construction work is done on force account. Hence the Census percentages, especially for public works construction, are too low for our purposes. (b) Since the Census is definitely incomplete, according to the statement of the authorities (see Vol. I, pp. xx–xxi), one may reasonably suppose that the relative shortage is greater among special trade contractors with their smaller units and less easily recognizable location than among the larger units in the group of general contractors. And it is with the special trade contractors that the relative weight of repairs and maintenance work is particularly heavy.

Thus, the acceptance of 80.8 as the percentage that repair and maintenance work constitutes new construction in the field of private construction in 1935 implies a definite underestimate its importance. What this ratio would be for other years is difficult to say, except that obviously would tend to be lower when the commodity volume of new construction was larger than in 1935 and would tend to be higher when the commodity volume of new construction was smaller than in 1935. For, assuming that the relative costs of new construction and repairs and maintenance work (as compared with those in 1935) would tend to move similarly, the value of repairs and maintenance work would be largely governed by the volume of existing structures, a magnitude that is subject to smaller relative changes than the gross additions to it represented by the commodity volume of new construction.

In Table VI–c the 1935 ratio is applied to our estimates of new construction in private and public utility fields in other years, a hypothetical value of repairs and maintenance work derived, and the latter compared with the estimate of such work as measured in Table VI–10.

Except during 1919–21 and 1930, the actual value of repairs and maintenance work in all years in which the commodity volume of new construction was larger than in 1935 was smaller than the hypothetical value based on the application of the 1935 ratios. This shortage was actually much

Table VI–c
HYPOTHETICAL AND ESTIMATED VALUE OF REPAIRS AND MAINTENANCE CONSTRUCTION IN THE PRIVATE AND PUBLIC UTILITY FIELDS
(millions of dollars)

Year	New construction, private and public utility (Table VI–6, lines I–3 + II–1)	Hypothetical repairs and maintenance	Estimated repairs and maintenance (Table VI–10, lines 4a + 5b)	Discrepancy (col. 4 — col. 3)
(1)	(2)	(3)	(4)	(5)
1919	4,493	3,630	5,900 [1]	+2,270
1920	4,622	3,735	6,662 [1]	+2,927
1921	4,428	3,578	4,810 [1]	+1,232
1922	6,307	5,096	3,899 [1]	—1,197
1923	7,722	6,239	3,820	—2,419
1924	8,226	6,647	3,587	—3,060
1925	9,264	7,485	3,437	—4,048
1926	9,123	7,371	4,392	—2,979
1927	9,001	7,273	4,579	—2,694
1928	8,640	6,981	5,272	—1,709
1929	7,590	6,133	5,132	—1,001
1930	5,606	4,530	5,366	+836
1931	3,494	2,823	3,536	+713
1932	1,541	1,245	1,799	+554
1933	1,328	1,073	1,817	+744

[1] In these years the 1923 estimate of public works highway and street maintenance has been subtracted in order to derive approximate residual totals excluding such maintenance.

larger than that shown in column 5 of Table VI–c, because column 3 is too small, being based on an obviously too low percentage for 1935, and column 4 is too large, including as it does some repairs and maintenance of public works. If we disregard the 1930 excess of column 5 over column 3 (as due to timing discrepancies, and thus subject to interpretation only if averaged with the discrepancy for 1929), it would appear that, except for 1919–21, our original estimates of the residual unallocable maintenance are well within the limits suggested by the 1935 Census of Construction ratio.

We cannot contend that our discussion justifies in any rigorous fashion the magnitude of the discrepancies shown in Table VI–10, and hence precludes the possibility that the global estimates are exaggerations or that the totals of construction by type are underestimates. But it does suggest that the disparity between the two sets of estimates is within reasonable and plausible limits; and that while there may be some exaggeration in the global estimates or some underestimate in the volume of construction by type, these errors cannot be large relatively. Furthermore, neither estimate can be greatly in error if due consideration be taken of the exact scope of respective coverage.

(b) We may now consider the changes over the period in the difference between the global estimates of construction and that of construction by type. Changes from one year to another are, for various reasons, neither fully significant nor fully explicable. First, a large portion of the estimate of construction by type is based on contract data; and while an attempt is made to report them when work actually starts, contracts on which work was begun one year may actually be carried through within the succeeding year. Consequently, the estimates of construction by type would tend to move somewhat in advance of the global estimates, based as the latter are upon the actual consumption of construction materials. Second, the two estimates are not sufficiently accurate to warrant ascribing significance to the year-to-year changes in the difference. But we are perhaps justified in inquiring what were the larger changes in this difference, observable over periods of several years.

Of the three global estimates of construction, that based upon variable ratios of cost of materials consumed to total value seems, for reasons submitted above, preferable. Examination of the difference between this particular global estimate and that of construction by type (Table VI–10, line 5b) reveals two significant changes in this difference over the period. First, as already noted, the absolute excess of the global estimate over that of construction by type appears to be somewhat higher in 1919, 1920, and 1921 than that prevailing before 1929: allowing for the lack of entries for these years in line 4b and assuming them to be equal to that in 1923, the discrepancy ranges from 3.79 billion in 1921 to 5.39 billion in 1920, a level higher than that for most subsequent years. And when this excess is expressed in percentages of the value of new construction its higher level in 1919–21 becomes still more apparent. Second, there is the substantial decline in the discrepancy since 1930.

The larger excess of the global estimate over that of construction by type in the first three years of the period may be due to the appreciably larger value of minor repairs and maintenance construction, or to the deficiency in either of the two estimates used in the comparison. Of the two explanations, the former seems to have more weight. The need for repairs and maintenance was relatively large in the first post-War years, when the effects of the restriction of construction activity during the War were felt, and at the same time there was hesitancy about launching new construction on a large scale owing to high prices and the difficulty of obtaining both materials and labor. This statement is partly confirmed by data on utilities, the one class of maintenance and repair work for which we have data for these years. Such work was, on the whole, absolutely larger than in subsequent years, and thus much larger when expressed as percentages of the current value of new construction. This does not mean that one or both estimates may not be at fault, showing a bias as between 1919–21 and subsequent years. But since the first explanation seems to be corroborated and reasonable, less importance should be attached to the possible errors in the estimates as accounting for the change in the disparity from 1919–21 to subsequent years.

The reduction in this disparity since 1929 presents at first some puzzling aspects. A decline in the absolute amount of this difference might have been expected, since the minor repairs and maintenance construction that it represents would decline during the depression. But one would not expect it to be more appreciable or even as appreciable as in new construction; and still Table VI–10 shows in line 5b a decline by 1932 of about 75 per cent of the 1930 value, whereas the decline in line 2 from 1927 to 1932 is, in percent-

ages of the value at the peak, only slightly over 70 per cent. An allowance for the difference in timing would merely aggravate this greater intensity of the decline in unallocable maintenance.

This difficulty resolves itself when we remember that the residual unallocable maintenance represents largely minor repair and alteration work performed in connection with residential, commercial, industrial, and other private properties, the new construction of which was estimated in Table VI–7. A glance at the corresponding total of new construction (line 3) shows that the percentage decline from the peak in 1925 (7.51 billion) to the trough in 1932 (0.82 billion) was much more appreciable than that in the residual unallocable maintenance. When the comparison is made in proper terms, i.e., between unallocable maintenance and repairs and new constructi in the fields in which such maintenance and pairs occurred, the effect of the depression on t former is, as might have been expected, less cc spicuous than on the latter.

The discussion of the two estimates of total cc struction leaves the following impressions cc cerning the character of the estimate most i portant in subsequent use, that of constructi by type. First, its average value and the bro sweeps of its movement over the period che fairly well with the global estimate, based on t consumption of construction materials. Secor the year-to-year changes in neither estimate me ure accurately the annual activity in constructic and little reliance should be placed upon them.

Table VI—1

OUTPUT AND ALLOCATION OF PRODUCERS' SALES OF CONSTRUCTION MATERIALS, 1919–1933

This table recapitulates for construction materials several steps in the analysis applied in the preceding Parts to finished manufactured products. The data on the output of manufactured construction materials for Census years are supplemented by those on the production of non-manufactured construction materials; the output for intercensal years is estimated; changes in producers' stocks of construction materials are taken into account in passing from production to sales; and the sales of these materials are allocated among the various channels of distribution and consumption.

The methods of estimate and the supporting data are described in detail in Notes A through F following the table. Further discussion will be found in the Preface to Part VI, Section 2.

Table VI-1

OUTPUT AND ALLOCATION OF PRODUCERS' SALES OF CONSTRUCTION MATERIALS

(millions of dollars)

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
1 Total output of construction materials at producers' current prices		3,742.7	5,064.0	3,114.7	3,756.5	4,887.7	4,690.7	5,191.8	5,345.2	5.063.4	4,995.5	5,214.4	3,942.6	2.670.8	1,430.2	1,616.9
2 Bureau of Labor Statistics wholesale price index of building materials	103.3	121.2	157.3	102.1	102.0	113.9	107.2	106.5	104.8	99.3	98.6	100.0	94.2	83.0	74.8	80.7
3 Total output at producers' prices of 1929, line 1 ÷ line 2		3,088.0	3,219.3	3,050.6	3,682.8	4,291.2	4,375.7	4,874.9	5,100.4	5,099.1	5,070.5	5,214.4	4,185.4	3,217.8	1,912.0	2,003.6
4 Index of ratios of stocks held by producers in 1929 prices to output in 1929 prices	102.8	87.2	117.5	105.2	81.5	76.3	78.7	81.0	85.8	91.5	87.2	100.0	147.4	178.7	230.8	237.9
5 Ratio of stocks held by producers in 1929 prices to output in 1929 prices (per cent)	23.8	20.2	27.3	24.4	18.9	17.7	18.3	18.8	19.9	21.2	20.2	23.2	34.2	41.5	53.5	55.2
6 Estimated Dec. 31 stocks held by producers in 1929 prices, line 3 x line 5	605.1	623.8	878.9	744.3	696.0	759.5	800.8	916.5	1,015.0	1,081.0	1,024.2	1,209.7	1,431.4	1,335.4	1,002.9	1,106.0
7 Changes in stocks held by producers in 1929 prices		+18.7	+255.1	-134.6	-48.3	+63.5	+41.3	+115.7	+98.5	+66.0	-56.3	+185.5	+221.7	-96.0	-312.5	+83.1
8 Changes in stocks held by producers in current prices, line 2 x line 7		+22.7	+401.3	-137.4	-49.3	+72.3	+44.3	+123.2	+103.2	+65.5	-56.0	+185.5	+208.8	-79.7	-233.8	+67.1
9 Total output corrected for changes in stocks held by producers, line 1 - line 8		3,720.0	4,662.7	3,252.1	3,805.8	4,815.4	4,646.4	5,068.6	5,242.0	4,997.9	5,051.5	5,214.4	3,733.8	2,750.5	1,664.0	1,549.8
10 Estimated cost of transportation		487.4	501.9	652.0	715.5	739.5	761.1	823.7	844.3	846.2	858.5	886.4	619.9	495.7	346.4	333.7
11 Total sales incl. transportation cost, line 9 + line 10		4,207.4	5,164.6	3,904.1	4,521.3	5,554.9	5,407.5	5,892.3	6,086.3	5,844.1	5,910.0	6,100.8	4,353.7	3,246.2	2,010.4	1,883.5
Allocation of total sales incl. transportation cost																
12 Direct to consumers		2,074.2	2,546.1	1,924.7	2,229.0	2,738.6	2,665.9	2,904.9	3,000.5	2,881.1	2,913.6	3,007.7	2,146.4	1,600.4	991.1	928.6
13 To retailers		235.6	289.2	218.6	253.2	311.1	302.8	330.0	340.8	327.3	331.0	341.6	243.8	181.8	112.6	105.5
14 To wholesalers		1,897.5	2,329.9	1,760.7	2,039.1	2,505.3	2,438.8	2,657.4	2,744.9	2,635.7	2,665.4	2,751.5	1,963.5	1,464.0	906.7	849.5

General Note to Table VI–1

Table VI–1 shows the steps involved in passing from output of construction materials at producers' prices to the distribution of sales. Although the linear sequence, together with Notes A through F, clearly reveal the technique, it seems desirable to supplement these explanations with brief comments on the composition of certain lines in the table.

Line

1 The values for the Census years are aggregates of construction materials produced. To the total output of manufacturers as taken from Table I–5 was added the value of non-manufactured construction materials. The method of estimating the latter is described in Note A below.

In order to estimate totals for the intercensal years a production sample was compiled. This sample is shown in Note B below and covers about 30 per cent of the total production of construction materials.

4, 5 The derivation of the 1929 inventory ratio and of the index of stock ratios is described in Note C below.

10 The cost of transportation is calculated in Note E below.

12, 13, 14 The distribution of sales in all years is based on the 1929 apportionment, the same apportionment being assumed to be applicable also to transportation charges. The 1929 distribution—49.3 per cent direct to consumers, 5.6 per cent to retailers, and 45.1 per cent to wholesalers—was obtained by summating the sales distribution figures for the separate construction materials given in Note F below.

Note A to Table VI–1
OUTPUT OF NON-MANUFACTURED CONSTRUCTION MATERIALS

Sand and gravel

The data include the value of sand produced for building and paving purposes and the value of all gravel. They were obtained from Bureau of Mines reports presented in the Minerals Yearbooks and in various volumes of Mineral Resources. Data were collected only for the Census years because both manufactured and non-manufactured construction materials are treated as a single total for purposes of interpolation.

Value of Sand and Gravel Used in Construction
(*thousands of dollars*)

	TOTAL VALUE	VALUE USED IN MAKING CONCRETE PRODUCTS (UNFINISHED) [1]	VALUE USED IN CONSTRUCTION
1919	34,931	2,936	31,995
1921	48,116	2,845	45,271
1923	75,368	4,323	71,045
1925	92,359	5,864	86,495
1927	101,204	7,156	94,048
1929	116,476	7,195	109,281
1931	76,959	4,721	72,238
1933	46,272	1,960	44,312

[1] All years other than 1929 estimated on the basis of the 1929 relationship of the cost of sand and gravel to the total cost of materials in the concrete products industry as reported in the *Census of Manufactures 1929*.

Crushed stone

In 1927 and all prior years the value of crushed stone was included in the Census of Manufactures under the paving materials industry (Industry 1632). Comparison of the available data indicated that the Census figures included only the value of crushed stone of the type reported as concrete and road metal by the Bureau of Mines and not the type reported as railroad ballast. Thus for 1919–27 the value of railroad ballast alone was taken from the Bureau of Mines; for later years the total value of all crushed stone was taken.

	PRODUCTION OF CRUSHED STONE (*thousands of dollars*) [1]
1919	5,852
1921	6,378
1923	9,573
1925	10,522
1927	13,297
1929	94,388
1931	70,405
1933	39,019

[1] Prior to 1929 includes railroad ballast alone.

Note B to Table VI–I
DATA USED IN MEASURING ANNUAL PRODUCTION OF SPECIFIED CONSTRUCTION MATERIALS

COMMODITY	SOURCE OF DATA
Yellow pine (also known as eastern or southern yellow pine)	*Census of Forest Products*
Western yellow pine (also known as Ponderosa pine)	*Census of Forest Products*
Douglas fir	*Census of Forest Products*
Oak flooring	Quantity produced from *Survey of Current Business;* price data from Bureau of Labor Statistics Wholesale Price Bulletins, prices for oak, plain, white No. 1, common, Cincinnati.
Shingles	Quantity produced from *Census of Forest Products;* price data from B. L. S. Wholesale Price Bulletins, prices for shingles, cedar red, per 1000, mill

Note B to Table VI–1 (Continued)

COMMODITY	SOURCE OF DATA	COMMODITY	SOURCE OF DATA
Lath	Quantity produced from *Census of Forest Products;* price data from B. L. S. Wholesale Price Bulletins, prices for lath, pine, yellow, No. 1, per 1000, mill	Asphalt	Quantity production from *Survey of Current Business;* price data from B. L. S. Wholesale Price Bulletins, prices for asphalt, bulk, refinery
Steel, structural shapes	Quantity produced from *Statistical Abstract;* price data from B. L. S. Wholesale Price Bulletins, prices for structural steel, mill	Common brick Face brick Vitrified brick or block Enameled brick Terra cotta Hollow building tile Sewer pipe Drain tile Floor, ceramic, mosaic, enameled, faience, and wall tile Roofing tile	Bureau of the Census reports on the *Clay-Products Industries*
Cast iron pipe	Quantity produced from *Metal Statistics, 1935;* price data from B. L. S. Wholesale Price Bulletins, prices for pipe, cast iron, 6 inch, N. Y.		
Iron and steel rails	Quantity produced from *Metal Statistics, 1935;* price data from B. L. S. Wholesale Price Bulletins, prices for rails, steel, open hearth, mill		
Portland cement	*Mineral Resources of the United States* and *Minerals Yearbook*	Crushed stone	*Mineral Resources of the United States* and *Minerals Yearbook*
Building stone sold or used by producers		Sand and gravel	

Note B to Table VI-1 (Concluded)

PRODUCTION OF SPECIFIED CONSTRUCTION MATERIALS

(Used for estimating output of all construction materials in the intercensal years)

(thousands of dollars)

	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
Yellow pine, eastern	375,037	398,056	212,841	272,108	386,130	331,519	350,223	311,889	258,885	261,225	298,418	156,902	75,260	40,878	79,620
Yellow pine, western	48,702	88,692	38,600	57,748	92,805	72,173	86,624	84,496	72,880	78,411	87,040	61,022	37,324	21,737	31,379
Douglas fir	145,311	240,746	83,744	142,985	221,934	164,755	170,753	177,628	164,217	160,706	174,208	109,121	56,014	30,959	53,861
Oak flooring	8,150	16,705	8,799	18,488	25,849	26,720	34,804	38,551	34,296	33,652	25,573	15,593	11,498	4,704	5,306
Shingles	41,257	29,077	18,285	26,817	21,792	18,714	20,646	16,367	16,374	15,612	18,344	8,685	5,070	3,101	5,813
Lath	10,048	17,553	8,141	14,645	16,630	11,481	15,708	15,289	8,018	6,542	6,206	2,718	1,249	879	1,175
Steel, structural shapes	147,616	209,547	58,268	105,540	184,818	164,396	161,626	171,562	155,422	171,120	205,600	134,384	75,180	33,254	40,409
Cast iron pipe production	40,830	65,643	43,310	66,014	94,505	110,733	100,463	102,860	85,343	70,498	60,521	56,454	38,909	16,038	18,304
Iron and steel rails	108,570	140,172	99,472	88,374	124,894	104,633	119,766	138,359	120,679	113,842	117,052	80,549	49,783	17,060	16,373
Portland cement	146,735	194,439	180,778	207,170	257,684	264,047	278,524	277,965	278,855	275,973	252,154	228,780	140,960	82,022	85,584
Building stone sold or used by producers	10,614	18,949	18,976	25,749	32,417	33,176	35,445	39,923	40,595	42,770	43,905	39,112	28,111	20,185	15,338
Asphalt	12,356	17,550	18,180	24,965	25,608	28,017	33,575	35,064	41,028	39,576	41,640	39,696	35,736	24,100	23,310
Common brick	63,585	82,216	57,096	72,613	94,473	86,692	88,551	88,227	78,408	69,333	58,733	37,433	21,652	8,705	8,816
Face brick	16,033	19,441	18,128	28,234	38,892	39,931	45,428	44,516	41,521	40,034	36,120	24,615	13,271	5,273	3,807
Vitrified brick or block	11,615	12,679	12,870	10,816	15,570	12,974	11,876	10,285	10.764	7,800	7,504	6,247	4,266	2,642	1,224
Enameled brick	847	1,040	1,203	1,297	1,671	1,789	1,508	1,276	1,375	1,135	1,259	941	484	302	172
Terra cotta	3,988	10,852	9,068	12,410	16,486	16,446	19,139	19,667	16,628	13,642	13,921	10,016	5,492	2,317	1,831
Hollow building tile	17,965	27,112	14,841	19,708	28,275	24,998	29,264	27,818	26,499	25,792	30,142	22,219	11,172	4,269	2,836
Sewer pipe	16,755	25,371	22,155	23,600	29,103	32,400	30,421	29,303	29,426	23,969	21,330	15,964	9,448	3,745	4,911
Drain tile	10,946	12,525	8,368	5,149	5,100	4,817	4,960	3,858	5,511	5,256	6,516	5,012	1,667	975	1,127
Floor tile, wall tile, etc.	6,854	10,937	10,245	13,773	19,782	21,008	21,968	27,969	27,418	26,759	28,902	20,035	16,574	6,824	5,524
Roofing tile	1,284	1,533	2,314	2,824	4,022	3,833	5,155	7,016	5,349	4,764	3,944	3,900	3,125	1,283	911
Crushed stone	36,405	50,847	51,717	54,130	67,929	73,862	80,508	87,872	97,474	94,186	94,388	87,554	70,405	46,892	39,019
Sand and gravel	34,931	48,326	48,116	53,205	75,368	83,219	92,359	95,525	101,204	104,499	116,476	102,981	76,959	51,266	46,272
Total	1,316,434	1,740,008	1,045,515	1,348,362	1,881,737	1,732,333	1,839,294	1,853,285	1,718,169	1,687,096	1,749,896	1,269,933	789,609	429,410	492,922

Note C to Table VI-1

INDEXES OF PRICES OF CONSTRUCTION MATERIALS

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
1 Bureau of Labor Statistics wholesale price index for building materials, annual av., 1929 = 100[1]	103.3	121.2	157.3	102.1	102.0	113.9	107.2	106.5	104.8	99.3	98.6	100.0	94.2	83.0	74.8	80.7
2 B. L.S. index, ay. Dec. and following Jan., 1929 = 100[1]	107.1	156.2	121.6	96.8	112.2	110.3	108.6	107.8	103.9	96.3	100.2	99.0	88.4	78.8	73.8	90.1
3 Index, whichever lower, of line 1 or line 2	103.3	121.2	121.6	96.8	102.0	110.3	107.2	106.5	103.9	96.3	98.6	99.0	88.4	78.8	73.8	80.7
4 Approximate distributive mark-up (per cent)[2]		41.0	37.4	33.9	37.6	39.3	37.7	41.4	38.9	38.7	39.5	40.0	40.1	39.1	38.1	44.5
5 Line 1 + (line 1 x line 4)		170.9	216.1	136.7	140.4	158.7	147.6	150.6	145.6	137.7	137.5	140.0	132.0	115.5	103.3	116.6
6 Index of line 5, 1929 = 100		122.1	154.4	97.6	100.3	113.4	105.4	107.6	104.0	98.4	98.2	100.0	94.3	82.5	73.8	83.3
7 Line 3 + (line 3 x line 4)		170.9	167.1	129.6	140.4	153.6	147.6	150.6	144.3	133.6	137.5	138.6	123.8	109.6	101.9	116.6
8 Index of line 7, 1929 = 100		122.1	119.4	92.6	100.3	109.7	105.4	107.6	103.1	95.4	98.2	99.0	88.4	78.3	72.8	83.3

[1]Prior to 1926 the level of the price index had to be adjusted to conform with that shown by the improved index available since 1926. This was accomplished by applying to the figures prior to 1926 the ratio of the new to the old figure for 1926.

[2]An approximate mark-up of 40 per cent was assumed in 1929, and after being expressed as a margin was moved by the index of distributive margins (see Note B to Table VI-2). The margins thus computed were then expressed as mark-ups. The application of these mark-ups to the wholesale price indexes makes it possible to approximate indexes representing the movement of retail prices. These are used in Table VI-4, below.

Note D to Table VI–1
DERIVATION OF THE INVENTORY-OUTPUT RATIOS FOR CONSTRUCTION MATERIALS IN THE HANDS OF PRODUCERS

Derivation of the 1929 ratio

xamination of *Statistics of Income* revealed three industrial ivisions of the manufacturing group engaged in the produc- on of construction materials. For the first of these—stone, ay, glass and related products—both gross income and inven- ıries were reported in 1929. For the other two—sawmill and laning mill products, and metal building material and equip- ıent—only gross income was reported, although the value of ıventories was given for the entire lumber group and the en- re metal and metal products group. It was thus necessary to ɔportion the inventory totals among the respective subdivi- ons. This was done on the basis of sample data given in R. C. pstein's *Source-Book for the Study of Industrial Profits.*

For 1924–28, the period covered by Dr. Epstein's sample, in- ɛntory-sales ratios were calculated for the two subdivisions of ıe lumber group, sawmill and planing mill products, and ther wood products. Only the former of these represents con- ruction materials and the problem was to obtain a proper in- ɛntory-gross income ratio for that subdivision. An average of ıch ratio for the period was computed (the means of the three ɛntral items) and the two averages then related; i.e., the saw- ıill average ratio was taken as 100 and the other average ex- ressed as a percentage of 100 (the average ratio of other wood roducts was thus calculated at 72.4 per cent of the average ıwmill ratio on this basis). The two ratios thus obtained were pplied to the respective gross income figures taken from *!atistics of Income, 1929*, the results being preliminary esti- ıates of inventories in the lumber group for that year. Since ıe actual inventory figure for the entire lumber group was nown (see Table VII–1), it remained merely to equate the reliminary estimates to the actual total, and to adjust accord- ıgly the inventory-sales ratio for the sawmill and planing mill roducts group as derived from Dr. Epstein's data.

A similar technique, though necessarily more complicated ecause of the larger number of subdivisions, was applied to ıe metal and metal products group in order to estimate the alue of inventories in the hands of the metal building mate- al and equipment manufacturers in 1929.

The final 1929 figures for all three divisions are given here- ith. The inventory-gross income ratio thus indicated in cur-

DIVISION	GROSS INCOME	INVENTORY
	(millions of dollars)	
tone, clay, glass and related products	1,655.2	336.9
awmill and planing mill products	1,464.1	435.3
Ietal building material and equipment	902.7	152.6
Total	4,022.0	924.8

ɛnt prices is 23.0 per cent. If the gross income and inventory gures are expressed in 1929 prices (on the basis of the price ıdexes, *average for the year*, in Note C to Table VI–1), the atio becomes 23.2 per cent.

Derivation of the inventory ratios for years other than 1929

'he accompanying table reveals the method used to secure n index of inventory ratios. Commodities for which both pro- uction and inventory data were available were assembled valued in 1929 prices); comparable totals were summated for ach pair of years and linked to the totals of those years in hich the sample was most complete; finally the inventory atios and the resulting index were computed. The basic data rom which the figures appearing in the table were computed re described below. In all instances quantity data were se- cured and translated into 1929 prices by use of appropriate annual average prices for 1929.

3 *Description of construction materials used in sample*

1 Yellow pine (also known as eastern or southern): from the *Survey of Current Business* data were obtained on the production and stocks of southern pine (for 1918 and 1930–33 stock estimates were made by comparing production and shipments as given in the Survey). Total yellow pine production was then obtained from the *Census of Forest Products*. To obtain total stocks, the stock-production ratios derived from the Survey series were applied. Finally the 1929 average value of yellow pine, M ft., f.o.b. mill, shown in the *Census of Forest Products*, was used to translate the quantity figures into dollar estimates.

2 Asphalt, other than liquid: series on production and stocks were secured from the *Survey of Current Business*. For 1918–1922 only monthly average stocks were available; the December 31 stock figures were estimated on the basis of the average relationship of December 31 stocks to the monthly average for 1923–26. Total production was secured for Census years from the *Census of Manufactures;* and the Survey production data were used to interpolate for intercensal years. The Survey stock series was then adjusted to conform with the total production estimates. Finally the 1929 average value per ton taken from the *Census of Manufactures* was applied.

3 Baths: quantity data on shipments and stocks from the *Survey of Current Business* were used without alteration (the data apparently represented total output). A 1929 average price per M tons was then derived from the *Census of Manufactures* and applied to the Survey figures.

4 Lavatories: a procedure similar to that described for baths was followed.

5 Portland cement: all data were taken from the reports on cement in various volumes of *Mineral Resources of the United States* and *Minerals Yearbook*.

6 Common brick: production data for 1921–33, stock data for 1924–33, and an average 1929 price were obtained from Bureau of the Census reports on the *Clay-Products Industries*. Stocks were estimated for 1921–23 on the basis of the movement of a series on stocks of burned common brick shown in the *Survey of Current Business*.

7 Face brick: a procedure similar to that described for common brick was followed. The 1923 stock estimate was based on the movement from 1924 to 1923 of the series on face brick (average per plant) in the *Survey of Current Business*.

8 Vitrified brick or block:
9 Enameled brick:
10 Terra cotta:
11 Hollow building tile:
12 Wall coping:
13 Sewer pipe:
14 Drain tile:
15 Floor tile, ceramic, mosaic, enameled, faience and wall:
16 Roofing tile:

} data were taken from Bureau of the Census reports on the *Clay-Products Industries*

17 Sand-lime brick: data were taken from Bureau of the Census reports on *Sand-Lime Brick*.

18 Oak flooring: quantity data on production and stocks were obtained from the *Survey of Current Business*. For translation into 1929 prices, the 1929 average price for oak, plain, white, No. 1 common, Cincinnati, compiled by the U. S. Bureau of Labor Statistics was used.

Note D to Table VI-1

PRODUCTION OR SHIPMENTS OF CONSTRUCTION MATERIALS, 1929 PRICES

(thousands of dollars)

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
1 Yellow pine, eastern	278,283	335,195	284,595	281,230	295,110	332,263	320,406	339,634	301,547	279,469	272,260	298,418	191,173	113,665	78,748	114,074
2 Asphalt	6,980	10,271	14,315	12,964	19,767	23,645	24,919	25,218	26,260	29,273	30,437	34,506	31,589	27,279	21,794	19,833
3 Baths		9,410	13,957	11,265	20,313	24,543	25,968	29,994	27,031	25,628	25,267	21,355	13,391	10,428		
4 Lavatories		3,958	4,449	5,033	7,917	9,560	9,539	11,017	9,842	9,034	9,128	8,050	5,357	3,966		
5 Portland cement	104,956	126,707	142,542	141,350	174,197	201,150	216,151	232,797	240,037	254,360	260,240	252,154	235,407	188,183	119,648	95,139
6 Common brick				47,460	62,942	77,699	76,387	80,687	80,206	75,341	68,427	58,733	38,743	24,701	10,809	10,883
7 Face brick						32,615	34,287	41,803	41,212	40,756	40,739	36,120	25,031	15,252	6,486	4,560
8 Vitrified brick and block							11,296	10,990	9,543	10,256	7,707	7,504	6,117	4,221	2,712	1,285
9 Enameled brick							1,554	1,244	1,134	1,333	1,134	1,259	987	633	464	295
10 Terra cotta							14,607	15,833	16,165	16,196	14,825	13,921	10,015	5,683	2,649	2,701
11 Hollow building tile							25,593	30,589	29,655	29,785	28,786	30,142	22,792	13,959	6,002	4,402
12 Wall coping								451	685	642	705	507	409	159	79	101
13 Sewer pipe							24,849	27,229	25,384	26,937	24,123	21,330	16,180	10,477	5,588	5,741
14 Drain tile							4,501	5,017	3,939	5,571	5,267	6,516	5,123	1,920	1,131	1,275
15 Floor tile....etc.							23,539	26,200	32,972	31,722	30,442	28,902	20,554	21,025	10,009	9,924
16 Roofing tile							3,241	3,086	4,349	3,921	3,739	3,944	3,164	3,036	1,339	1,096
17 Sand-lime brick							3,058	3,405	3,567	3,448	3,384	2,910	2,063	1,551	571	248
18 Oak flooring	3,359	6,985	7,430	8,582	15,819	20,816	24,093	31,766	33,648	31,056	32,770	25,573	17,241	14,307	6,510	6,826
Comparable Totals	393,578	479,158 492,526	467,288	460,424 507,884	596,065	689,676 722,291	731,750 843,988	916,509 916,960	887,176	874,728	859,380	851,844	645,336	446,051 460,445	274,539	278,383

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VALUE OF PRODUCERS' STOCKS OF CONSTRUCTION MATERIALS, END OF YEAR, 1929 PRICES

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
1 Yellow pine, eastern	61,525	72,461	87,465	70,296	68,775	68,316	61,350	69,690	65,335	65,224	53,380	71,347	87,515	75,122	58,297	68,452
2 Asphalt	986	1,053	776	1,141	1,330	1,197	953	1,496	1,740	1,895	2,183	2,393	2,936	2,770	2,493	2,282
3 Baths		294	1,312	1,199	860	995	2,352	2,805	4,004	3,687	3,958	3,710	3,800	2,941		
4 Lavatories		339	324	808	490	606	1,413	1,651	1,911	1,529	1,500	1,118	1,543	1,168		
5 Portland cement	15,467	7,780	13,073	18,046	13,841	16,003	20,945	27,137	30,695	33,236	33,685	35,077	38,331	35,782	30,119	29,015
6 Common brick				12,132	9,037	14,266	16,080	14,810	14,874	16,560	15,749	15,856	14,469	10,979	8,280	6,925
7 Face brick						7,026	9,577	10,252	11,063	12,448	12,668	13,664	13,563	11,164	9,205	7,634
8 Vitrified brick and block							2,753	3,038	2,447	2,671	2,508	2,691	2,651	2,549	2,569	2,059
9 Enameled brick							707	751	699	810	758	766	736	884	780	957
10 Terra cotta							2,223	2,078	2,815	2,940	2,389	1,953	1,486	1,257	810	727
11 Hollow building tile							5,329	5,821	5,466	6,617	7,110	7,464	8,811	7,378	5,647	5,075
12 Wall coping								74	119	133	258	131	120	64	61	76
13 Sewer pipe							8,045	8,529	7,447	7,791	8,465	6,658	7,192	5,741	3,832	4,672
14 Drain tile							1,176	1,495	1,397	1,328	1,343	1,404	1,541	1,351	1,040	842
15 Floor tile....etc.							3,842	3,663	4,310	6,196	6,295	8,853	9,734	8,586	7,345	7,326
16 Roofing tile							403	479	1,223	963	967	1,217	1,250	1,641	1,124	958
17 Sand-lime brick							234	255	237	271	227	245	203	147	104	32
18 Oak flooring	1,352	489	2,204	1,254	1,223	2,371	2,525	2,577	4,453	4,309	5,063	4,796	4,807	3,904	3,155	3,759
Comparable Totals	79,330	81,783 82,416	105,154	92,744 104,876	95,556	103,754 110,780	115,195 139,907	156,527 156,601	160,235	168,608	158,506	179,345	200,688	169,319 173,428	134,861	140,791
Percentage that stocks are of production (after linking)	21.7	18.4	24.8	22.2	17.2	16.1	16.6	17.1	18.1	19.3	18.4	21.1	31.1	37.7	48.7	50.2

Note E to Table VI-1

DERIVATION OF FREIGHT REVENUE INDEX AND TRANSPORTATION BILL FOR CONSTRUCTION MATERIALS

	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
1 All commodities: freight revenue per ton (dollars)[1]	3.23	3.44	4.16	3.90	3.60	3.65	3.64	3.59	3.61	3.64	3.60	3.53	3.63	3.79	3.56
2 Construction materials: freight revenue per ton (dollars)[2]				3.09						2.70	2.74	2.52	2.41	2.51	2.80
3 Ratio of line 2 to line 1				.7923	.7839	.7755	.7671	.7587	.7503	.7418	.7611	.7139	.6639	.6623	.7865
4 Estimated freight revenue per ton for construction materials (dollars)	2.56	2.73	3.30	3.09	2.82	2.83	2.79	2.72	2.71	2.70	2.74	2.52	2.41	2.51	2.80
5 Index of freight revenue per ton for construction materials, 1929 = 100	93.4	99.6	120.4	112.8	102.9	103.3	101.8	99.3	98.9	98.5	100.0	92.0	88.0	91.6	102.2
6 Total output in 1929 prices corrected for changes in stocks held by producers (millions of dollars)	3,069.3	2,964.2	3,185.2	3,731.1	4,227.7	4,334.4	4,759.2	5,001.9	5,033.1	5,127.3	5,214.4	3,963.7	3,313.8	2,224.5	1,920.5
7 Estimated transportation bill assuming constant ratio of 17% (millions of dollars)[3]	521.8	503.9	541.5	634.3	718.7	736.8	809.1	850.3	855.6	871.6	886.4	673.8	563.3	378.2	326.5
8 Estimated transportation bill in current prices, line 7 x line 5 (millions of dollars)	487.4	501.9	652.0	715.5	739.5	761.1	823.7	844.3	846.2	858.5	886.4	619.9	495.7	346.4	333.7

[1] Statistics of Railways, 1933, Statement 25; Statistical Abstract, 1925, Table 391, p. 381.

[2] 1922 figure derived from special release of Interstate Commerce Commission, Comparison of Freight Revenue with Value of Commodities Transported, Class I Roads; figures for other years based on data from Freight Commodity Statistics.

[3] Based on 1928 percentages as derived from mimeographed I.C.C. release, Freight Revenue and Value of Commodities Transported on Class I Steam Railways in the U.S., Calendar Year, 1928, Statement No. 29111.

Note F to Table VI-1

DISTRIBUTION OF FACTORY SALES OF CONSTRUCTION MATERIALS (EXCL. TRANSPORTATION CHARGES), 1929

(thousands of dollars)

Industry Number	Commodity	Total	To Wholesalers Sales	Per Cent	To Retailers Sales	Per Cent	To Industrial Consumers (except Contractors) Sales	Per Cent	To Contractors and Ultimate Consumers Sales	Per Cent
	Total Construction Materials	5,214,409	2,352,955		291,937				2,569,515	
	Total Unfinished	(1,082,780)	(425,039)				(657,741)			
307	Cork insulation products incl. tiling and flooring	9,604	6,684	69.6	451	4.7			2,468	25.7
311	Lumber and timber products	769,681	3,574	46.6	93,901	12.2	(247,837)	32.2	69,271	9.0
	Construction materials	166,747	(355,097)							
	Unfinished	(602,934)								
314	Planing mill products, incl. dressed lumber, doors, sash, window and door frames, portable houses, misc. millwork and not reported by kind	1,006,307	442,775	44.0			(61,583)	6.1	501,949	49.9
	Construction materials	944,724								
	Unfinished	(61,583)								
319	Wood preserving	116,928	11,693	10.0	3,742	3.2			101,494	86.8
407	Building papers	39,376	26,894	68.3	630	1.6			11,852	30.1
411	Wall paper	30,005	20,223	67.4	9,722	32.4			60	.2
602	Blasting and detonating caps and railroad torpedoes	9,170	2,668	29.1					6,502	70.9
613	Explosives	62,953	(15,901)	29.1			(38,742)	70.9	5,892	70.9
	Construction materials	8,310	2,418	29.1						
	Unfinished	(54,643)								
626	Paints and varnishes (construction materials)	373,672	137,511	36.8	75,855	20.3			160,305	42.9
701,703,705	Total tar	25,971	16,933	65.2	5,038	19.4			4,000	15.4
	Tar (made in the coke industry)	14,652								
	Tar (made in the mfd. gas industry)	8,170								
	Residuum or tar (made in the petroleum refining industry)	3,149								
705	Total asphalt	45,547	7,060	15.5					38,487	84.5
	Liquid asphaltic road oils	11,041								
	Asphalt, other than liquid	34,506								
802	Rubber flooring	4,267	2,970	69.6	201	4.7			1,097	25.7
1001,1644	Asbestos building materials	10,424	6,004	57.6					4,420	42.4
	Asbestos pipe and boiler coverings	10,219	4,568	44.7					5,651	55.3
1002	Cement	266,808	221,984	83.2			(15,865)	5.9	28,959	10.9
	Construction materials	250,943								
	Unfinished	(15,865)								
1004	Total clay products	291,375	143,357	49.2			(38,369)	13.2	109,649	37.6
	Clay products (other than pottery)	225,221								
	Non-clay refractories (except refractory cement)	27,785								
	Unfinished clay products	(38,369)								
1005	Concrete products	89,795	17,869	19.9					71,926	80.1
1008	Window glass	25,962	25,391	97.8					571	2.2
	Obscured glass	5,256	5,140	97.3					116	2.2
	Wire glass	5,992	5,860	97.8					132	2.2

Note F to Table VI-1 (Continued)

Industry Number	Commodity	Total	To Wholesalers Sales	Per Cent	To Retailers Sales	Per Cent	To Industrial Consumers (except Contractors) Sales	Per Cent	To Contractors and Ultimate Consumers Sales	Per Cent
1008,1009	Total plate glass	54,576	14,736	79.6			(11,134)	20.4		
	Construction materials	14,736								
	Unfinished	(39,840)	(28,706)							
1009	Leaded, stained, etc. glass	5,217	5,102	97.8					115	2.2
1013	Lime (excl. agricultural)	27,146	10,071	37.1	6,868	25.3			10,207	37.6
1014	Marble, granite, slate, etc. (except monumental stone)	130,449	46,309	35.5					84,140	64.5
1017	Vitreous china and semi-vitreous or porcelain plumbing fixtures (excl. fittings)	28,957	28,088	97.0					869	3.0
	Porcelain electrical supplies	22,135	13,038	58.9					9,097	41.1
1018	Sand-lime brick	2,910	1,525	52.4					1,385	47.6
1020	Wall plaster, wall board, etc.	75,622	65,942	87.2					9,680	12.8
1101	Bolts, nuts, washers and rivets	136,846	40,280	30.6	821	.6	(94,150)	68.8		
	Construction materials	41,101								
	Unfinished	(95,745)	(1,595)							
1102	Cast-iron pipe	85,890	36,847	42.9					49,043	57.1
1104	Doors, shutters, and window sash and frames, metal	69,369	8,602	12.4	1,804	2.6			58,964	85.0
1109	Builders' hardware other than locks	58,309	21,749	37.3	7,697	13.2			28,863	49.5
1112	Rails, rail-joints, etc.	163,619	70,520	43.1					93,099	56.9
	Concrete-reinforcing bars	42,417	18,282	43.1					24,135	56.9
1113	Cut and wrought nails, spikes and tacks	7,504	1,876	44.2	375	5.0	(3,812)	50.8		
	Construction materials	2,251								
	Unfinished	(5,253)	(1,441)							
1114	Plumbers' supplies	137,463	116,844	85.0	8,248	6.0			12,372	9.0
1117	Woodscrews	12,990	2,351	18.1	312	2.4			10,327	79.5
1119,1121	Valves and fittings	90,180	74,849	83.0	902	1.0			14,429	16.0
	Specialties	50,550	22,191	43.9	8,240	16.3			20,119	39.8
1119,1121,1303	Heating apparatus	150,947	105,065						45,882	
1122	Structural and ornamental iron and steel work	482,284	100,315	20.8					381,969	79.2
1126,1127	Wire nails, brads, spikes, tacks and staples	47,917	11,979	44.2	2,396	5.0	(24,342)	50.8		
	Construction materials	14,375								
	Unfinished	(33,542)	(9,200)							
1128	Wrought pipe, welded and heavy riveted	455,277	187,119	41.1			(83,417)	58.9	184,741	
	Construction materials	371,860								
	Unfinished	(83,417)								
1204	Copper, tin and sheet-iron work, n.e.c.	222,485	46,749	26.9	33,595	15.1	(38,490)	17.3	90,551	40.7
	Construction materials	170,896								
	Unfinished	(51,589)	(13,099)							
1207	Total lighting fixtures, etc.	63,848	28,157	44.1	11,046	17.3			24,645	38.6
	Electric lighting equipment	47,804								
	Street and highway fixtures	7,337								
	Gas fixtures and equipment	3,796								
	Equipment and fixtures not reported by kind	4,921								
1303	Wiring devices	38,395	36,821	95.9	192	.5			1,382	3.6
	Interior conduits	58,158	55,774	95.9	291	.5			2,094	3.6
1305	Elevators and elevator machinery	44,044							44,044	
1632	Paving materials	27,619	4,281	15.5					23,338	84.5

Note F to Table VI-1 (Continued)

Industry Number	Commodity	Total	To Wholesalers Sales	To Wholesalers Per Cent	To Retailers Sales	To Retailers Per Cent	To Industrial Consumers (except Contractors) Sales	To Industrial Consumers (except Contractors) Per Cent	To Contractors and Ultimate Consumers Sales	To Contractors and Ultimate Consumers Per Cent
1638	Roofing, asphalt, shingles, roof coatings, etc.	101,085	65,907	65.2	19,610	19.4			15,567	15.4
	Non-manufactured products									
	Sand and gravel	109,281							109,281	
	Crushed stone	94,388							94,388	

Recapitulation	Excl. transportation cost	Incl. transportation cost
Sales to wholesalers	2,352,955	2,752,957
Sales to retailers	291,937	341,566
Sales direct to contractors and ultimate consumers	2,569,515	3,006,333
Total	5,215,409	6,100,859
Transportation bill (17%)		886,450

Note F to Table VI—1 (concluded)

Unless otherwise indicated all sales ratios were taken from *Distribution of Sales of Manufacturing Plants, 1929.*

INDUSTRY NO.	
307	Sales ratios for entire cork products industry used. All industrial sales assumed to represent sales to contractors.
311	The value of firewood (approximately one million dollars) is not included in the total. All sales of unfinished lumber and timber products not sold directly to industrial consumers assumed to be sold to wholesalers. Sales ratios used as shown in special section on lumber and timber products industry, local sales being assumed to represent sales to ultimate consumers and/or contractors.
314	The value of tanks and vats (about six million dollars) is not included in the total. All unfinished planing mill products were assumed to be sold directly to industrial consumers, and the sales ratios were adjusted in accordance with this assumption.
319	Sales ratios adjusted to include interplant transfers. All industrial sales assumed to represent sales to contractors and/or large ultimate consumers.
407, 411	All industrial sales assumed to represent sales to contractors and/or large ultimate consumers.
602	Same ratios used as for explosives consumed as construction materials (see Industry 613).
613	The value of explosives used as construction materials ($8,310 thousand) was assumed to be sold in the same proportions as all explosives, industrial sales being treated as sales to contractors.
626	Sales ratios for entire industry used, industrial sales being considered as sales to contractors and large ultimate consumers.
701, 703, 705	Sales ratios for roofing materials industry used, sales to industrial consumers being treated as sales to contractors and large ultimate consumers.
705	Sales ratios for the paving materials industry used, sales to industrial consumers being treated as sales to contractors and large ultimate consumers.
802	Same ratios used as for cork tiling and flooring (Industry 307).
001, 1644	All sales to industrial consumers treated as sales to large ultimate consumers and/or contractors.
1002	All sales of unfinished cement assumed to be sold directly to industrial consumers.
1004	Sales ratios for entire clay products (other than pottery) and non-clay refractories used. All unfinished sales assumed to be sold directly to industrial consumers.
1005	Sales ratios derived after subtraction of sales of monuments, grave markers, etc. from total. All industrial sales treated as sales to contractors and/or large ultimate consumers.
1008	Sales ratios for obscured and wire glass used for window glass. Sales to industrial consumers treated as sales to large ultimate consumers and/or contractors. In the case of plate glass all industrial sales were assumed to represent unfinished plate glass (total value of unfinished plate glass $39,840 thousand).
1009	Same ratios used for leaded, stained, etc., glass as for obscured and wire glass.
1013	Sales ratios for entire industry used, sales to industrial consumers being treated as sales to contractors and/or large ultimate consumers.
1014	Sales ratios recomputed after subtraction of monumental stone.
1014, 1017, 1018, 1020, 1102, 1104	Sales to industrial consumers treated as sales to contractors and/or large ultimate consumers.
1017	Vitreous china ratios used for vitreous and semi-vitreous fixtures.
1101	All industrial sales treated as sales of unfinished bolts, nuts, washers and rivets.
1104, 1112, 1114, 1117, 1122, 1207, 1632, 1638	Sales ratios for entire industry used, all sales to industrial consumers being treated as sales to contractors and/or large ultimate consumers.
1113, 1126, 1127	Sales ratios for nails, spikes, etc. industry utilized. All industrial sales assumed to be unfinished; remainder of unfinished assumed to be sold through wholesalers.
1119, 1121	All industrial sales of valves, fittings and specialties assumed to be to contractors and/or large ultimate consumers. The distribution data for heating apparatus were derived from the treatment of consumers' goods (Minor Group 16). Industrial sales of all types of heating apparatus were assumed to be sales to contractors and/or large ultimate consumers; all other construction material heating apparatus was considered sold through wholesalers.
1128	All industrial sales assumed to be sales of unfinished.
1204	All unfinished not sold directly to industrial consumers assumed to be sold to wholesalers.
1303	Sales ratios given for interior conduits and fittings used with all sales to industrial consumers treated as sales to contractors and/or sales to large ultimate consumers.
1305 and Non-Manufactured Products	Assumption made that all sales are directly to contractors and/or large ultimate consumers.
Transportation Bill	The percentage used was derived from a weighted average of the freight charge percentages for gravel and sand; stone, broke, ground or crushed; stone, finished, n.o.s; asphalt; posts, poles and piling; railroad ties; lumber, shingles and lath; rails, etc.; cast-iron pipe and fittings; iron and steel pipe and fittings; cement; brick, common; brick, n.o.s. and building tile; lime; plaster; sewer pipe and drain tile; paints; building paper and prepared roofing materials; and building woodwork. The values of these commodities at point of origin and the freight charge paid were used as reported by the Interstate Commerce Commission in *Freight Revenue and Value of Commodities Transported on Class I Steam Railways in the U. S., Calendar Year 1928.*

Table VI—2

MOVEMENT OF CONSTRUCTION MATERIALS TO AND FROM WHOLESALERS, CURRENT PRICES, 1919–1933

The movement of construction materials from producers to wholesalers, combined with imports, yields the total flow of these materials to wholesalers. Adjustments for changes in wholesalers' stocks and for wholesale mark-up result in an estimate of sales by wholesalers. The volume of these sales is distributed among exports, sales direct to consumers and sales to retailers.

Notes A through C, following the table, show the methods of estimate and the supporting data. Comments on the table will be found in the Preface to Part VI, Section 2.

Table VI-2

MOVEMENT OF CONSTRUCTION MATERIALS TO AND FROM WHOLESALERS, CURRENT PRICES

(millions of dollars)

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
1 Sales by producers to wholesalers (incl. transportation costs), Table VI-1, line 14		1,897.5	2,329.2	1,760.7	2,039.1	2,505.3	2,438.8	2,657.4	2,744.9	2,635.7	2,665.4	2,751.5	1,963.5	1,464.0	906.7	849.5
2 Imports		25.9	31.7	24.0	27.8	34.1	33.2	36.2	37.4	35.9	36.3	37.5	26.8	20.0	12.4	11.6
3 Total cost to wholesalers, line 1 + line 2		1,923.4	2,360.9	1,784.7	2,066.9	2,539.4	2,472.0	2,693.6	2,782.3	2,671.6	2,701.7	2,789.0	1,990.3	1,484.0	919.1	861.1
4 Ratio of stocks held by wholesalers to cost of goods to wholesalers (per cent)		16.7	17.3	19.0	15.6	14.1	15.1	15.0	13.7	13.7	13.5	15.4	17.6	19.7	27.0	28.1
5 Estimated Dec. 31 stocks held by wholesalers, line 3 x line 4	265.6[1]	321.2	408.4	339.1	322.4	358.1	373.3	404.0	381.2	366.0	364.7	429.5	350.3	292.3	248.2	242.0
6 Total cost to wholesalers corrected for changes in stocks		1,867.8	2,273.7	1,854.0	2,083.6	2,503.7	2,456.8	2,662.9	2,805.1	2,686.8	2,703.0	2,724.2	2,069.5	1,542.0	963.2	867.3
7 Index of distributive margins for dealers in construction materials		101.8	95.0	88.4	95.3	98.5	95.8	102.6	97.9	97.5	98.8	100.0	100.1	98.2	96.4	107.6
8 Margins obtained by wholesalers (per cent)		17.0	15.9	14.8	15.9	16.4	16.0	17.1	16.3	16.3	16.5	16.7	16.7	16.4	16.1	18.0
9 Mark-up obtained by wholesalers (per cent)		20.5	18.9	17.4	18.9	19.6	19.0	20.6	19.5	19.5	19.8	20.0	20.0	19.6	19.2	22.0
10 Total sales by wholesalers, line 6 + (line 6 x line 9)		2,250.7	2,703.4	2,176.6	2,477.4	2,994.4	2,923.6	3,211.5	3,352.1	3,210.7	3,238.2	3,269.0	2,483.4	1,844.2	1,148.1	1,058.1
11 Sales by wholesalers directly to consumers		495.2	594.7	478.9	545.0	658.8	643.2	706.5	737.5	706.4	712.4	719.2	546.3	405.7	252.6	232.8
12 Exports		142.0	170.6	137.3	156.3	188.9	184.5	202.6	211.5	202.6	204.3	206.2	156.7	116.4	72.4	66.8
13 Sales by wholesalers to retailers, line 10 - line 11 - line 12		1,613.5	1,938.1	1,560.4	1,776.1	2,146.7	2,095.9	2,302.4	2,403.1	2,301.7	2,321.5	2,343.6	1,780.4	1,322.1	823.1	758.5

[1]Estimated on the basis of the reported movement of stocks held by producers; see Note D to Table VI-1.

Note A to Table VI-2

IMPORTS AND EXPORTS OF CONSTRUCTION MATERIALS IN 1929 [1]

IMPORTS

COMMODITY	VALUE	DUTY	TOTAL
	(*thousands of dollars*)		
Railroad ties	736	Free	736
Poles—telegraph, telephone, etc.	4,090	Free	4,090
Clapboards	25	Free	25
Fence posts	55	5	60
Hardwood flooring	259	Free	259
Laths	3,562	Free	3,562
Shingles	6,850	Free	6,850
Pickets and palings	446	Free	446
Cork tile	60	18	78
Wall board	76	16	92
Hanging paper, printed, lithographed, dyed or colored	733	183	916
Sheathing and roofing paper	79	8	87
Building or monumental stone (except monuments...vases, etc.)	2,885	763	3,648
Sand and gravel	751	Free	751
Cement	3,000	20	3,020
Lime	391	46	437
Plate glass	2,620	2,359	4,979
Windows, stained or painted	190	95	285
Clay tiles and bricks (except magnesite brick and fire brick)	1,550	650	2,200
Sanitary earthenware...	6	3	9
Asbestos shingles and slate	751	188	939
Lumber of asbestos cement...	22	5	27
Gypsum, calcined or plaster of Paris	40	2	42
Asphalt and bitumen	956	Free	956
Iron and steel products			
Fabricated structural shapes	45	9	54
Building forms, sashes and frames	580	145	725
Rails, etc.	185	14	199
Cast-iron pipe	1,419	284	1,703
Rivets...	16	5	21
Hinges and hinge blanks	115	46	161
Builders' hardware, n.e.s.	28	11	39
Wood screws	40	10	50
Railway fish plates...	13	2	15
Bath tubs, lavatories and sinks	1	less than 0.5	1
Total	32,575	4,887	37,462

[1] For years other than 1929, 1929 ratios were used. For imports the ratio to sales *to* wholesalers was used; for exports the ratio to sales by wholesalers.

EXPORTS

COMMODITY	VALUE (*thousands of dollars*)
Railroad ties	4,334
Piling	1,719
Telegraph, trolley and electric light poles	1,107
Sawed timber, soft woods and creosoted or otherwise preserved	17,367
Boards, planks and scantlings, soft woods	62,075
Lath	234
Shingles	367
Hardwood flooring	1,150
Doors	3,987
Sash and blinds	182
Trimmings and moldings	287
Other millwork and house fixtures	280
Bristols and bristol board	286
Sheathing and building paper	757
Fiber insulating lath or board	1,014
Wall board of paper or pulp	2,233
Paper hangings (wall paper)	582
Petroleum asphalt	8,543
Stone, sand, cement and lime	6,819
Plate and window glass	1,350
Earthenware plumbing fixtures	2,825
Clay building bricks and hollow tiles, and wall and floor tiles	1,083
Asbestos pipe covering and cement	409
Gypsum plasterboard and wall board, and plaster	924
Steel-mill products	
Fabricated structural shapes	5,170
Metal lath	816
Other structural shapes	4,008
Railway track material	8,556
Tubular products and fittings (except boiler tubes)	34,092
Bath tubs, lavatories, sinks and other plumbing fixtures	1,436
Hinges and butts	523
Other builders' hardware	1,934
Wood screws	775
Copper pipes and tubes	967
Brass and bronze: pipes and tubes, pipe fittings and valves, plumbers' brass goods, brass wood screws and hinges and butts	4,781
Metal conduit, outlet and switch boxes	1,549
Sockets, receptacles and lighting switches	2,129
Electric lighting fixtures	3,240
Elevators, freight and passenger	1,387
Paints, stains and enamels	11,631
Varnishes	1,367
Composition roofing	1,886
Total	206,161

Note B to Table VI–2
INVENTORY-COST OF GOODS RATIOS FOR WHOLESALERS OF CONSTRUCTION MATERIALS

For two years, 1929 and 1933, direct data were available. The Wholesale Census data in these years made it possible to compute ratios for dealers in the major kinds of construction materials. Four types of firm were selected: dealers in paints, varnishes, lacquers and enamels, in hardware, in lumber and building materials (other than metal), and in plumbing and heating equipment and supplies. In 1929 data on sales and inventories were summated from Table 2 of the *U. S. Summary of Wholesale Distribution*, which covered wholesalers only. The sales figure was reduced to terms of cost by using the wholesale margin shown in line 8 of Table VI–2 (see Note C for derivation of this margin). In 1933 data were summated from Table 2B of *Wholesale Distribution, Volume 1, Summary for the United States*. Data were obtained not alone for wholesalers only (wholesalers proper in 1933) but also for manufacturers' sales branches. Here again the sales total was reduced to terms of cost by using the wholesale margin given in line 8 of Table VI–2. The 1933 inventory ratio thus derived was accepted as a base ratio, the level of the 1929 ratio being adjusted on the basis of 1933 relationships to allow for the effect of manu facturers' sales branches.

For years other than 1929 and 1933 it was necessary to us various extrapolating indexes. A weighted average of the in ventory ratios for producers' stocks (see Note D to Table VI– the series there given being first expressed in current price and the resultant ratios then adjusted to the correct 1929 leve and of the ratios for stocks in the hands of contractors (se Note A to Table VI–4) was used for 1928 and for 1930–32. Th weights applied were 2 and 1 respectively. The relationship o this average to the base ratios for 1929 and 1933 was ascertained and the values for 1930–32 calculated on the basis of straight lin interpolation of these relationships. In 1928 the 1929 relation ship was used. From 1924 to 1927 inventory ratios based upo a sample of wholesale lumber and building material, and hard ware corporations as reported in Dr. Epstein's *Source-Boo* were used as the extrapolating index. Prior to 1924 the serie for producers' stocks alone was available. The calculations inci dental to the derivation of the final wholesale ratios are show in the accompanying table.

Note C to Table VI–2
THE WHOLESALE MARK-UP AND THE DISTRIBUTION OF SALES BY WHOLESALERS

Lack of satisfactory commodity sales data necessitated the application of a wholesale mark-up. In 1929 an approximation of 20 per cent was adopted. This was derived from a study of the operating expense ratios of the various types of paint, varnish, enamel and lacquer, lumber and building materials (other than metal), and plumbing and heating equipment and supply wholesalers. These ratios, reported in Tables 5, 6 and 7 of the *U. S. Summary of Wholesale Distribution*, were averaged, a small profit allowance added, and the result transposed to a cost basis.

For years other than 1929 an index of distributive margins of dealers in construction materials was calculated. Its composition is given in the table following this note. The index was applied to the 1929 estimated margin figure and the resultant margins then expressed as mark-ups (lines 7, 8 and 9 of Table VI–2).

The 1929 percentage of sales by wholesalers direct to consumers was derived from data in Tables 3 and 13 of the *U. S. Summary of Wholesale Distribution*. From Table 3 were taken th net sales and the sales direct to consumers of paint and var nish . . . , log, pile and post, railroad tie, builders' hardware heavy hardware, lumber and building material, and plumbin and heating equipment and supply wholesalers. Total net sale were reduced by 15 per cent to eliminate duplication (removal of agents', brokers', etc. sales) on the basis of pertinent com modity data reported in Table 13. The value of direct sales wa then expressed as a percentage of the corrected net sales total and this figure, 22 per cent, used for both 1929 and all othe years.

The subtraction of sales direct to consumers and of export (estimated for years other than 1929 on the basis of the 192 ratio to total wholesale sales) from total wholesale sales left as remainder wholesale sales to retailers.

Note B to Table VI-2

DERIVATION OF INVENTORY—COST OF GOODS RATIOS FOR WHOLESALERS OF CONSTRUCTION MATERIALS

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
1 Sales, Epstein sample, lumber and building material, and hardware wholesalers (millions of dollars)							225.0	230.0	227.0	220.0	217.0					
2 Estimated cost of goods (millions of dollars)							189.0	190.7	190.0	184.1	181.2					
3 Inventories, Epstein sample (millions of dollars)							49.5	49.7	45.5	43.9	42.5					
4 Ratio of line 3 to line 2 (per cent)							26.2	26.1	23.9	23.8	23.5					
5 Wholesale Census inventory ratio to cost of goods (per cent)												15.4				28.1
6 Average of inventory ratio of producers' stocks (weight 2) and inventory ratio of contractors' stocks (weight 1) (per cent)											20.1	23.0	27.8	32.9	47.8	53.1
7 Estimated inventory ratio to cost of goods for wholesalers, (per cent)							15.1	15.0	13.7	13.7	13.5	15.4	17.6	19.7	27.0	28.1
8 Inventory ratio of producers' stocks (per cent)	24.0	20.3	21.1	23.2	19.0	17.2	18.4									
9 Estimated inventory - cost of goods ratios for wholesalers (per cent)	19.7	16.7	17.3	19.0	15.6	14.1	15.1	15.0	13.7	13.7	13.5	15.4	17.6	19.7	27.0	28.1

Note C to Table VI-2

INDEX OF DISTRIBUTIVE MARGINS OF DEALERS IN CONSTRUCTION MATERIALS, 1926 = 100

	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
Retail hardware chains (74)[1]	99.6	93.0	86.6	93.3	95.8	91.9	97.2	100.0	101.8	98.2	95.4	95.1			
Retail hardware stores (75)				94.5	98.4	96.9	99.0	100.0	101.6	102.3	103.5	103.9	102.0	100.0	111.7
Retail hardware stores (77)						101.4	98.2	100.0	98.9						
Retail lumber yards, Wyoming and Colorado (82)						97.9	121.2	100.0	104.7	106.8	111.9				
Wholesale plumbing supplies (84)						100.9	108.0	100.0	103.3						
Building material dealers															
Sales over 75% lumber (78)								100.0	96.8	104.0					
Sales over 75% mason materials (79)								100.0	99.6	97.1					
Sales over 75% lumber and mason materials (80)								100.0	95.6	98.0					
Sales over 75% mason materials and coal (81)								100.0	93.2	96.6					
Arith. average	99.6	93.0	86.6	93.9	97.1	97.8	104.8	100.0	99.5	100.4	103.6	99.5	102.0	100.0	111.7
Comparable arith. averages	99.6	93.0	86.6	93.3											
				93.9	97.1	94.4									
						97.8	104.8	100.0							
								100.0	99.5						
									99.0	100.4					
										102.4	103.6				
											99.4	99.5			
												103.9	102.0	100.0	111.7
Linked arith. average, 1926 = 100	103.9	97.0	90.3	97.3	100.6	97.8	104.8	100.0	99.5	100.9	102.1	102.2	100.3	98.4	109.9
Linked average, 1929 = 100	101.8	95.0	88.4	95.3	98.5	95.8	102.6	97.9	97.5	98.8	100.0	100.1	98.2	96.4	107.6

[1]The numbers in parentheses refer to the entry numbers in Table IV-5.

Table VI—3

MOVEMENT OF CONSTRUCTION MATERIALS TO AND FROM RETAILERS, CURRENT PRICES, 1919–1933

The flow of construction materials to retailers, adjusted for changes in retailers' stocks and raised by the retail mark-up, yields the volume of sales by retailers. The methods of estimate and the supporting data are reviewed in Notes A through C following the table. Some comments upon it will be found in the Preface to Part VI, Section 2.

Table VI—4

MOVEMENT OF CONSTRUCTION MATERIALS TO AND FROM ULTIMATE CONSUMERS, CURRENT PRICES, 1919–1933

The movement of construction materials to their ultimate consumers is derived from the preceding tables. This table provides a measure of changes in stocks of construction materials in the hands of their consumers, and thus yields an estimate of the volume of materials consumed. The derivation of consumers' stocks of construction materials is described in Note A following the table. The table is discussed in the Preface to Part VI, Section 2.

Table VI-3

MOVEMENT OF CONSTRUCTION MATERIALS TO AND FROM RETAILERS, CURRENT PRICES

(millions of dollars)

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
1 Total cost to retailers		1,849.1	2,227.3	1,779.0	2,029.3	2,457.8	2,398.7	2,632.4	2,743.9	2,629.0	2,652.5	2,685.2	2,024.2	1,503.9	935.7	864.0
2 Ratio of stocks held by retailers to cost to retailers (per cent)	32.3	27.4	28.4	31.3	25.6	23.2	24.8	25.1	24.0	23.5	25.0	29.0	28.5	30.9	47.9	55.3
3 Estimated Dec. 31 stocks held by retailers, line 1 x line 2	419.0	506.7	632.6	556.8	519.5	570.2	594.9	660.7	658.5	617.8	663.1	778.7	576.9	464.7	448.2	477.8
4 Total cost to retailers adjusted for changes in stocks		1,761.4	2,101.4	1,854.8	2,066.6	2,407.1	2,374.0	2,566.6	2,746.1	2,669.7	2,607.2	2,569.6	2,226.0	1,616.1	952.2	834.4
5 Index of distributive margins for dealers in construction materials		101.8	95.0	88.4	95.3	98.5	95.8	102.6	97.9	97.5	98.8	100.0	100.1	98.2	96.4	107.6
6 Margin obtained by retailers (per cent)		27.4	25.6	23.8	25.6	26.5	25.8	27.6	26.3	26.2	26.6	26.9	26.9	26.4	25.9	28.9
7 Mark-up obtained by retailers (per cent)		37.7	34.4	31.2	34.4	36.1	34.8	38.1	35.7	35.5	36.2	36.8	36.8	35.9	35.0	40.6
8 Total sales by retailers, line 4 + (line 4 x line 7)		2,425.4	2,824.3	2,433.5	2,777.5	3,276.1	3,200.2	3,544.5	3,726.5	3,617.4	3,551.0	3,515.2	3,045.2	2,196.3	1,285.5	1,173.2

Table VI-4

MOVEMENT OF CONSTRUCTION MATERIALS TO AND FROM ULTIMATE CONSUMERS

(millions of dollars)

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
1 Total cost to ultimate consumers in current prices		4,994.8	5,965.1	4,837.1	5,551.5	6,673.5	6,509.3	7,155.9	7,464.5	7,204.9	7,177.0	7,242.1	5,737.9	4,202.4	2,529.2	2,334.6
2 Total cost in 1929 prices		4,090.7	3,863.4	4,956.0	5,534.9	5,884.9	6,175.8	6,650.5	7,177.4	7,322.1	7,308.6	7,242.1	6,084.7	5,093.8	3,427.1	2,802.6
3 Ratio of stocks held by contractors to cost of materials (per cent)		21.9	29.5	26.4	20.4	19.1	19.7	20.3	21.5	23.0	19.5	23.3	20.1	20.7	37.3	48.3
4 Estimated Dec. 31 stocks held by consumers in 1929 prices, line 2 x line 3	869.0[1]	895.9	1,139.7	1,308.4	1,129.1	1,124.0	1,216.6	1,350.1	1,543.1	1,684.1	1,425.2	1,687.4	1,223.0	1,054.4	1,278.3	1,353.7
5 Changes in stocks in 1929 prices		+26.9	+243.8	+168.7	-179.3	-5.1	+92.6	+133.5	+193.0	+141.0	-258.9	+262.2	-464.4	-168.6	+223.9	+75.4
6 Changes in stocks in current prices		+32.8	+376.4	+164.7	-179.8	-5.8	+97.6	+143.6	+200.7	+138.7	-254.2	+262.2	-437.9	-139.1	+165.2	+62.8
7 Total cost to consumers of construction materials consumed, in current prices, line 1 - line 6		4,962.0	5,588.7	4,672.4	5,731.3	6,679.3	6.411.7	7,012.3	7,263.8	7,066.2	7,431.2	6,979.9	6,175.8	4,341.5	2,364.0	2,271.8

[1]Estimated on the basis of the reported movement of stocks held by producers; see Note D to Table VI-1.

Note A to Table VI–3

INVENTORY-COST OF GOODS RATIOS FOR RETAILERS OF CONSTRUCTION MATERIALS

The technique employed was similar to that described in Note B to Table VI–2. Base ratios were calculated for 1929 and 1933, sales and inventory data for the lumber and building group being available in the Retail Census for these years. The sales totals were reduced to cost by use of the respective margins (see Note B below for the derivation of the margins). The base ratios thus obtained were then moved by the use of various extrapolating indexes, the calculations involved being shown in the accompanying table.

Note B to Table VI–3

RETAIL MARK-UP OF CONSTRUCTION MATERIALS

In 1929 a retail margin figure of 26.9 per cent was obtained from an unpublished release by the Bureau of Foreign and Domestic Commerce: *Summary of Estimated Net Retail Sales, Gross Margin, Operating Expenses and Net Profit by Leading Trades.* This percentage represented the operating expense figure of 26.0 per cent shown by the data in the 1929 Retail Census plus an allowance of 0.9 per cent for profit.

For years other than 1929 the index of distributive margins described in Note C to Table VI–2 was applied to the 1929 margin. The margins thus calculated were then expressed as mark-ups.

Note A to Table VI–4

INVENTORY-COST OF GOODS RATIOS FOR CONSUMERS OF CONSTRUCTION MATERIALS

The procedure by which the 1929 ratios were derived is as follows:

From a special tabulation of the *Census of Construction* figures were obtained for firms doing a business of more than $25,000.

Type of firm	Number	Value of work done (*thousands of dollars*)	Average work per firm
Corporate	11,086	3,112,195	280.7
All other	19,520	1,683,456	86.2
Total	30,606	4,795,651	156.7

From Table VII of the Census the following data were obtained for firms doing a business of less than $25,000.

Total	113,799	983,681	8.6
Grand total, all firms		5,779,332	

In order to obtain a figure for average work per firm for corporations 'under $25,000' the same relationship between corporate and total was assumed as shown in the special tabulation for those 'over $25,000'. The average per corporate firm 'under $25,000' was thus estimated at $15,480.

The next step was to obtain the total number of construction corporations. As reported in *Statistics of Income* there were 19,659 construction corporations in 1929. Comparison of this figure with the special Census tabulation indicates that there were 8,573 corporations that presumably did a business of less than $25,000 in 1929. When multiplied by the estimated average work per firm, these residual corporations represented a total business of $132,710 thousand. This figure was added to the corporate figure shown in the special Census tabulation, and a total of work done by all corporate firms thus obtained, a total which represented 56.1 per cent of the total work reported in the Census for all firms.

Corporate inventories for 1929 as estimated from *Statistics of Income* and given in Table VII–1 below were $320.2 million. On the basis of the raising ratio indicated above a total estimate of $570.8 million, which included all stocks for the volume of business covered by the *Census of Construction,* was derived. When this final inventory estimate is expressed as a percentage of the cost of materials ($2,477.6 million as indicated in Census Table VII) used in the volume of business covered by the Census, an inventory-cost of goods ratio of 23.0 per cent is obtained.

The inventory ratio just calculated is a ratio in terms of current prices. In order to get a similar ratio in 1929 prices, the inventory and cost of materials figures need to be adjusted by the appropriate price indexes, average for the year, shown in Note C to Table VI–1. Thus calculated the 1929 inventory ratio becomes 23.3 per cent.

For years other than 1929 two extrapolating indexes were used: for 1926–33 data for construction corporations as derived from *Statistics of Income,* and for years prior to 1926 the series based on the sample used for stocks in the hands of producers (Note D to Table VI–1). As is shown by the accompanying table all calculations were carried through in terms of 1929 prices. In 1918 the actual movement of the sample of producers' stocks (Note D to Table VI–1) was used to extrapolate the 1919 estimate of stocks held by consumers.

Note A to Table VI-3

DERIVATION OF INVENTORY—COST OF GOODS RATIOS FOR RETAILERS OF CONSTRUCTION MATERIALS

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
1 Sales, Epstein sample, lumber and building material and hardware retailers, and hardware, and lumber and building material wholesalers and retailers (millions of dollars)							83.0	85.0	88.0	87.0	84.0					
2 Estimated cost of goods (millions of dollars)							61.6	61.5	64.9	64.2	61.7					
3 Inventories, Epstein sample (millions of dollars)							22.2	22.4	22.6	21.9	22.4					
4 Ratio of line 3 to line 2 (per cent)							36.0	36.4	34.8	34.1	36.3					
5 Retail Census inventory-cost of goods ratio (per cent)												29.0				55.3
6 Average of inventory ratio of producers' stocks (weight 1) and inventory ratio of contractors' stocks (weight 2) (per cent)											19.8	23.0	23.4	26.3	42.3	50.7
7 Estimated inventory-cost of goods ratio for retailers (per cent)							24.8	25.1	24.0	23.5	25.0	29.0	28.5	30.9	47.9	55.3
8 Inventory ratio of producers' stocks (per cent)	24.0	20.3	21.1	23.2	19.0	17.2	18.4									
9 Estimated inventory-cost of goods ratio for retailers (per cent)	32.3	27.4	28.4	31.3	25.6	23.2	24.8	25.1	24.0	23.5	25.0	29.0	28.5	30.9	47.9	55.3

Note A to Table VI-4

DERIVATION OF INVENTORY—COST OF MATERIALS RATIOS FOR STOCKS HELD BY CONSTRUCTION COMPANIES

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
Current Prices																
1 Cost of goods sold, construction corporations (Statistics of Income) (millions of dollars)									1,957.7	2,086.5	2,051.1	2,017.1	2,003.3	1,400.8	571.4	392.9
2 Inventories, construction corporations (Statistics of Income) (millions of dollars)									273.4	305.7	263.2	304.8	248.4	180.4	138.0	124.6
3 Ratio of line 2 to line 1 (per cent)									14.0	14.7	12.8	15.1	12.4	12.9	24.2	31.7
4 Index, line 3, 1929 = 100									92.7	97.4	84.8	100.0	82.1	85.4	160.3	209.9
5 Inventory ratio of stocks held by contractors to cost of materials (per cent)									21.3	22.4	19.5	23.0	18.9	19.6	36.9	48.3
1929 Prices																
1 Cost of goods...in 1929 prices (millions of dollars)									1,882.4	2,120.4	2,088.7	2,017.1	2,124.4	1,697.9	774.3	471.7
2 Inventories...in 1929 prices (millions of dollars)									265.2	320.4	268.0	307.9	281.0	230.4	189.6	149.6
3 Ratio of line 2 to line 1 (per cent)									14.1	15.1	12.8	15.3	13.2	13.6	24.5	31.7
4 Index, line 3, 1929 = 100									92.2	98.7	83.7	100.0	86.3	88.9	160.1	207.2
5 Inventory ratio of stocks held by contractors to cost of materials (per cent)									21.5	23.0	19.5	23.3	20.1	20.7	37.3	48.3
6 Ratio of stocks of producers' of construction materials to production (Note D to Table VI-1) (per cent)	21.7	18.4	24.8	22.2	17.2	16.1	16.6	17.1	18.1							
7 Estimated inventory ratio of stocks held by contractors to cost of materials (per cent)	25.8	21.9	29.5	26.4	20.4	19.1	19.7	20.3	21.5	23.0	19.5	23.3	20.1	20.7	37.3	48.3

Table VI—5

TOTAL CONSTRUCTION, 1919–1933
(ESTIMATES DERIVED FROM CONSUMPTION OF CONSTRUCTION MATERIALS)

In this table the value of construction materials consumed (see Table VI–4) is combined with data on the ratio of cost of materials to total cost of construction to yield a global estimate of total construction. Different assumptions concerning the movement of the materials-total cost ratio result in several variants of the estimate of total construction.

Notes A through D following the table describe in detail the data used in approximating the movement over the period in the ratio of the value of materials consumed to the total cost of construction. Some discussion of the table will be found in the Preface to Part VI, Section 3.

Table VI-5

VOLUME OF ALL CONSTRUCTION

(Estimates derived from consumption of construction materials)

(millions of dollars)

	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
1 Total cost of construction materials to consumers in current prices adjusted for changes in stocks (Table VI-4, line 7)	4,962.0	5,588.7	4,672.4	5,731.3	6,679.3	6,411.7	7,012.3	7,263.8	7,066.2	7,431.2	6,979.9	6,175.8	4,341.5	2,364.0	2,271.8
Volume of construction based on constant 1929 ratios given varying weights															
2 Percentage of cost of materials to cost of materials and wages and salaries	54.2	54.1	54.1	54.3	54.1	54.1	54.2	54.2	54.1	54.0	53.9	53.5	53.4	53.2	53.4
3 Cost of materials and wages and salaries, line 1 ÷ line 2	9,155.0	10,330.3	8,636.6	10,554.9	12,346.2	11,851.6	12,937.8	13,401.8	13,061.4	13,761.5	12,949.7	11,543.6	8,130.1	4,443.6	4,254.3
4 Percentage of materials and wages and salaries to total construction	80.6	80.2	80.1	80.5	80.9	80.7	80.8	80.8	80.5	80.3	79.9	78.8	78.1	76.7	76.6
5 Volume of construction, line 3 ÷ line 4	11,358.6	12,880.7	10,782.3	13,111.7	15,261.1	14,686.0	16,012.1	16,586.4	16,225.3	17,137.6	16,207.4	14,649.2	10,409.9	5,793.5	5,553.9
Volume of construction based on changing ratios and weights															
6 Percentage of materials to materials and wages and salaries	53.7	53.5	52.2	57.1	60.7	54.9	55.2	54.5	51.8	53.1	53.9				
7 Estimated cost of materials and wages and salaries, line 1 ÷ line 6	9,240.2	10,446.2	8,951.0	10,037.3	11,003.8	11,678.9	12,703.4	13,328.1	13,641.3	13,994.7	12,949.7				
8 Percentage of materials and wages and salaries to total construction	76.0	78.3	79.5	79.5	79.7	80.7	81.1	81.1	80.9	80.5	79.9				
9 Volume of construction, line 7 ÷ line 8	12,158.2	13,341.3	11,259.1	12,625.5	13,806.5	14,472.0	15,663.9	16,434.2	16,861.9	17,384.7	16,207.4				
10 Estimated volume of public works, 1929-33, using line A-III-3, Table VI-6, as an index											4,505.7	4,692.7	4,097.9	3,249.6	3,057.4
11 Cost of materials and wages and salaries, public works, 1929-33, 1929 percentage (see Note C) held constant											3,271.1	3,406.9	2,975.1	2,359.2	2,219.7
12 Cost of materials, public works, 1929-33, 1929 percentage (see Note A) held constant											1,733.7	1,805.7	1,576.8	1,250.4	1,176.4
13 Cost of materials for construction other than public works, 1929-33, line 1 - line 12											5,246.2	4,370.1	2,764.7	1,113.6	1,095.4
14 Wages and salaries for construction other than public works, 1929-33, (line 7 - line 1 - line 11 + line 12 in 1929) multiplied by the index in Note B to Table VI-5											4,432.4	3,962.6	2,464.4	1,152.4	913.1
15 Line 13 + line 14												8,332.7	5,229.1	2,266.0	2,008.5

Table VI-5 (concluded)

	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
16 Percentage of materials and wages and salaries to total construction other than public works												84.1	85.7	87.0	81.9
17 Volume of construction other than public works, line 15 ÷ line 16												9,908.1	6,101.6	2,604.6	2,452.4
18 Volume of all construction, line 9, and line 10 + line 17	12,158.2	13,341.3	11,259.1	12,625.5	13,806.5	14,472.0	15,663.9	16,434.2	16,861.9	17,384.7	16,207.4	14,600.8	10,199.5	5,854.2	5,509.8
Volume of construction based on constant 1929 ratios given varying weights and applied to materials in 1929 prices															
19 Total cost of materials in 1929 prices adjusted for changes in stocks (Table VI-4, line 2 - line 5)	4,063.8	3,619.6	4,787.3	5,714.2	5,890.0	6,083,2	6,517.0	6,984.4	7,181.1	7,567.5	6,979.9	6,549.1	5,262.4	3,203.2	2,727.2
20 Cost of materials and wages and salaries in 1929 prices, line 19 ÷ line 2	7,497.8	6,690.6	8,849.0	10,523.4	10,887.2	11,244.4	12,024.0	12,886.3	13,273.8	14,013.9	12,949.7	12,241.3	9,854.7	6,021.1	5,107.1
21 Volume of construction in 1929 prices, line 20 ÷ line 4	9,302.5	8,342.4	11,047.4	13,072.5	13,457.6	13,933.6	14,881.2	15,948.4	16,489.2	17,451.9	16,207.4	15,534.6	12,618.1	7,850.2	6,667.2
22 Index of construction costs (See Note D)	100.6	129.7	98.9	95.4	106.0	104.7	101.9	101.3	101.4	100.4	100.0	97.3	88.7	80.0	82.1
23 Volume of construction in current prices, line 21 x line 22	9,358.3	10,820.1	10,925.9	12,471.2	14,265.1	14,588.5	15,163.9	16,235.5	16,720.0	17,521.7	16,207.4	15,115.2	11,192.3	6,280.2	5,473.8

Note A to Table VI-5

DERIVATION OF PERCENTAGES OF COST OF MATERIALS TO COST OF MATERIALS AND WAGES AND SALARIES

	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
1 Percentage of cost of materials to cost of materials and wages and salaries, Pennsylvania	52.6	52.5	51.2								53.1				
2 Index of line 1, 1929 = 100	99.1	98.9	96.4								100.0				
3 U.S. Bureau of Labor Statistics wholesale price index for building materials			100.3	100.2	111.9	105.4	104.7	104.8	99.3	98.6	100.0				
4 National Industrial Conference Bureau index of wage rates			80.1	75.7	82.0	88.3	90.3	94.5	97.1	97.2	100.0				
5 B. of L.S. price index expressed as percentage of preceding year				99.9	111.7	94.2	99.3	100.1	94.8	99.3	101.4				
6 N.I.C.B. index expressed as percentage of preceding year				94.5	108.3	107.7	102.3	104.7	102.9	100.1	102.9				
7 Ratio of 5 to 6, per cent				105.7	103.1	87.5	97.1	95.6	92.2	99.2	98.5				
8 Logarithms of line 7				2.02407	2.01326	1.94201	1.98722	1.98046	1,96473	1.99651	1.99344				
9 Logarithms of line 2			1.98408								2.00000				
10 Interpolation of line 9 based on lines 8 and 9			1.98408	2.02243	2.04997	2.00626	2.00776	2.00250	1.98151	1.99230	2.00000				
11 Index of percentages of cost of materials to cost of materials and wages and salaries	99.1	98.9	96.4	105.3	112.2	101.5	101.8	100.6	95.8	98.2	100.0				
12 Percentage of cost of materials to materials and wages and salaries, private construction	54.8	54.7	53.3	58.2	62.0	56.1	56.3	55.6	53.0	54.3	55.3				
13 Percentage of cost of materials to materials and wages and salaries, public utility construction	50.7	50.6	49.4	53.9	57.4	52.0	52.1	51.5	49.0	50.3	51.2				
14 Percentage of cost of materials to materials and wages and salaries, public works	52.5	52.4	51.1	55.8	59.5	53.8	54.0	53.3	50.8	52.0	53.0				
15 Weighted average varying percentages, varying weights (weights from Table VI-6-B)	53.7	53.5	52.2	57.1	60.7	54.9	55.2	54.4	51.8	53.1	53.9				
16 Weighted average holding 1929 percentage constant, but varying weights (weights from Table VI-6-B)	54.2	54.1	54.1	54.3	54.1	54.1	54.2	54.2	54.1	54.0	53.9	53.5	53.4	53.2	53.4

Note A to Table VI–5 (Continued)

Line 1

The 1929 percentage was calculated from data in the Construction Census, Table 8 of the report on Pennsylvania. In order to make the percentage comparable with those derived for the earlier years only the following types of construction establishment were included: building, highway, street paving, railroad, electrical, heating and plumbing, masonry, painting and decorating, roofing and sheet-metal work, steel erection, stonework and marble and tiling.

The percentages for 1919–21 were derived from the Pennsylvania *Reports on Productive Industries* for the respective years. From these reports the percentages of wages and salaries to total construction were obtained. In order to break down the complementary percentages, which included materials and gross profits, it was necessary to estimate gross profits ratios. This was done by applying the index of gross profits ratios in line 8, Note C below, to the 1929 ratio as calculated from the data for Pennsylvania in the Construction Census. By subtracting the estimated gross profits percentages from 100 in each year residuals representing wages and salaries and materials were obtained. Since the percentages of wages and salaries to total construction were known, the materials percentage could then be easily derived. It remained only to express the materials percentages as percentages of the totals of wages and salaries and materials.

Lines 12, 13, 14

The 1929 percentage was calculated from Table 8 of the Construction Census, the numerous classes of establishments reported there being divided among private, public utility, and public construction. The establishments were grouped as follows:

Private: General building contractors and the following types of subcontractors: carpentering and wood flooring, concreting, electrical, elevator construction, heating and plumbing, masonry, glass and glazing, roofing and sheet-metal work, steel erection, stonework, marble and tiling, wrecking, excavating, and ornamental iron.

Public utility: General contractors: railroad, foundation, central station, light and power plant, air transport work, oil and natural gas pipe line, vehicular subway and tunnel, telephone line and system, radio tower, etc., and miscellaneous, n.e.s. Subcontractors: railroad, foundation, power plant, metal work, n.e.s., and pipe line.

Public: General contractors: highway, bridge and culvert, grading, street paving, sewer, gas, water, conduit, dam and reservoir, waterworks, dredging, river, harbor, etc., levee, refuse disposal plant, and subway (other than buildings). Subcontractors: highway, bridge and culvert, grading, street paving, sewer, gas, water, conduit, dam and reservoir, waterworks, dredging, river, harbor, etc.

Other years were estimated by applying the index shown in line 11.

Lines 15, 16

The derivation of the weights is shown in Table VI–6.

Note B to Table VI–5

INDEX OF WAGES AND SALARIES, 1929 = 100 [1]

	1929	1930	1931	1932	1933
1 Number of wage earners	1,209,254	1,044,795	706,204	490,957	447,424
2 Number of salaried workers	129,064				
3 Ratio of salaried workers to wage earners	.1067	.1236	.1290	.1393	.1449
4 Estimated number of salaried workers	129,064	129,137	91,100	68,390	64,832
5 Estimated average salary (dollars)	2,937	2,834	2,628	2,235	1,903
6 Estimated total salaries (thousands of dollars)	379,061	365,974	239,411	152,852	123,375
7 Estimated total wages (thousands of dollars)	2,141,588	1,887,376	1,161,960	502,011	394,969
8 Total salaries and wages (thousands of dollars)	2,520,649	2,253,350	1,401,371	654,862	518,344
9 Index, line 8, 1929 = 100 [2]	100.0	89.4	55.6	26.0	20.6

[1] These data were taken from the *National Income Study*. The wage earner figures were derived from the 1929 *Census of Construction* and extrapolated by a six state employment index. The movement of salaried workers was determined by using the ratio of salaried workers to wage earners in non-metal mining. Average wage data were obtained from special tabulations of the Department of Commerce; the movement of average salaries was based on that of average salaries in non-metal mining.

[2] This index was applied only to wages and salaries on construction other than public works. In public construction the 1929 ratios of materials and of wages and salaries to the total value of materials and payroll were held constant for years after 1929. The validity of this procedure was indicated by a comparison of material and payroll expenditures by the government (Public Works funds, R. F. C. funds, and regular governmental appropriations) for selected types of public construction in 1934 and 1935 with the 1929 Census percentages for similar types of construction. Further indication of constancy was afforded by examination of the data on highway construction in the 1935 *Census of Construction*.

Note C to Table VI-5

PERCENTAGES OF GROSS PROFITS TO SALES FOR MANUFACTURERS OF CONSTRUCTION MATERIALS AND DERIVATION OF SIMILAR RATIOS FOR CONSUMERS OF CONSTRUCTION MATERIALS

(dollar values in millions)

	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
1 Gross sales of lumber and wood products corporations[1]	2,373.9[2]	3,179.6[2]	1,773.1[2]	2,306.0	2,863.9	2,723.7	2,803.0	2,938.0	2,694.8	2,730.8	2,684.1	1,910.4	1,284.7	794.0	931.1
2 Gross sales of stone, clay and glass products corporations[1]	813.3[2]	1,278.0[2]	926.1[2]	1,138.3	1,328.6	1,348.9	1,456.8	1,618.9	1,558.1	1,604.5	1,612.5	1,374.6	1,009.2	644.3	691.2
3 Line 1 + line 2	3,187.2	4,457.6	2,699.2	3,444.3	4,192.5	4,072.6	4,259.8	4,556.9	4,252.9	4,335.3	4,296.6	3,285.0	2,293.9	1,438.3	1,622.3
4 Gross profits of lumber and wood products corporations[3]	758.0	891.4	443.9	638.4	768.1	661.8	664.9	683.0	621.9	642.4	633.9	374.7	207.8	106.1	227.3
5 Gross profits of stone, clay and glass products corporations[3]	315.3	443.1	314.8	352.8	446.9	450.8	476.6	537.1	509.4	525.3	537.4	423.2	293.6	175.8	227.1
6 Line 4 + line 5	1,073.3	1,334.5	758.7	991.2	1,215.0	1,112.6	1,141.5	1,220.1	1,131.3	1,167.7	1,171.3	797.9	501.4	281.9	454.4
7 Percentage of line 6 to line 3	33.7	29.9	28.1	28.8	29.0	27.3	26.8	26.8	26.6	26.9	27.3	24.3	21.9	19.6	28.0
8 Index of percentages of gross profit to gross sales	123.4	109.5	102.9	105.5	106.2	100.0	98.2	98.2	97.4	98.5	100.0	89.0	80.2	71.8	102.6
9 Percentage, private construction[4]	20.0	17.7	16.7	17.1	17.2	16.2	15.9	15.9	15.8	16.0	16.2	14.4	13.0	11.6	16.6
10 Percentage, public utility[4]	25.2	22.3	21.0	21.5	21.7	20.4	20.0	20.0	19.9	20.1	20.4	18.2	16.4	14.6	20.9
11 Percentage, public works[4]	33.8	30.0	28.2	28.9	29.1	27.4	26.9	26.9	26.7	27.0	27.4				
12 Weighted average, all construction, varying percentages, varying weights[5]	24.0	21.7	20.5	20.5	20.3	19.3	18.9	18.9	19.1	19.5	20.1	15.9[6]	14.3[6]	13.0[6]	18.1[6]
13 Weighted averages holding 1929 percentage constant, but varying weights[5]	19.4	19.8	19.9	19.5	19.1	19.3	19.2	19.2	19.5	19.7	20.1	21.2	21.9	23.3	23.4

[1] Data from Statistics of Income.

[2] Estimated on the basis of the movement of gross income.

[3] Data from Statistics of Income; the figures represent the difference between sales and cost of goods.

[4] 1929 figure derived from Census of Construction; for types of establishment included, see Note A above; all other years obtained by use of index shown in line 8.

[5] The weights used are those given in Table VI-6-B.

[6] Weighted average of private and public utility alone.

Note D to Table VI-5

COMPOSITE INDEX OF CONSTRUCTION COSTS, 1929=100

	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
1 Building construction costs, all types, American Appraisal Co.	104.1	131.5	100.5	92.8	104.1	102.7	99.7	100.0	100.2	99.7	100.0	96.8	83.8	74.0	71.6
2 Aberthaw index of cost of factory building	91.0	123.8	89.9	94.7	106.9	104.8	103.2	103.7	102.1	101.1	100.0	99.5	94.7	89.4	88.9
3 Richey electric light and power cost index	100.6	116.6	100.6	90.1	98.3	99.4	97.8	97.2	96.7	98.3	100.0	99.4	91.2	83.4	80.9[2]
4 Railway construction costs, Interstate Commerce Commission, release of the engineering section of the Bureau of Valuation	111.2	133.8	109.4	98.1	106.9	106.9	103.8	103.8	102.5	100.6	100.0	95.0	89.4	81.9	79.4
5 Highway construction costs, Bureau of Public Roads				114.9	128.0	122.8	116.5	112.3	110.6	103.5	100.0	93.1	83.4	66.2	80.6
6 Composite index[1]	100.6	129.7	98.9	95.4	106.0	104.7	101.9	101.8	101.4	100.4	100.0	97.3	88.7	80.0	82.1
Other general construction cost indexes															
7 Associated General Contractors	97.5	121.7	98.5	90.6	99.0	99.5	98.0	97.0	98.5	98.0	100.0	98.5	96.6	84 2	80.3
8 Engineering News-Record	95.8	121.4	97.5	84.3	103.4	104.0	99.8	100.5	99.6	99.9	100.0	98.0	87.6	75.8	82.2
9 Federal Reserve Bank of New York	93.0	120.0	91.0	90.0	100.0	99.0	99.0	100.0	98.0	98.0	100.0	98.0	91.0	82.0	84.0

[1]Based on the estimates of total new construction in current and 1929 prices shown in Table VI-6. The index is equivalent to a weighted average of the five separate indexes, the weights being the volume of new construction by type given in Table VI-6 (see especially Note A to Table VI-6.)

[2]Estimated on basis of 1932 relationship to railway index.

Table VI—6

VOLUME OF NEW CONSTRUCTION AND MAINTENANCE BY TYPE, 1919–1933

The total of new construction, inclusive of major repairs and alterations and of maintenance in some fields, is a sum of the estimates given in greater detail in Tables VI–7 through VI–9. These estimates, as distinct from those in Table VI–5, are based upon information that relates directly to the volume of construction and that makes possible a distinction among different types of construction such as residential, commercial, industrial, public utility and public works.

This and the following tables relating to the estimates of construction by type are discussed in the Preface to Part VI, Section 4.

Table VI-6

VOLUME OF NEW CONSTRUCTION AND MAINTENANCE BY TYPE

(millions of dollars)

	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
A Construction by Type in Current Prices															
I Private construction															
1 Total residential incl. additions, etc., and farm dwellings (Table VI-7, line 1)	1,731.9	1,492.6	2,241.4	3,523.8	4,422.0	4,713.3	5,202.5	4,757.4	4,523.6	4,254.9	3,009.7	1,805.4	1,261.8	444.3	392.3
2 Total nonresidential (Table VI-7, line 2)	2,005.5	2,224.4	1,346.1	1,807.6	1,660.6	1,708.7	2,309.7	2,533.6	2,507.9	2,476.4	2,551.1	1,606.4	905.7	377.8	485.6
3 Total private, line 1 + line 2	3,737.4	3,717.0	3,587.5	5,331.4	6,082.6	6,422.0	7,512.2	7,291.0	7,031.5	6,731.3	5,560.8	3,411.8	2,167.5	822.1	877.9
II Public utility															
1 New construction excl. duplication (Table VI-8)	756.0	904.7	840.3	975.7	1,639.1	1,804.5	1,752.2	1,832.3	1,969.3	1,909.0	2,029.6	2,194.0	1,326.3	719.6	449.9
2 Maintenance excl. duplication (Table VI-8)	967.1	1,274.0	1,022.0	1,002.6	1,065.1	1,032.7	1,065.9	1,103.4	1,112.6	1,052.8	1,081.4	1,007.3	854.0	680.5	647.9
3 Total public utility	1,723.1	2,178.7	1,862.3	1,978.3	2,704.2	2,837.2	2,818.1	2,935.7	3,081.9	2,961.8	3,111.0	3,201.3	2,180.3	1,400.1	1,097.8
III Public works															
1 New construction (Table VI-9, line 6)	1,421.6	1,713.9	1,677.6	2,076.2	1,921.4	2,264.1	2,546.5	2,469.6	2,785.8	2,931.6	2,927.6	3,023.0	2,614.8	1,954.8	1,901.8
2 Maintenance (Table VI-9, line 2)	No data				343.4	394.1	415.8	449.4	496.2	540.9	557.1	606.3	554.5	558.4	462.8
3 Total public works					2,264.8	2,658.2	2,962.3	2,919.0	3,282.0	3,472.5	3,484.7	3,629.3	3,169.3	2,513.2	2,364.6
IV Total new construction, incl. major additions, etc., line A-I-3 + line A-II-1 + line A-III-1	5,915.0	6,335.6	6,105.4	8,383.3	9,643.1	10,490.6	11,810.9	11,592.9	11,786.6	11,571.9	10,518.0	8,628.8	6,108.6	3,496.5	3,229.6
V Grand total, all construction, line A-I-3 + line A-II-3 + line A-III-3					11,051.6	11,917.4	13,292.6	13,145.7	13,395.4	13,165.6	12,156.5	10,242.4	7,517.1	4,735.4	4,340.3
B Percentage Distribution of New Construction in Current Prices															
I Private	63.2	58.7	58.8	63.6	63.1	61.2	63.6	62.9	59.7	58.2	52.9	39.5	35.5	23.5	27.2
II Public utility	12.8	14.3	13.8	11.6	17.0	17.2	14.8	15.8	16.7	16.5	19.4	25.4	21.7	20.6	13.9
III Public	24.0	27.1	27.5	24.8	19.9	21.6	21.6	21.3	23.6	25.3	27.8	35.1	42.8	55.9	58.9
C New Construction by Type of User, 1929 Prices[1]															
Consumers															
1 Residential	1,663.7	1,135.1	2,230.2	3,797.2	4,247.8	4,589.4	5,218.2	4,757.4	4,514.6	4,267.7	3,009.7	1,865.1	1,505.7	600.4	547.9
Business															
2 Nonresidential	2,054.8	1,743.3	1,414.0	1,927.1	1,574.0	1,646.1	2,277.8	2,488.8	2,478.2	2,466.5	2,551.1	1,635.8	1,015.4	462.4	605.5
3 Public utility	721.4	732.6	807.2	1,045.8	1,611.7	1,762.2	1,748.7	1,836.0	1,989.2	1,924.4	2,029.6	2,248.0	1,465.5	869.1	560.3
Public															
4 Public works	1,438.9	1,275.2	1,718.9	2,019.6	1,666.4	2,021.5	2,347.0	2,305.9	2,640.6	2,871.3	2,927.6	3,119.7	2,898.9	2,440.4	2,221.7
Total new construction, line C-1 + line C-2 + line C-3 + line C-4	5,878.8	4,886.2	6,170.3	8,789.7	9,099.9	10,019.2	11,591.7	11,388.1	11,622.6	11,529.9	10,518.0	8,868.6	6,885.5	4,372.3	3,935.4

[1]The price indexes used to transfer the values of new construction from current prices to 1929 prices were derived from Note D to Table VI-5. For residential construction the American Appraisal Co. index was used; for nonresidential, an average of the American Appraisal Co. index and the Aberthaw index, weighted equally; for public utility construction, an average of the Richey index, weight 6, and the Interstate Commerce Commission railway index, weight 4; for public works the Aberthaw index, weight 6, and the Bureau of Public Roads highway index, weight 4, were used (prior to 1922 the Aberthaw index was linked to the 1922 average). The weights indicated in the above combinations are approximations based on examination of the available data.

Table VI—7

VOLUME OF PRIVATE CONSTRUCTION, 1919–1933

Private construction comprises residential, both urban and farm, and non-residential, exclusive of public utility and public construction. Notes A through C following the table indicate the sources of those parts of the estimates whose derivation has not been described fully elsewhere.

Table VI-7

VOLUME OF PRIVATE CONSTRUCTION RESIDENTIAL AND NONRESIDENTIAL

(millions of dollars)

	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
1 Residential construction	1,731.9	1,492.6	2,241.4	3,523.8	4,422.0	4,713.3	5,202.5	4,757.4	4,523.6	4,254.9	3,009.7	1,805.4	1,261.8	444.3	392.3
a New residential excl. farm[1]	1,352.0	1,122.0	1,841.0	3,115.0	3,980.0	4,244.0	4,754.0	4,314.0	4,064.0	3,813.0	2,623.0	1,456.0	1,005.0	282.0	204.0
b Additions, alterations, and repairs[2]	162.0	134.4	220.6	225.5	257.9	286.0	260.5	255.4	270.3	256.6	201.4	202.7	153.5	112.3	118.3
c Farm dwellings	217.9	236.2	179.8	183.3	184.1	183.3	188.0	188.0	189.3	185.3	185.3	146.7	103.3	50.0	70.0
2 Nonresidential construction	2,005.5	2,224.4	1,346.1	1,807.6	1,660.6	1,708.7	2,309.7	2,533.6	2,507.9	2,476.4	2,551.1	1,606.4	905.7	377.8	485.6
a Commercial	534.6	584.8	437.1	653.6	595.1	678.9	959.6	1,013.0	1,026.1	973.2	1,022.2	691.7	351.3	136.7	113.7
b Industrial	646.0	733.4	201.0	371.4	334.6	256.7	345.1	480.6	408.1	538.9	573.5	244.5	108.6	39.5	123.1
c Social and recreational	103.6	112.9	134.3	135.9	123.9	138.3	273.6	271.8	286.8	235.5	154.0	124.6	108.6	42.6	34.2
d Religious and memorial	52.8	58.3	84.9	121.1	101.4	135.5	168.4	163.7	172.2	140.7	116.7	102.1	58.4	30.0	19.5
e Additions, alterations, and repairs for nonresidential excl. farm[2]	341.7	380.7	219.1	250.6	229.5	224.3	281.0	322.5	330.7	310.1	406.7	223.5	123.8	54.0	90.1
f Farm construction and repairs other than dwellings	326.8	354.3	269.7	275.0	276.1	275.0	282.0	282.0	284.0	278.0	278.0	220.0	155.0	75.0	105.0
3 Total private construction, line 1 + line 2	3,737.4	3,717.0	3,587.5	5,331.4	6,082.6	6,422.0	7,512.2	7,291.0	7,031.5	6,731.3	5,560.8	3,411.8	2,167.5	822.1	877.9

[1]These estimates were prepared by David L. Wickens and Ray R. Foster. A detailed description of the derivation of the figures for 1920-33 is given in Bulletin 65 (National Bureau of Economic Research, September 15, 1937); the 1919 estimate is based on examination of the building permits and contracts awarded data.

[2]These estimates were obtained by applying the percentages derived in Note C to this table to the estimates of new residential and nonresidential construction. In 1919 and 1920, the 1921 percentages were used.

Note A to Table VI–7

FARM CONSTRUCTION

Data relating to the construction of farm buildings and repairs n buildings have been reported since 1924 in *Crops and Markets* (April 1933 and September 1936). The figures were extrapolated back to 1919 by means of an unpublished series of he Bureau of Agricultural Economics on the depreciation of arm buildings. Even though this series seemingly bears little elationship to new construction, its movements are decidedly milar to the estimates of construction inclusive of repairs in he years prior to 1930. No other available series showed such greement.

These estimates of construction of farm buildings and repairs n buildings unfortunately cover only 'business' buildings. arm dwellings are excluded and the available data enable no nore than rough estimates of such construction. From the 1930 *Census of Agriculture* the values of farm dwellings and of buildings other than dwellings were obtained. These figures were multiplied by depreciation rates of 3 and 5 per cent respectively (approximations suggested by the Bureau of Internal Revenue rates). The resultant depreciation figure for farm buildings other than dwellings was then expressed as a percentage of the total depreciation thus calculated. This percentage approximated 60 per cent; on the basis of these indirect calculations for 1930 the construction and repairs of farm buildings other than dwellings were then set at 60 per cent of all farm construction and repairs. Because of the lack of similar data in other years the percentage was held constant throughout the period.

Note B to Table VI–7

NONRESIDENTIAL CONSTRUCTION

The estimates of the different types of nonresidential construction are based on Dodge contract data. Comparable series were btained from the business cycles study.[1] These series, however, over 37 states from 1925 to date, 36 states in 1923 and 1924; nd only 27 states from 1919 to 1922. Consequently the figures or the earlier years had to be raised to cover 37 states (accomlished by splicing at the overlapping years), and all the data ad to be raised to cover the entire 48 states. Examination of the data on total building construction (excluding subcontract work) in the 1929 *Census of Construction* showed 48 states to be 110 per cent of the 37 states covered by Dodge. A raising ratio of 1.1, held constant because of lack of further data, was thus used in order to obtain the estimates for the United States as a whole.

The values of private nonresidential construction are underestimates because of the omission of such classifications as private schools and hospitals. These items are included in our estimates of public works below. In the aggregate, they are probably too small to affect materially the usefulness of the public works estimates or of the private nonresidential estimates.

[1] The business cycles unit of the National Bureau benefited from the ooperation of the F. W. Dodge Corporation in the compilation of these eries. Industrial construction excludes power plants and petroleum and ipe lines throughout. Commercial construction includes airports throughut.

Note C to Table VI-7

DERIVATION OF PERCENTAGES OF MAJOR ADDITIONS, ALTERATIONS, AND REPAIRS TO NEW RESIDENTIAL AND NEW NONRESIDENTIAL CONSTRUCTION[1]

(dollar values in thousands)

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
I Total construction													
1 Additions, alterations, and repairs as percentage of new construction, varying number of cities[2]	14.06	11.11	10.71	10.31	8.40	9.04	9.91	9.62	12.89	16.65	17.56	31.35	34.59
2 Additions, alterations, and repairs as percentage of new construction, 257 cities	17.43	11.41	10.93	10.89	9.14	9.79	10.86	10.34	13.62	17.03	17.95	26.96	39.37
3 Ratio of line 2 to line 1	1.2397	1.0270	1.0205	1.0563	1.0881	1.0830	1.0959	1.0748	1.0566	1.0228	1.0222	.8600	1.1382
II Residential construction													
1 Cost of new residential construction, varying number of cities[2]	683,530	1,255,744	1,491,842	1,381,213	1,630,074	1,666,326	1,472,912	1,447,069	1,096,949	431,747	317,222	68,880	69,343
2 Additions, alterations, and repairs, varying number of cities[2]	66,009	88,534	94,774	88,157	82,231	91,201	89,401	90,531	79,736	58,740	47,382	31,897	35,327
3 Additions, etc., as percentage of new construction	9.66	7.05	6.35	6.38	5.04	5.47	6.07	6.26	7.27	13.61	14.94	46.31	50.95
4 Percentages in line 3 adjusted to cover 257 cities, line II-3 x line I-3	11.98	7.24	6.48	6.74	5.48	5.92	6.65	6.73	7.68	13.92	15.27	39.83	57.99
III Nonresidential construction													
1 Cost of new nonresidential construction, varying number of cities[2]	459,391	642,687	741,299	749,335	855,506	927,982	936,361	859,112	797,187	612,966	474,385	168,901	154,388
2 Additions, alterations, and repairs, varying number of cities[2]	94,711	122,380	144,301	131,582	126,487	143,319	149,289	131,306	164,408	115,155	91,637	42,642	42,064
3 Additions, etc., as percentage of new construction	20.62	19.04	19.47	17.56	14.79	15.44	15.94	15.28	20.62	18.79	19.32	25.25	27.25
4 Percentages in line 3 adjusted to cover 257 cities, line III-3 x line I-3	25.56	19.55	19.87	18.55	16.09	16.72	17.47	16.42	21.79	19.22	19.75	21.72	31.02

[1] Based on revised building permit data (special tabulations) compiled by the U.S. Bureau of Labor Statistics

[2] The number of cities ranges from 180 in 1921 to 222 in 1933.

Table VI—8

VOLUME OF PUBLIC UTILITY CONSTRUCTION, 1919–1933

The volume of public utility construction, both new and maintenance, as measured on the basis of available data, includes the cost of some commodities included elsewhere in this study under finished producers' durable; and must be adjusted correspondingly. The sources of the data upon which the estimates rest, as well as the procedure used in adjusting for duplication, are described in detail in Note A following the table.

Table VI-8

VOLUME OF PUBLIC UTILITY CONSTRUCTION

(millions of dollars)

	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
New construction															
Steam railroads	223.7	260.1	231.4	177.2	363.4	366.6	395.4	494.7	464.6	434.1	509.3	521.3	239.7	108.3	104.9
Electric railways				113.0	112.0	73.0	57.6	58.8	80.9	97.4	89.5	90.7	74.8	37.5	27.4
Electric light and power	264.8	319.5	273.5	387.3	700.5	801.1	746.4	683.8	698.2	664.6	754.9	808.4	525.8	251.4	117.1
Telephone	122.0	186.9	216.5	253.7	309.8	381.3	381.0	397.8	394.0	444.9	599.8	609.7	412.3	252.1	171.9
Telegraph											48.3	56.7	24.3	13.7	
Gas, manufactured											113.0	96.0	72.0	46.0	21.0
Natural gas							204.0	247.0	308.0	330.0	119.0	125.0	73.0	38.0	23.0
Pipe lines, oil and gasoline							23.0	42.0	104.0	65.0	108.0	119.0	84.0	17.0	18.0
Waterworks, private							14.0	13.0	13.0	11.0	12.0	20.0	16.0	10.0	5.0
Comparable totals by groups of years	610.5	766.5	721.4	818.2 931.2	1,485.7	1,622.0	1,580.4 1,821.4	1,937.1	2,062.7	2,047.0	2,186.5 2,353.8	2,446.8	1,521.9	760.3 774.0	488.3
Estimated total	862.0	1,082.2	1,018.5	1,155.2	1,843.2	2,012.3	1,960.7	2,085.3	2,220.5	2,203.6	2,353.8	2,446.8	1,521.9	774.0	497.1
Estimated duplication	106.0	177.5	178.2	179.5	204.1	207.8	208.5	253.0	251.2	294.6	324.2	252.8	195.6	54.4	47.2
Net total	756.0	904.7	840.3	975.7	1,639.1	1,804.5	1,752.2	1,832.3	1,969.3	1,909.0	2,029.6	2,194.0	1,326.3	719.6	449.9
Maintenance															
Steam railroads	794.4	1,058.1	770.2	741.4	828.0	805.1	828.1	879.0	877.0	848.1	863.4	709.0	535.1	352.2	324.1
Electric railways	82.3	98.4	96.2	95.2	96.1	93.4	89.1	86.8	82.6	66.5	75.2	72.7	61.8	49.3	44.9
Electric light and power	60.7	71.6	72.4	74.7	78.0	83.9	90.3	95.5	100.2	104.0	102.3	100.5	92.6	78.4	74.7
Telephone	72.3	88.7	91.9	99.2	111.5	122.4	132.2	147.0	160.6	177.1	205.0	217.0	200.1	180.6	184.2
Telegraph	14.2	16.1	14.0	14.1	14.9	14.9	16.7	17.6	17.1	17.8	19.1	15.5	12.9	9.9	9.8
Gas, manufactured	20.4	23.4	26.3	26.8	28.2	28.2	28.2	30.8	32.1	31.9	31.7	30.0	26.6	22.6	20.3
Natural gas	6.4	7.8	7.0	8.9	9.6	10.2	10.6	12.0	12.7	14.5	16.5	16.6	16.5	15.4	14.4
Pipe lines, oil and gasoline	4.4	5.1	5.7	6.3	6.4	7.2	8.1	8.5	9.6	10.9	12.3	11.7	10.9	10.4	10.6
Waterworks, private											6.1	5.5	5.3	5.1	5.0
Comparable totals	1,055.1	1,369.2	1,083.7	1,066.6	1,172.7	1,165.3	1,203.3	1,277.2	1,291.9	1,270.8	1,325.5 1,331.6	1,178.5	961.8	723.9	688.0
Estimated total	1,060.0	1,375.5	1,088.7	1,071.5	1,178.1	1,170.7	1,208.8	1,283.1	1,297.8	1,276.6	1,331.6	1,178.5	961.8	723.9	688.0
Estimated duplication	92.9	101.5	66.7	68.9	113.0	138.0	142.9	179.7	185.2	223.8	250.2	171.2	107.8	43.4	40.1
Net total	967,1	1,274.0	1,022.0	1,002.6	1,065.1	1,032.7	1,065.9	1,103.4	1,112.6	1,052.8	1,081.4	1,007.3	854.0	680.5	647.9
Grand total, public utility construction	1,922.0	2,457.7	2,107.2	2,226.7	3,021.3	3,183.0	3,169.5	3,368.4	3,518.3	3,480.2	3,685.4	3,625.3	2,483.7	1,496.9	1,186.1
Grand total, excluding duplication	1,723.1	2,178.7	1,862.3	1,978.3	2,704.2	2,837.2	2,818.1	2,935.7	3,081.9	2,961.8	3,111.0	3,201.3	2,180.3	1,399.1	1,098.8

Note A to Table VI–8

SOURCES OF DATA

New Construction

Steam railways

For 1930–34 data on expenditures for new lines and extensions and expenditures for additions and betterments of road by Class I Steam Railways were reported in Statement 47 of *Statistics of Railways*. From the totals there given the figures for the following eight accounts were removed: land for transportation purposes, roadway machines, roadway small tools, assessments for public improvements, cost of road purchased, shop machinery, power plant machinery, and power substation apparatus. The residual totals were taken to represent new construction for Class I Railways. In order to obtain totals inclusive of all railways, raising ratios based on the relationship between the capital investment of Class I and that of all railways were utilized.

For 1922–29 the estimates of the Bureau of Railway Economics on gross capital expenditures of Class I Steam Railways for roadways and structures were used for extrapolation. The figures were first raised to cover all railways by means of the investment ratios. They were then adjusted to agree with the new construction expenditures as estimated above on the basis of the 1930 relationship between the Bureau of Railway Economics figure (corrected to cover all railways) and the actual construction expenditure in that year as previously determined.

It was also possible to obtain a gross capital expenditure figure for road and structure in 1919 from *Recent Economic Changes*, Volume I, p. 258. This figure, taken from the report of the Director General of Railways in 1920, refers to all railways and needed to be adjusted to agree with the new construction estimates of the later years. This was done by applying the same 1930 ratio that had been applied to the Bureau of Railway Economics figures for 1922–29.

For 1920 and 1921 the Bureau of Railway Economics figures for gross capital expenditures of Class I Steam Railways on roadway and structure and on equipment were the only available means of interpolation. For the three years, 1920–22, these totals were raised to represent all railways. A comparable 1919 total was then obtained from *Recent Economic Changes*. The 1919 and 1922 totals were next related to the 1919 and 1922 gross capital expenditures on roadway and structure alone. The two ratios were interpolated along a straight line and the resultant ratios applied to the 1920 and 1921 grand totals of all capital expenditures. Finally the derived estimates of roadway and structure expenditures were adjusted to the level of the new construction estimates by means of the 1930 ratio for all years prior to 1930.

Electric railways

Expenditures by transit companies on way and structures and on power equipment are reported from 1922 to date in the annual statistical issues of the *Transit Journal*.

Electric light and power

A procedure similar to that used by Corrington Gill in the Federal Employment Stabilization Board estimate was followed. Total construction expenditures as provided by the Edison Electric Institute were adjusted to exclude the value of land, the adjustment being made on the basis of average percentages given to Mr. Gill by the engineering department of the Institute. Careful examination of A. D. Gayer's public works estimates (*Public Works in Prosperity and Depression*) indicates the inclusion of lighting system contracts in his estimates in the value of about 5 per cent of total electric light and power. Since we are concerned with the elimination of duplication in our estimates we have arbitrarily reduced our electric light and power totals 5 per cent. To subtract an actual figure in each year would have required more time and labor than the correction justified.

Telephone

Data for the Bell System are compiled by the American Telephone and Telegraph Company. In order to cover all telephone companies, the raising ratio established by Mr. Gill was used. This was based upon information secured from the United States Independent Telephone Association and from the American Telephone and Telegraph Company.

Telegraph

Data for four years as calculated by Mr. Gill have been used. The estimates are based on Western Union and Postal Telegraph Company figures obtained by Mr. Gill from correspondence with the companies. In order to cover all companies, raising ratios indicated by the relationship of the total investment of Western Union and Postal to that of all companies reporting to the Interstate Commerce Commission were used.

Gas, manufactured

From 1929 to date totals are published in the annual statistical summaries of the American Gas Association. The figures for 1925–28, together with those for natural gas in the same years were taken from an estimate by Peter Stone in *Construction Expenditures and Employment, 1925–1936* (Works Progress Administration, 1937).

Natural gas

From 1929 to date totals were reported by the American Gas Association. For 1925–28, see manufactured gas above.

Pipe lines

Mr. Stone's estimates were used. He described his method as follows: "Volume of construction reported by the Pipe Line Contractors' Association for 1928–33 was expanded to include pipe and coverings. Other years (i.e., 1925–27) were estimated on the basis of the relation of Dodge totals to the totals for 1928–33. Such figures were checked with the mileage of pipe lines as reported by the Bureau of Mines" (*ibid.*, p. 28).

Waterworks, private

Mr. Stone's estimates were used. He computed totals for 1925–32 from capital outlays for waterworks as shown in *Financial Statistics of Cities*, and estimated subsequent years on the basis of Dodge reports. He then estimated private waterworks on the assumption that they constituted 10 per cent of the total for 1925–33. This percentage was derived from a special tabulation of Dodge figures (*ibid.*, pp. 28, 30).

Maintenance

The maintenance estimates were prepared by Solomon Fabricant of the National Bureau staff. His memorandum on method follows:

Steam railways

The Interstate Commerce Commission data in *Statistics of Railways* were compiled for maintenance on way and structure other than depreciation, retirements, insurance, and injuries to persons, Class I Steam Railways. These were then stepped up to include all steam railways, on the basis of operating expenses (96.29 per cent in 1919, 96.86 in 1933).

Electric railways

Basic data for 1917, 1922, 1927, and 1932 were obtained from the *Census of Electrical Industries*. The figures include railway operating expenditures on way and structures, other than depreciation; and on power maintenance of plant and grounds

Note A to Table VI—8 (concluded)

other than depreciation (only 50 per cent of wages to employees being treated as maintenance). Interpolations for 1917–27 were made on the basis of total operating expenses as reported by the American Transit Association, *Transit Journal,* January 1934, p. 4; interpolations for 1927–33 on the basis of maintenance materials and labor as reported by the American Transit Association.

Electric light and power

Basic data on 'maintenance expense' for 1932 were obtained from the *Census of Electrical Industries* (commercial establishments); for 1929–33 the figures are based on a sample covering about 80 per cent of total revenues and collected from *Moody's Public Utilities;* for 1921–29, the figures were obtained from the Edison Electric Institute; for 1919–20 they were estimated on the basis of the ratio of maintenance expense to operating revenues in 1921.

Telephone companies

Basic data for 1917 and 1922, covering 'repairs and maintenance', were taken from the Census of Electrical Industries. Interpolations for 1920–33 were based on 'current maintenance' of the Bell Telephone System. The amount for 1919 was estimated on the basis of the number of telephone connections made.

Telegraphs and ocean-cables

Data on maintenance (excluding depreciation) for 1929–31 are from the reports to the Interstate Commerce Commission. Other years are based on the ratio of the above maintenance charges to operating revenues (*Census of Electrical Industries,* for quinquennial years; Western Union (Moody's) for 1917–33).

Gas, manufactured

Data on maintenance expense (excluding retirement expense) as a percentage of operating revenues, for 1929–33, were taken from reports of the American Gas Association. Ratios for 1919–28 were assumed equal to that for 1929. These were applied to operating revenues for biennial years obtained from the Census of Manufactures, interpolated by data from the American Gas Association.

Natural gas

The ratio of maintenance to operating revenues, derived for 1931–35 by the American Gas Association from a sample, was applied to the value of natural gas consumed (*Minerals Yearbook*). For 1919–30 the average ratio of 1931–35 was used.

Pipe lines

Maintenance expenses for 1930 were estimated by Mr. Gill from I. C. C. returns. Estimates for other years (1920–34) were based on operating revenues (I. C. C.), and for 1919–20 on crude petroleum production.

Waterworks

Estimated by Mr. Gill for 1930 from various unpublished data secured by correspondence with a prominent waterworks engineer. Estimates for 1929–33 based on a sample of companies (7 for 1929–32, 13 for 1932–33) collected from *Moody's Publ Utilities.* No explicit estimates made for 1919–28.

Estimated Duplication

Examination of our producers' durable classification of ele trical appliances, industrial and commercial (Minor Group 3 indicated the inclusion of several items that are included al in the estimates of public utility construction.[1]

Although it was impossible to segregate accurately this dupl cation, a rough approximation seemed preferable to none. Th first step was to determine the commodities of which the maj portion seemed to be destined for public utility constructio This was done by reference to Minor Group 33 in Table I– and by inspection of the more detailed breakdowns of the orig nal data in the Census of Manufactures. The commoditi finally chosen, necessarily an arbitrary selection, were as follov (the nomenclature is that of the 1929 Census):

Duplication in new public utility construction: generators, n including motor-generator sets, automotive generators . . alternating current; synchronous condensers and frequen chargers; constant-potential transformers . . . over 500 k.v.a motors, d.c., over 200 h.p.; motors, a.c., synchronous motor motors, a.c., polyphase induction, over 200 h.p.; switchboard current breakers and switches; and telephone and telegrap apparatus.

Duplication in maintenance: rubber insulated wire and cabl lighting and power circuit and telephone; paper insulated wi and cable: lighting and power circuit and telephone and tel graph cable; fuses and fuse blocks; overhead trolley-line m terial; pole line hardware; and railway signals and attachment

The items were totaled in each Census year.[2] An approxima correction, based on examination of the 1929 data in *Foreig Commerce and Navigation of the United States,* I, 1929, was the made for exports and imports. Next the two sets of adjusted tota were estimated for the intercensal years by using the totals Minor Group 33 as shown in Table II–5. Finally a consta mark-up of 7 per cent as indicated by the 1929 data for Min Group 33 in Table III–5 was applied; the resultant figures we assumed to represent the volume of duplication.[3] These figur are the ones shown in Table VI–8, and they have been su tracted from the public utility construction estimate in ord to eliminate possible duplication of commodities already treate under producers' durable. They can of course be included wi construction, if desired. In that event, however, they should removed from the totals of producers' durable commodities.

[1] A small amount may be included also under public works, i.e., the construction of municipal light and power systems, etc., and industrial construction. Because the amounts are undoubtedly small a cannot be estimated in a satisfactory manner, we have not attempt to make allowances for such duplication in these categories. We ha treated the entire duplication under public utilities: thus the n total for public utilities is probably an underestimate.

[2] Several had to be estimated for particular years. This was usual done by using the percentage breakdown for the nearest year for whi the more detailed data were available.

[3] An insignificant amount of electrical equipment, which is treated und accounts not included in our railroad construction estimates, is us by steam railroads. The amount was so small that no adjustment w deemed necessary.

Table VI—9

VOLUME OF PUBLIC CONSTRUCTION, 1919–1933

This table measures the volume of construction of public buildings, streets and roads, educational buildings, and of all other units utilized by public agencies. The sources of the estimates are described in Note A following the table.

Table VI-9

VOLUME OF PUBLIC CONSTRUCTION

(millions of dollars)

	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
1 Volume of public construction based primarily on Gayer estimates					2,264.8	2,658.2	2,962.3	2,919.0	3,282.0	3,472.5	3,484.7	3,629.3	3,169.3		
2 Maintenance, highways, and streets					343.4	394.1	415.8	449.4	496.2	540.9	557.1	606.3	554.5	558.4	462.8
3 Volume of new public construction, line 1 - line 2					1,921.4	2,264.1	2,546.5	2,469.6	2,785.8	2.931.6	2,927.6	3,023.0	2,614.8		
4 Dodge series (27 states) public works and utilities; educational; hospitals and institutions; and public buildings	674.1	812.7	795.5	984.5	911.1										
5 Stone estimates of public construction[1]													2,512.0	1,878.0	1,827.0
6 Volume of new public construction	1,421.6	1,713.9	1,677.6	2,076.2	1,921.4	2,264.1	2,546.5	2,469.6	2,785.8	2,931.6	2,927.6	3,023.0	2,614.8	1,954.8	1,901.8

[1]Peter A. Stone, Construction Expenditures and Employment, 1925-1936 (Works Progress Administration, 1937), Table A.

Note A to Table VI–9

SOURCES OF DATA

ne 1

ese estimates are based primarily on data given in *Public orks in Prosperity and Depression* by Arthur D. Gayer (Table p. 51) and in *An Economic Survey of Motor Vehicle Transrtation in the United States,* a publication of the Bureau of ilway Economics. Mr. Gayer's estimates of city streets have en removed from his total for each year, because of the pecurities evident in the year-to-year movement. As a substitute new construction of city streets the estimates of the Bureau Railway Economics were used. These were derived from city tlay data and are shown in Appendix N of *An Economic rvey.*

ne 2

ie data used for maintenance of rural highways are the same those given by Mr. Gayer, except for the substitution in 1931 the final estimate for that year as shown in Appendix K of *Economic Survey.* The figures were extrapolated for 1932 d 1933 on the basis of the movement of the maintenance data state highways as reported by the Bureau of Public Roads. ie data on maintenance of city streets were estimated for 23–31 from the figures on roadways and waterways given in *nancial Statistics of Cities* for cities with a population of 30,000 more. The annual per capita expenditure was calculated d adjusted to represent per capita expenditures of cities with population of 2,500 to 30,000. This was done by applying the tio that total per capita expenditures of the latter group of ies bore in 1931–32 to the group of cities of 30,000 or more ata from *Financial Statistics of States and Local Governments, 1932*). The derived per capita expenditures on roadways and waterways of cities between 2,500 and 30,000 were then multiplied by the total population of these cities, reported in Appendix N of *An Economic Survey.* By summation, total maintenance on city streets and waterways was obtained for 1923–31. For 1932 and 1933 these totals were extrapolated on the basis of the movement of maintenance expenditures on highways by cities with population of 100,000 or more.

Finally the estimates for rural and city highways and streets, etc., were totaled as shown in line 2 of Table VI–9.

Line 4

As indicated in the table, the Dodge series for 27 states includes the following Dodge classifications: public works and utilities, educational buildings, hospitals and institutions, and public buildings. These series were most conveniently summated from the Dodge data given in *Recent Economic Changes,* Chapter III, Table 1; the aggregate was used as an index with which to move Mr. Gayer's estimates back to 1919. The 1923 relationship of the Dodge total to Mr. Gayer's total was utilized for this purpose.

Line 5

Mr. Stone's estimates in line 5 were taken from *Construction Expenditures and Employment, 1925–36,* prepared by him for the Works Progress Administration. They were used as an index with which to extend the estimates in line 3 beyond 1931, the 1931 relationship between the two series being applied to Mr. Stone's estimates for the later years.

Table VI—10

COMPARISON OF ESTIMATES OF TOTAL CONSTRUCTION BASED ON CONSUMPTION OF MATERIALS WITH THOSE OF NEW CONSTRUCTION DERIVED FROM THE ESTIMATES BY TYPE, 1919–1933

A comparison of the global total of construction, obtained in Table VI–5, with the total of new construction by type, reveals a disparity that is only partly accounted for by the volume of repairs and maintenance calculable from the available data. But these data obviously fail to cover all construction repairs and maintenance. For the discussion of this comparison and of its implications for the validity of the estimates, see the Preface to Part VI, Section 5.

Table VI-10

COMPARISON OF ESTIMATES OF VOLUME OF CONSTRUCTION BASED ON CONSUMPTION OF MATERIALS WITH THAT FOR NEW CONSTRUCTION DERIVED FROM THE ESTIMATES BY TYPE

(millions of dollars)

	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
1 Materials estimates															
a Using constant 1929 raising ratio in current prices (Table VI-5, line 5)	11,358.6	12,880.7	10,782.3	13,111.7	15,261.1	14,686.0	16,012.1	16,586.4	16,225.3	17,137.6	16,207.4	14,649.2	10,409.9	5,793.5	5,553.9
b Using varying ratios in current prices (Table VI-5, line 18)	12,158.2	13,341.3	11,259.1	12,625.5	13,806.5	14,472.0	15,663.9	16,434.2	16,861.9	17,384.7	16,207.4	14,600.8	10,199.5	5,854.2	5,509.8
c Using constant ratio in 1929 prices and cost index (Table VI-5, line 23)	9,358.3	10,820.1	10,925.9	12,471.2	14,265.1	14,588.5	15,163.9	16,235.5	16,720.0	17,521.7	16,207.4	15,115.2	11,192.3	6,280.2	5,473.8
2 New construction incl. major additions, alterations, etc. (Table VI-6, line A-IV)	5,915.0	6,335.6	6,105.4	8,383.3	9,643.1	10,490.6	11,810.9	11,592.9	11,786.6	11,571.9	10,518.0	8,628.8	6,108.6	3,496.5	3,229.6
3 Differences between lines 1 and 2															
a Line 1a - line 2	5,443.6	6,545.1	4,676.9	4,728.4	5,618.0	4,195.4	4,201.2	4,993.5	4,438.7	5,565.7	5,689.4	6,020.4	4,301.3	2,297.0	2,324.3
b Line 1b - line 2	6,243.2	7,005.7	5,153.7	4,242.2	4,163.4	3,981.4	3,853.0	4,841.3	5,075.3	5,812.8	5,689.4	5,972.0	4,090.9	2,357.7	2,280.2
c Line 1c - line 2	3,443.3	4,484.5	4,820.5	4,087.9	4,622.0	4,097.9	3,353.0	4,642.6	4,933.4	3 949.8	5,689.4	6,486.4	5,083.7	2,783.7	2,244.2
4 Calculable maintenance															
a Maintenance, public utilities (Table VI-6, line A-II-2)	967.1	1,274.0	1,022.0	1,002.6	1,065.1	1,032.7	1,065.9	1,103.4	1,112.6	1,052.8	1,081.4	1,007.3	854.0	680.5	647.9
b Segregable maintenance, public works (Table VI-6, line A-III-2)		No	data		343.4	394.1	415.8	449.4	496.2	540.9	557.1	606.3	554.5	558.4	462.8
5 Residual unallocable maintenance															
a Line 3a - line 4	4,476.5	5,271.1	3,654.9	3,725.8	4,209.5	2,768.6	2,719.5	3,440.7	2,829.9	3,972.0	4,050.9	4,406.8	2,892.8	1,058.1	1,213.6
b Line 3b - line 4	5,276.1	5,731.7	4,131.7	3,239.6	2,754.9	2,554.6	2,371.3	3,288.5	3,466.5	4,219.1	4,050.9	4,358.4	2,682.4	1,118.8	1,169.5
c Line 3c - line 4	2,476.2	3,210.5	3,798.5	3,085.3	3,213.5	2,671.1	1,871.3	3,089.8	3,324.6	4,356.1	4,050.9	4,872.8	3,675.2	1,544.8	1,133.5