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Chapter 10

Price Changes and Measures of Capital Consumption

PRICES UNDERLYING ACCOUNTING MEASURES OF CAPITAL CONSUMPTION

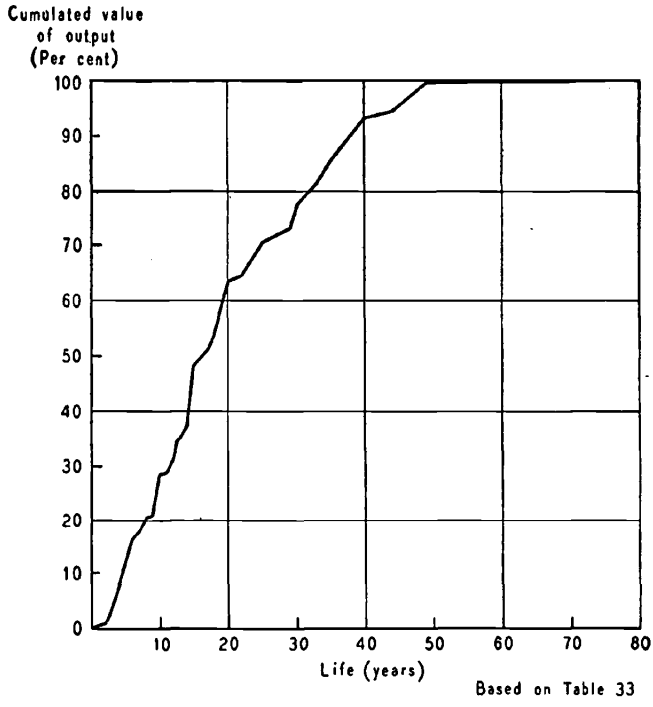
THE measures in Parts II and III, summarized in Table 29, are strictly comparable in the sense that they represent the accounting estimates of capital consumed in each year they cover. As such their significance in an analysis of economic behavior cannot be denied. But to the extent that the price units actually used in the evaluations for a given year are not contemporaneous, the meaning of the measures for our purpose is obscure. Items such as repairs and provision for fire and marine losses are already expressed in current prices. But charges for depreciation are in terms of prices paid at the time of original investment. Until gains, or even losses, are realized in the market place, capital assets are usually valued on the books of a business enterprise at their original cost. As a consequence of this prevailing method of accounting, one supported by the requirements of the tax laws, depreciation charges (as well as depletion charges) represent an amalgam of non-contemporaneous prices; for the various items of capital equipment and buildings are of diverse average spans of life. The expected useful life of the business capital goods produced in 1929, for example, ranged from two years to one hundred, with concentrations (indicative of the approximative character of the estimates) at 10, 15, and 20 years (see Chart 1). Half of the 1929 output in value had an anticipated

life of between 10 and 30 years; one-fourth exceeded 30 years. We are not wrong in supposing, therefore, that even as late as 1929 capital goods purchased at 1913 and earlier price levels

Chart 1

Value of Output of Business Capital Goods in 1929 Distributed by Length of Expected Useful Life

(*cumulative frequency distribution*)



were still being depreciated. If the depreciation charges on different capital goods are to be expressed in the prices of a common period, rather than in the original cost prices of many periods, a step must be taken beyond the figures already presented.

TREATMENT OF PRICE CHANGES

The 'heterotemporality' of the prices underlying the available figures may be eliminated by several methods. We may reduce the figures to constant dollars, replacing the prices that were actually used by prices of some one period. Thus, the depreciation charges in 1925, which involve price levels of many earlier years, would be expressed in prices prevailing during, say, 1929. Similar treatment would be accorded other years and other series representing capital consumption. An alternative procedure, which involves reduction to constant prices as a necessary statistical step, would be to express the measures relating to a given year in the prices prevailing during it. The depreciation charged in 1925 would be expressed in 1925 prices, rather than in the prices prevailing at the time when the goods being depreciated were purchased or during a base period such as 1929. The elements of capital consumption already computed in current prices would require no change. Finally, another method, involving in practice both the procedures mentioned, would be to express the various measures in terms of purchasing power, general or particular. Depreciation charges in 1925 would be computed by using 1925 prices of capital goods, deflated by an index of the prices of those goods in terms of the purchasing power of which it was desired to evaluate the capital consumed through depreciation.

The greatest statistical difficulty, confronting all attempts to cut through the maze of changing prices, arises from the paucity of data. But even if current sales prices were plentiful, they would relate chiefly to the new types of equipment in use. They are more representative of the prices underlying tomorrow's productive equipment than of today's. The changing kind and quality of the capital goods produced is, indeed, a major reason for the paucity of the data. Not only may there be a steady improvement in the quality of equipment produced and quoted on the market. Sometimes, as a limiting

Table 29

Accounting Measures of Capital Consumption, 1919–1935

(Unit: $1,000,000)

	1919	*1920*	*1921*	*1922*	*1923*	*1924*
Business Capital [1]						
Depreciation	3,411	3,585	3,632	3,949	4,044	4,154
Depletion [2]						
Depreciation and depletion	3,906	4,208	4,040	4,388	4,586	4,688
Repairs and maintenance (public utilities)	2,289	2,983	2,338	2,297	2,592	2,372
Development costs charged to current expenses (mining)	334	498	253	284	328	292
Provision for fire and marine losses	209	218	217	212	210	207
Governmental Capital						
Depreciation	264	276	292	312	334	362
Repairs and maintenance (highways and sewers)					367	421
Consumers' Capital						
Depreciation (residences)	928	977	948	1,019	1,120	1,237
Depreciation [4] (automobiles)	865	1,101	1,250	1,340	1,575	1,802

[1] Including property of farmers, but excluding depreciation on work animals and dairy cattle.

[2] Figures for 1919–24 are not available. The figures for depreciation alone, and for depreciation and depletion combined, for 1919–24 are reasonably good estimates, but the difference between the two series is open to question. A (relatively) slight error in either the subtrahend or the minuend may mean a (relatively) large error in

case of quality change, no replacement price at all is recorded or quoted.[1]

The direction of influence of quality changes upon the various price indexes with which we are concerned may be indicated for the indexes related to business depreciation charges (Chart 2). (These indexes are discussed more fully

[1] Recent inventions cannot, obviously, be priced on markets existing at times antecedent to the date of invention. But equipment seldom disappears rapidly from the market. The above difficulty may be sometimes avoided, therefore, when constant prices are used, by selecting a recent base period. Of course, the problem of obsolescence remains.

1925	*1926*	*1927*	*1928*	*1929*	*1930*	*1931*	*1932*	*1933*	*1934*	*1935*
4,386	4,861	4,877	5,175	5,498	5,549	5,481	5,119	4,879	4,745	4,721[3]
522	614	539	553	595	493	289	262	264	330	370[3]
4,908	5,475	5,416	5,728	6,093	6,042	5,770	5,381	5,143	5,075	5,091[3]
2,392	2,485	2,423	2,341	2,413	2,082	1,656	1,210	1,156	1,281	1,364
319	366	297	267	321	233	109	107	96	138	184
212	224	235	230	223	206	191	168	158	156	160
392	428	466	501	524	555	591	616	638	666	696
445	481	533	579	597	646	592	595	494	571	588
1,373	1,506	1,631	1,743	1,838	1,888	1,895	1,890	1,887	1,888	1,885
1,990	2,226	2,341	2,383	2,512	2,488	2,219	1,864	1,539	1,360	1,371

the difference.

[3] The 1935 totals in Tables 1 and 3 have been changed slightly to render them comparable with those for earlier years. They were multiplied by the ratio of the 1934 figures, old classification, to the 1934 figures, new classification.

[4] Declining percentage of cost method (see Table 28).

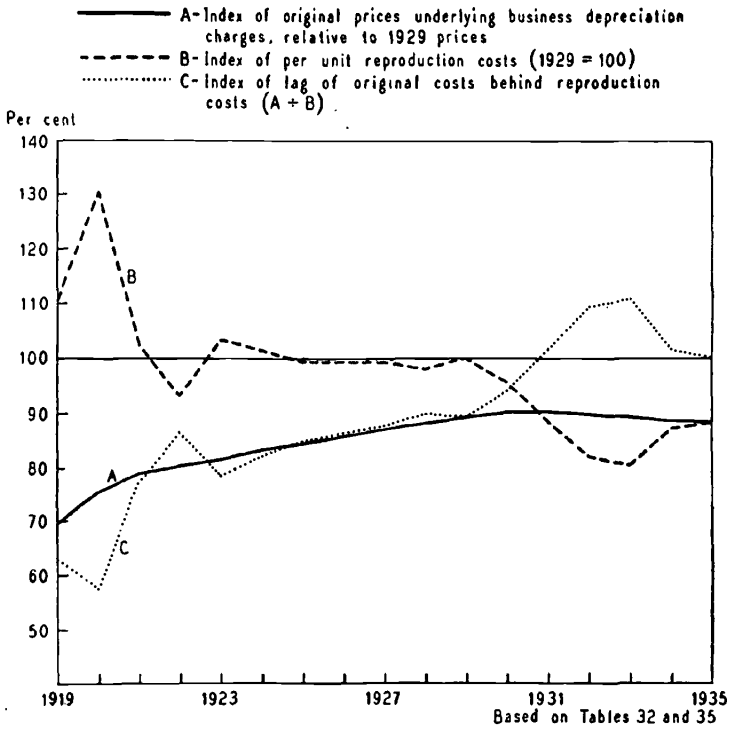
below.) If improvements in capital goods may be assumed to go on at a steady rate, then in order to reflect this progressive cheapening the index of current prices (the broken line in Chart 2) would be swung about the 1929 base so that the 1919–28 figures were raised and the 1930–35 figures lowered. The solid line, representing prices used in computing accounting charges for depreciation, would also be swung about the 1929 point in much the same manner. But it would also be raised, to an extent depending on the rate of improvement in quality and the average durability of capital goods. The

series represented by the dotted line (which reveals the lag in which we are chiefly interested) would not be changed very much in direction; however, it would be raised as much as the solid line.

Chart 2

Indexes of Per Unit Original and Replacement Costs, 1919–1935

Business Depreciation Charges



Expression in terms of purchasing power introduces the problem of selecting the goods in which purchasing power is to be measured and increases the statistical difficulties by

bringing in the need for other prices. No attempt is made here to do more than suggest the meaning to be ascribed to purchasing power. We confine ourselves below to the first two modifications mentioned.

Price and quality changes perplex the business man as well as the economist, and are the source of some of the chief difficulties in accounting for capital consumption. It is partly because of changes in the quality of the new capital equipment flowing through the market that even great changes in price levels are ignored in the records of business. The difficulties of adequately measuring capital consumed, of computing costs, and of setting prices arise in large part from such changes in quality. It is these difficulties that help to explain some of the recognized inadequacies of current accounting methods.

Changes in prices may be foreseen and investment made or withheld accordingly. If an investment is made it is presumably in the expectation that depreciation and obsolescence charges can be raised sufficiently to take account of the future rise in quality or fall in price. This may not be as exceptional as it seems offhand. If business men have, by long experience, become used to improvements in quality (at a given price), depreciation practices may come to anticipate them in the form of allowances for obsolescence. However, the wide prevalence of straight line depreciation charges means that in actual practice no attempt is made to pro-rate depreciation charges so that the expected losses from obsolescence are properly allocated over the life of the equipment. The accounting estimates of depreciation in Table 29 may therefore understate the decline in the value of capital goods (arising from both wear and tear and obsolescence) during the first half of their useful lives and overstate it in the second half. In an economy in which the amount of capital is fairly constant, however, the discrepancies tend to cancel one another. If capital is growing there may be something of a continuous lag in the level of capital charges.

CONSTANT PRICES

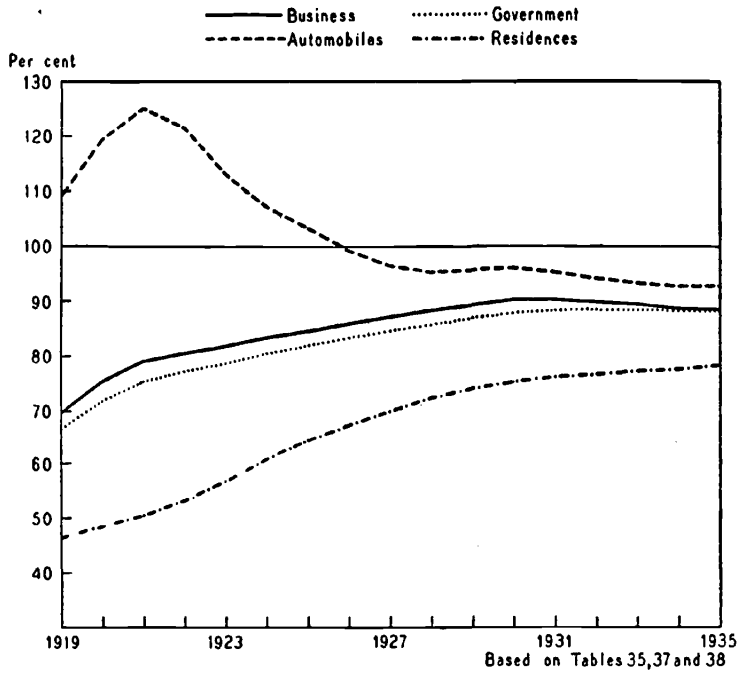
Depreciation charges

As a result of the great fall in the purchasing power of the dollar with rising prices during the War, the prices implicit in

Chart 3

Indexes of Prices underlying Depreciation Charges, 1919–1935

(1929 prices: 100)



depreciation charges were usually lower than the prices actually paid for replacements. This situation, revealed by the indexes in Chart 3, prevailed during most of the period we are examining. The one exception is automobiles, the price

of which declined.[2] The indexes represent the average of the original cost prices on the basis of which depreciation charges are computed, as a percentage of the corresponding 1929 prices.

In 1929 the original cost prices of the business equipment and buildings being depreciated averaged about 9 per cent less than reproduction costs in 1929. In 1919 the prices originally paid for capital assets in existence averaged some 29 per cent less than 1929 prices. Not until the decline of prices in 1930 did reproduction costs fall below the amounts set aside in depreciation reserves to make possible the replacement of equipment. The extent of the lag is indicated by the line representing the ratio of this index to an index of current prices (Chart 2).

The indexes in Chart 3 are harmonic means of various available indexes of prices of capital goods and construction costs, weighted by the estimated depreciation charge applicable to the goods produced at the given prices. The harmonic mean of prices was employed because, when used to deflate a value series, it yields a series expressed in constant (base year) prices.[3] The underlying price indexes, especially those of construction, are not entirely satisfactory, and the weights used are rather rough. There can be little doubt, however, that the picture as a whole is as outlined here. (The figures are given

[2] The short life of automobiles also influences the index of prices underlying depreciation charges on automobiles.

[3] If $p_1 =$ the given year price,
$p_0 =$ the base year price,
$q_1 =$ the given year quantity,
$q_0 =$ the base year quantity,
then $\sum p_1q_1 =$ the aggregate of the given year values, expressed in given year prices;

$$1 \Big/ \frac{\sum \frac{p_0}{p_1} p_1q_1}{\sum p_1q_1} = \frac{\sum p_1q_1}{\sum p_0q_1} =$$ the harmonic mean of price relatives, weighted by given year values; and

$$\sum p_1q_1 \Big/ \frac{\sum p_1q_1}{\sum p_0q_1} = \sum p_0q_1 =$$ the aggregate of values for the given year, expressed in base year prices.

Table 30

Measures of Capital Consumption, 1919–1935, in 1929 Prices[1]

(Unit: $1,000,000)

	1919	*1920*	*1921*	*1922*	*1923*	*1924*
Business capital[2]						
Depreciation	4,901	4,767	4,597	4,912	4,956	4,993
Depletion	408	459	362	390	522	494
Depreciation and depletion	5,309	5,226	4,959	5,302	5,478	5,487
Repairs and maintenance (public utilities)	2,004	2,260	2,259	2,502	2,488	2,244
Development costs charged to current expenses (mining)	321	379	252	306	315	284
Provision for fire and marine losses	185	166	212	227	203	205
Governmental capital						
Depreciation	395	384	387	405	424	450
Repairs and maintenance (highways and sewers)					311	360
Consumers' capital						
Depreciation (residences)	2,000	2,027	1,885	1,919	1,975	2,045
Depreciation (automobiles)	792	923	999	1,103	1,394	1,682

[1] Derived by dividing the figures in Table 29 by the appropriate price indexes (given in the note to Ch. 10), except in the case of depletion charges, for which see the text.

in the note to this chapter, with some further details on the method of computation.)

It is the index of the original cost prices underlying depreciation charges that we must use to reduce the charges to constant dollars. The deflated figures appear in Table 30.[4]

The deflating index represents a peculiar price level. It is in essence a moving average of earlier prices, centered at the last year of the span covered. It measures one of the factors tying together different periods and suggests the extent of the influence of previous prices upon the present economic situation. As such it represents an institutional force of some weight and indicates one lagging element through which rising prices are

[4] Deflated figures for depreciation on work animals and dairy cattle appear in Appendix B, Table VI; and for automobiles on the straight line basis, in Table VII.

1925	*1926*	*1927*	*1928*	*1929*	*1930*	*1931*	*1932*	*1933*	*1934*	*1935*
5,191	5,659	5,599	5,867	6,164	6,159	6,076	5,694	5,464	5,349	5,335
510	544	547	547	595	513	423	343	377	405	440
5,701	6,203	6,146	6,414	6,759	6,672	6,499	6,037	5,841	5,754	5,775
2,424	2,518	2,418	2,396	2,413	2,131	1,824	1,467	1,440	1,476	1,521
320	366	296	268	321	241	131	144	134	179	237
214	226	238	236	223	216	215	204	196	176	178
479	514	551	584	602	631	669	696	722	755	788
388	433	478	568	597	713	725	846	609	616	640
2,139	2,239	2,333	2,414	2,484	2,511	2,490	2,467	2,447	2,433	2,407
1,929	2,243	2,427	2,500	2,625	2,593	2,334	1,981	1,651	1,466	1,479

[2] Including property of farmers, but excluding depreciation on work animals and dairy cattle.

a stimulus to business enterprise and declining prices are a depressant.

Depletion charges

The depletion charges reported by business concerns are also composites including prices determined in different years. But the adjustment of depletion charges presents additional difficulties. Unlike depreciation charges, which are computed chiefly as a percentage of original cost, depletion charges are based on a more heterogeneous mixture of prices. Some of the values used relate to the date of discovery as well as to the time of the original purchase of the land and in some instances depletion charges are calculated simply as percentages of gross income. In a stationary state we might measure depletion by an amount "adequate to provide some form of man-made

capital equivalent in 'value' to this wear and tear".[5] In a dynamic industrial system only the roughest approximations are possible. This is recognized in the entrepreneurial estimates themselves, and in the degree of reliability ascribed to them by business men and accountants.[6]

Here we attack the problem of reducing depletion charges to constant dollars by going directly to an index of output of raw minerals and forest products. This index is taken to represent the movements of these charges had they been expressed in constant prices. The index of depletion thus derived may be expressed in dollars by the further assumption that the actual charges in some one year are correct. We select 1929 as this base. Only slightly different results are yielded by the use of other years.

Other elements of capital consumption

The available estimates, in Table 29, of items other than charges for depreciation and depletion, are in current prices.[7] Their deflation by appropriate indexes to convert them into 1929 prices therefore requires no detailed explanation. The deflators are described in the note to this chapter.

It is curious that the large fluctuations in prices during 1919–22 are not reflected in the provision for fire and marine losses: some over-insurance is suggested by the figures in Table 30. However, provision for losses declined in response to the fall in the amount of insurable property beginning in 1930.

CURRENT PRICES

Depreciation charges

Conversion to current prices, prices prevailing at the time that depreciation is charged, is an additional step following con-

[5] A. C. Pigou, *The Economics of Stationary States* (Macmillan, 1935) p. 22.

[6] In certain branches of mining, it will be remembered, it is common practice to ignore depletion, except for tax purposes.

[7] This is obvious for all the items except, perhaps, provision for fire and similar losses. Benefit payments for such damage are made, in accordance with insurance law, on a current value basis. Presumably, therefore, the provision for loss also relates to current values. See Ch. 5, and the references there cited.

version to constant prices. It is necessary only to multiply the charges expressed in constant prices by an index of current costs of capital goods (Table 31).

Depletion charges

To express depletion charges in 'current' dollars is more difficult. Probably the most suitable index would be the per unit values of natural resources. The difficulties in the way of securing these prices are obvious, however. It would further be necessary, assuming they were available, to adjust them for variation in the rate of capitalization. To secure prices of comparable items would, in the nature of the case, be impossible. Even the same mine is a different thing from one time to another simply because of developments in the way of knowledge as to its mineral content, changes in costs of extracting the ore, and so on. The prices of mineral products and logs, while relatively easy to obtain, represent the value of the extracted and slightly processed product. Their adequacy for our purpose would depend on the degree to which they were an index of the value of the unextracted ore and timber—that is, were correlated with the value of the mine or timber tract. Since they represent but one of the factors affecting the latter values, and a very volatile one, their suitability may be doubted. In fact, expected prices are probably more relevant than current prices.

For our purpose we may use also indexes of the general price level or of the prices of capital goods. While they may not be more closely correlated with the prices desired than are the prices of mineral and timber products, they probably fluctuate within a range of amplitude that is closer to that of the prices we need. They are related, also, to the costs of discovering and developing resources. The index of the prices of capital goods is our most readily available choice. This assumes that, among other things, our knowledge of mineral resources is constant, that technological changes have been relatively unimportant, and that relative price changes have been small.[8] These are

[8] It may, perhaps, be expected that the unit values of depletable resources will, in the long run, rise relatively to general prices, on account of increasing

Table 31

Measures of Capital Consumption, 1919–1935, in Current Prices[1]

(Unit: $1,000,000)

	1919	*1920*	*1921*	*1922*	*1923*	*1924*
Business capital[2]						
Depreciation	5,416	6,207	4,707	4,568	5,130	5,063
Depletion	451	597	371	363	540	501
Depreciation and depletion	5,867	6,804	5,078	4,931	5,670	5,564
Repairs and maintenance (public utilities)	2,289	2,983	2,338	2,297	2,592	2,372
Development costs charged to current expenses (mining)	334	498	253	284	328	292
Provision for fire and marine losses	209	218	217	212	210	207
Governmental capital						
Depreciation	443	508	401	380	450	465
Repairs and maintenance (highways and sewers)					367	421
Consumers' capital						
Depreciation (residences)	2,082	2,666	1,894	1,781	2,056	2,100
Depreciation (automobiles)	1,018	1,338	1,291	1,160	1,366	1,630

[1] The figures on repairs, development expense, and fire losses are the same as in Table 29. As stated in the text, these types of capital consumption are already expressed in current prices. The data on depreciation and depletion are derived from the corresponding figures in Table 30 (in constant prices), multiplied by appropriate

bold assumptions, of course, involving as they do the absence of change in the chief elements characteristic of a dynamic economy. However, any other reasonable treatment would affect total capital consumption but slightly since depletion charges constitute a relatively small portion of our total.

Other elements of capital consumption

The other items in Table 29 are already expressed in current prices. For this reason they are identical with the correspond-

scarcity, etc. On the other hand, technological progress may, if somewhat more rapid in mining, tend to reduce relative prices. It may safely be assumed that over a short period, such as we are concerned with, secular relative price changes may be ignored.

1925	*1926*	*1927*	*1928*	*1929*	*1930*	*1931*	*1932*	*1933*	*1934*	*1935*
5,165	5,625	5,554	5,750	6,164	5,894	5,390	4,675	4,399	4,664	4,716
507	541	543	536	595	491	375	281	303	353	389
5,672	6,166	6,097	6,286	6,759	6,385	5,765	4,956	4,702	5,017	5,105
2,392	2,485	2,423	2,341	2,413	2,082	1,656	1,210	1,156	1,281	1,364
319	366	297	267	321	233	109	107	96	138	184
212	224	235	230	223	206	191	168	158	156	160
480	514	554	575	602	606	597	548	582	648	686
445	481	533	579	597	646	592	595	494	571	588
2,133	2,239	2,338	2,407	2,484	2,431	2,087	1,826	1,752	1,873	1,853
1,832	2,023	2,243	2,410	2,625	2,443	2,082	1,761	1,451	1,365	1,355

indexes of current (reproduction cost) prices given in the note to Ch. 10.

[2] Including property of farmers, but excluding depreciation on work animals and dairy cattle.

ing figures in Table 31, where all the series are in current prices.

COMPARISON OF THE SEVERAL MEASURES

The results of the conversion of the estimates in Table 29 into fixed prices are presented in Table 30. The year 1929 has been selected as the base. The average of a broader period such as 1925–29 as the base yields much the same results as the use of 1929. We are here measuring the declines in capital goods in constant prices instead of the varying cost prices appearing on the books of business enterprises. In Table 31 the same series are expressed in the prices current year by year, that is, the

estimate for 1925 is in 1925 prices, and so on. (Only the changes in per unit replacement costs are eliminated by expressing capital consumption in either current or cost prices; changes in values arising from normal obsolescence remain, and properly so.) We thus make our estimates of capital consumption comparable with those of gross national product and gross capital formation and may in this way obtain a measure of national income or of net capital formation that, from the economic point of view, is not ambiguous.

The various measures in Tables 29, 30, and 31 are brought together in Chart 4, which makes graphic comparison possible. As was suggested earlier, the rising trend of business and other depreciation charges (except for automobiles) was partly a consequence of the change in price levels from 1913 to the post-War period. Elimination of the price changes leaves a less rapidly rising trend (with the same exception). The response of business depreciation charges to the cyclical declines in business before 1931 is slight. Only in the later years of the major recession of 1929–33 was there a substantial decline in business depreciation charges expressed in constant prices.[9] Depreciation of governmental capital fell off slightly in 1920, but rose without exception each year after 1929. The response of depreciation on residences (in constant prices) to declines in building construction is noticeable in 1921 and also beginning with 1930. But the changes are small. The high amplitude of fluctuation in automobile depreciation reflects not only changes in the output of cars but also their relatively short lives.

Owing to the prevailing methods of computing depletion charges, their movements are responsive to the fluctuations in general business.

The absence of trend in business repairs and maintenance is a consequence of the great weight, in this series, of steam rail-

[9] An important factor making for this stability is the widely prevalent and consistent use of the straight line method of accruing depreciation charges. Charging on the basis of output would change the figures rather appreciably. See Ch. 11.

ways. This industry grew little if any during the post-War decade. The radical decline since 1929 is indicative of the under-maintenance already suspected. An increasing proportion of business capital consumption is being recorded in the form of depreciation charges rather than in charges for repairs and maintenance, chiefly as a consequence of the decline in the relative importance of steam railways.

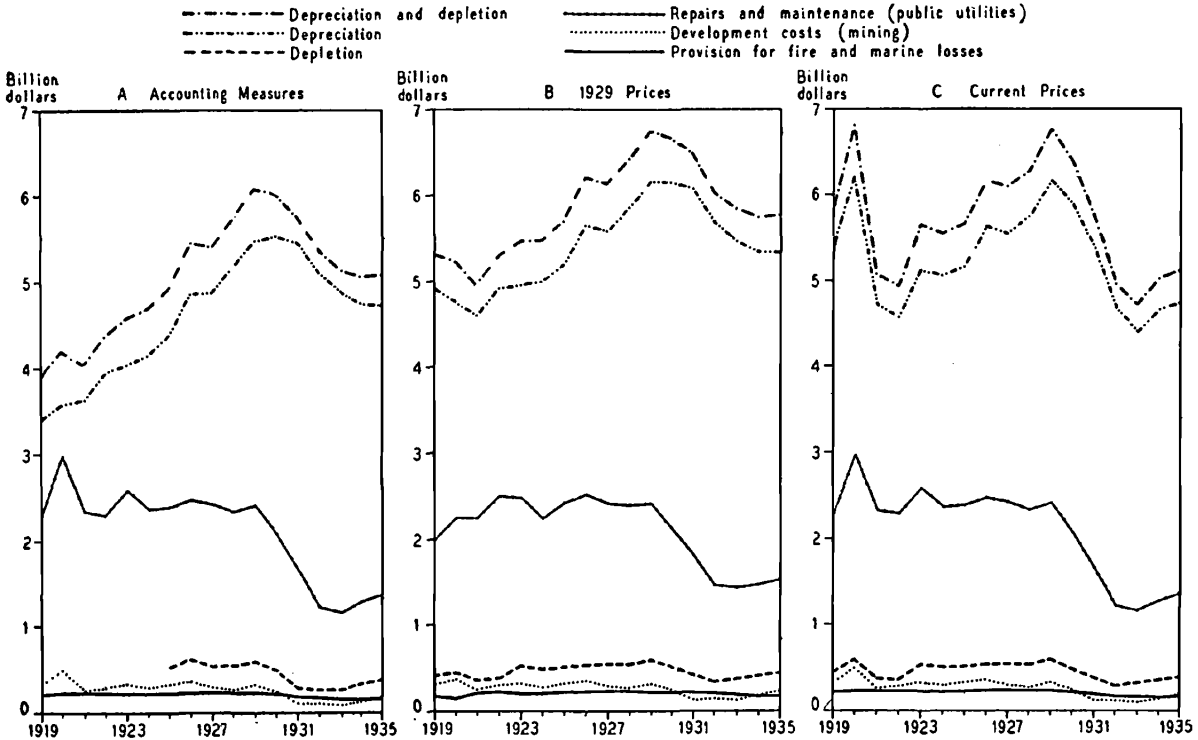
Costs of developing mines have fluctuated with the current rate of mining output. Recorded depletion charges and costs of development of our national resources declined in relative importance during the fifteen years under review.

The decline in provision for fire losses since 1930 is striking. Despite a large increase in the nation's capital stock, losses by fire and marine disaster showed no appreciable upward trend during the 1920's.

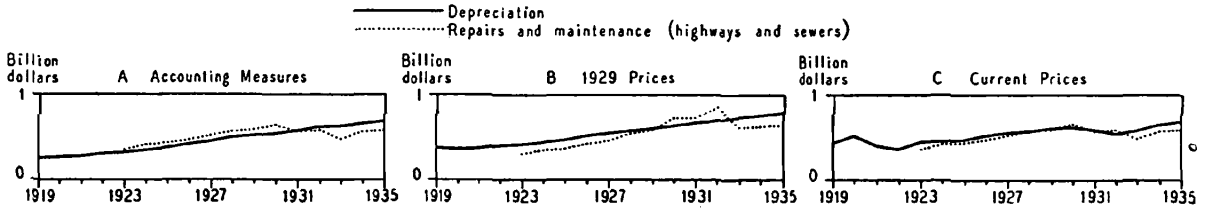
The influence of the high post-War prices and low depression prices upon the measure of capital consumption is interesting (Table 31). Substitution of these prices for the original cost prices underlying the accounting estimates of depreciation charges raises the values assigned to the earlier years of the period 1919–35 and lowers the values of the later years (except in the case of automobiles).

Chart 4

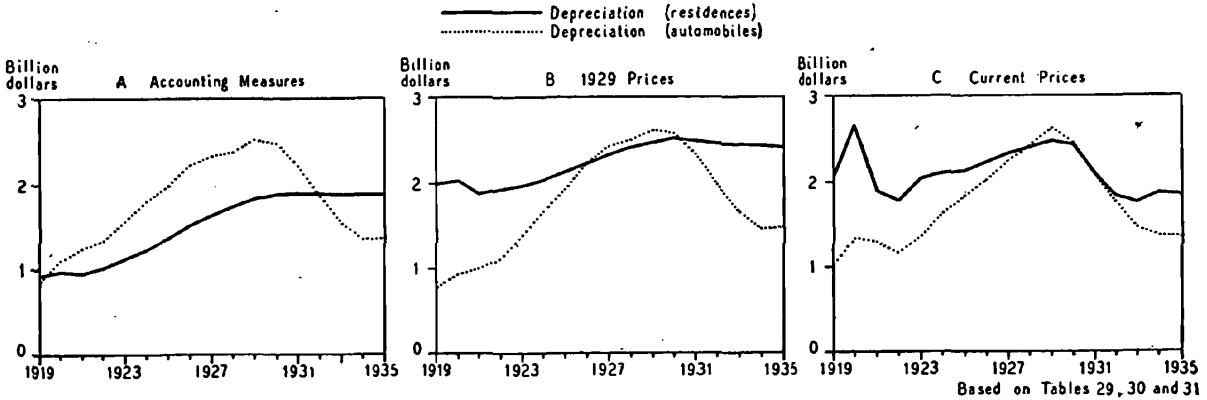
I Business Capital Goods



II Government Capital Goods



III Consumers' Capital Goods



Based on Tables 29, 30 and 31

Note: SOURCES AND METHODS OF ESTIMATION

BUSINESS CAPITAL

PRICES RELATED TO BUSINESS DEPRECIATION CHARGES

Indexes of current replacement costs

Two indexes were constructed, one covering the prices of producers' durable goods, the other construction costs. In the absence of more satisfactory information, the weights used in combining the various price series available were round figures based on a consideration of the representativeness and reliability of each series. The various series, together with the derived indexes, are presented in Table 32.

The two indexes thus derived were used to estimate the movements of prices underlying depreciation charges, and were also combined for later use in expressing depreciation charges in current prices. The weights used for these purposes are described below.

Weights used in computing indexes of prices underlying depreciation charges

Two sets of weights were necessary. One set defined the relative importance ascribed to each life group of the capital goods produced in any year (life being defined as expected useful life). The other set of weights defined the relative importance ascribed to each year's output of capital goods.

The first set of weights was based on the distribution of the 1929 value of output of business capital goods, by length of expected useful life. Depreciation rates collected by the Treasury Department and published in *Depreciation Studies—Preliminary Report of the Bureau of Internal Revenue* (1931) were used. Expected useful life was assumed to be the reciprocal of the depreciation rate, no allowance being made for scrap value. (This tends to overstate but slightly the actual length of life expected.)

Producers' durable goods were again treated separately from building and other construction. Weights for each depreciation rate on producers' durable goods were determined by looking up each class of equipment in the Census of Manufactures as indexed in Products of Manufacturing Industries, 1929, *Census of*

Distribution (Washington, 1932). The weights thus determined totaled 4,398 million dollars. This was raised to 6,500 million, the approximate value of all producers' durable goods manufactured in 1929. Construction was assigned a total weight of 3,000 million dollars (a good deal of public utility construction being excluded because accounted for on a maintenance basis).[10] Each one of the individual types of buildings (and the depreciation rates corresponding to each) given by the Bureau of Internal Revenue under the general heading 'Buildings' was assigned an equal portion of this total weight. The weight distributions for 1929 thus derived are given in Table 33, separately and combined.[11]

The time distribution of the output of business capital goods was based on two indexes of output. In the absence of detailed information, it was assumed that the output of all types of producers' durable goods, of any average life group, could be represented by the same index. This index was derived as follows:

1919, 1919, 1909, 1904, 1899, Census of Manufactures, total value of product *modity Flow and Capital Formation*, Table VIII–2).

1919, 1914, 1909, 1904, 1899, Census of Manufactures, total value of product of the following industries:

Foundry and machine shop products	Cars, steam railroad
Locomotives	Cars, electric railroad
Machine tools	Electrical machinery
Textile machinery	Agricultural implements
Tools, not elsewhere classified	Business vehicles

1919–1914, Census of Manufactures of Massachusetts, annual reports on the value of product of foundries and machine shops and of electrical machinery, excluding ordinance and accessories.

Interpolations for the intercensal years 1914–1899 were by means of a straight line. Weights for years prior to 1899 were assumed to be equal to that for 1899. Any errors involved in determining the

[10] These weights were derived from Dr. Kuznets' preliminary estimates, published in final form in *Commodity Flow and Capital Formation*. Because of revisions, weights based on the published figures would be higher than those used, but insufficiently so to make recomputation necessary.

[11] Since two or more types of buildings may be subject to the same rate of depreciation, and since the number of types corresponding to each depreciation rate varies from rate to rate, there is no reason to expect identical weights for each life group under the caption 'Construction' in Table 33.

Table 32

Indexes of Prices of Business Capital Goods, 1913–1935

(*1929: 100*)

	1913	*1914*	*1915*	*1916*	*1917*	*1918*	*1919*	*1920*	*1921*	*1922*	*1923*	*1924*
Producers' Durable Goods (excl. Buildings)												
I.C.C., railroad construction costs [1]												
Roadway machines			70.9	76.4	85.8	98.6	106.8	114.9	109.5	100.7	102.0	102.0
Roadway small tools			52.6	52.6	94.2	94.2	96.8	106.3	95.3	89.5	91.1	97.4
Shop machinery, road			60.2	66.0	81.2	100.5	104.7	109.9	103.7	90.6	95.8	96.9
Equipment			51.6	69.9	89.2	117.7	129.0	142.5	99.5	87.6	106.5	97.8
American Appraisal Company, wholesale prices [2]												
Machine tools		41.0	43.9	54.9	73.0	89.8	94.7	103.3	91.0	78.3	83.2	85.7
Woodworking machinery		41.0	41.0	44.3	52.5	68.9	77.5	96.7	98.8	91.8	95.9	95.5
J. G. Brill Company,[3] commercial cost of electric cars			36.4	44.4	65.5	85.8	82.5	101.1	98.9	84.7	91.6	103.3
National Bureau, wholesale prices of processed capital equipment [4]	62.5	58.2	61.4	83.4	107.6	119.1	124.9	155.4	109.3	103.2	113.7	107.8
Weighted average	55.9	52.1	54.7	68.9	89.3	107.2	114.0	131.3	102.6	93.0	103.3	100.3
Construction Costs												
American Appraisal Company,[5] all types	49.0	48.1	49.5	56.9	70.5	84.1	104.1	131.5	100.5	92.8	104.1	102.7
Richey,[6] electric light and power	55.2	51.9	55.2	70.2	90.6	96.7	100.6	116.6	100.6	90.1	98.3	99.4
I.C.C.,[1] railroad construction costs, road			63.1	68.8	83.8	99.4	111.2	133.8	109.4	98.1	106.9	106.9
Tuttle,[7] factory		51.0	51.0	55.1	70.9	76.0	87.8	120.9	91.3	86.7	103.1	103.1
Aberthaw,[7] factory												
Weighted average	55.4	53.6	55.2	62.8	78.4	90.0	103.2	128.0	102.0	93.1	103.9	103.6
General Index	55.7	52.7	54.9	66.7	85.6	101.5	110.5	130.2	102.4	93.0	103.5	101.4

Producers' Durable Goods (excl. Buildings)												
I.C.C., railroad construction costs [1]												
Roadway machines	102.0	102.0	102.0	100.7	100.0	99.3	97.3	93.2	93.2	99.3	99.3	1
Roadway small tools	100.0	100.0	100.5	100.5	100.0	84.2	81.6	81.6	78.9	78.9	78.9	1
Shop machinery, road	96.9	97.4	97.9	99.0	100.0	92.1	86.9	81.2	81.2	93.7	93.7	2
Equipment	93.0	93.5	98.4	93.5	100.0	99.5	91.4	82.3	82.3	90.9	96.8	5
American Appraisal Company, wholesale prices [2]												
Machine tools	86.1	88.5	91.4	94.7	100.0							1
Woodworking machinery	95.5	95.5	94.7	94.7	100.0							1
J. G. Brill Company,[3] commercial cost of electric cars	102.9	103.3	104.0	101.1	100.0	98.9	93.8	85.8	73.8	90.5	92.7	1
National Bureau, wholesale prices of processed capital equipment [4]	106.4	104.5	99.4	99.0	100.0	92.7	85.7	81.4	79.9	86.3	85.4	5
Weighted average	98.7	98.5	98.7	97.2	100.0	95.2	88.8	82.8	81.3	89.5	91.3	
Construction Costs												
American Appraisal Company,[5] all types	99.7	100.0	99.8	99.7	100.0	96.8	83.6	74.0	71.5	76.9	77.4	2
Richey,[6] electric light and power	97.8	97.2	96.7	98.3	100.0	99.4	91.2	83.4				1
I.C.C.,[1] railroad construction costs, road	103.8	103.8	102.5	100.6	100.0	95.0	89.4	81.9	79.4	81.9	81.9	2
Tuttle,[7] factory	102.0	104.1	101.0	99.5	100.0							1
Aberthaw,[7] factory					100.0	97.9	92.6	88.4	89.5	93.2	93.2	1
Weighted average	101.1	101.5	100.4	99.7	100.0	96.8	88.3	80.6	78.9	82.8	83.0	
General Index	99.5	99.4	99.2	98.0	100.0	95.7	88.7	82.1	80.5	87.2	88.4	

[1] Engineering Section, Bureau of Valuation, Railroad Construction Indices (Washington, July 1, 1936, mimeographed); not available prior to 1915.

[2] American Appraisal Company, chart showing "relative fluctuations in basic prices of certain elements of property values" (Milwaukee, 1929?); not available for 1913 or since 1929.

[3] J. G. Brill Company, chart showing "commercial cost of (electric) cars" (Philadelphia, 1937); not available prior to 1915.

[4] F. C. Mills, *Prices in Recession and Recovery* (National Bureau of Economic Research, 1936), pp. 494, 508.

[5] *Survey of Current Business*, 1936 Supplement (Washington, 1936).

[6] *Survey of Current Business*, 1933 Supplement (Washington, 1933); discontinued since 1932.

[7] *Engineering News-Record, Construction Costs* (1936 ed.), p. 32.

weights for these years are small, because of their minor importance even in the first years of the period with which we are concerned.

For construction also it was necessary to assume that private (non-residential) construction of all types, of any average life-group, could be represented by one index. The index was derived as follows:

1919–35, Dr. Kuznets' estimates of construction, including one-half of public utility construction *(loc. cit.)*.
1914, 1919, Output of construction materials, Census of Manufactures.
1910–19, Interpolation by the *Engineering News-Record* index of construction.
1869–1910, Per capita building permits collected by Dr. Riggleman, multiplied by non-farm population.

The two sets of weights thus derived were crossed. The resulting weight represents the estimated output, in any year, of each group of capital goods classified by length of expected life. If, now, we divide the output of any life group (say the 10-year group) in any one year (say 1915) by 10, we have the weight that must be assigned to the 1915 price of this group of goods in order to determine the average price underlying depreciation charges in each year 1916–25. The weight of the 1915 price of the 20-year group in each year 1916–35 is one-twentieth of its 1915 output.

The weights thus derived are in fact estimates of the depreciation charges in each year covered. If we compare the total weight assigned to the prices implicit in the depreciation charges of (say) 1925, with the actual depreciation charged in 1925, a check upon our weight distribution is possible (the *relative* weights are of most significance, of course). This comparison (Table 34) suggests that the relative weights assigned to the several years agree fairly well with the distribution of total depreciation charges over the period. The upward trends of both series are close and the peak year is identical. The higher level of the weights (which average about 20 per cent above depreciation charges) may perhaps be explained by inadequate allowance for expenditures on durable goods charged to maintenance rather than capitalized. The cyclical fluctuations in the ratio of the first series to the second series in Table 34 arises from our use, in the computation of the second series, of a straight line depreciation formula. As

Table 33

Value of Output of Business Capital Goods in 1929
Distributed by Length of Expected Useful Life

LIFE [1] (years)	VALUE OF OUTPUT (percentage of total) Producers' durable goods (excl. construction)	Construction	Total	DEPRECIATION RATE (per cent)
75	0.5	..	0.3	1⅓
50	0.6	14.8	5.1	2
44	0.0	4.5	1.4	2¼
40	2.2	19.3	7.6	2½
35	0.1	12.5	4.0	2 6/7
33	0.8	10.2	3.8	3
30	1.4	11.4	4.6	3⅓
29	0.7	6.8	2.6	3½
25	2.4	13.6	5.9	4
22	0.5	2.3	1.1	4½
20	11.7	4.6	9.5	5
18	4.1	..	2.8	5½
17	2.0	..	1.4	6
16	2.2	..	1.5	6¼
15	16.0	..	10.9	6⅔
14	3.2	..	2.2	7
13	0.9	..	0.6	7½
12.5	4.3	..	2.9	8
12	3.9	..	2.7	8⅓
11	0.8	..	0.5	9
10	11.1	..	7.6	10
9	0.6	..	0.4	11
8	4.1	..	2.8	12½
7	2.3	..	1.6	14
6	6.0	..	4.1	16⅔
5	6.3	..	4.3	20
4	5.6	..	3.8	25
3	2.9	..	2.0	33⅓
2.5	1.6	..	1.1	40
2	1.2	..	0.8	50
	100.0	100.0	100.0	

[1] Reciprocal of depreciation rate, not allowing for scrap value.

we have seen in Chapter 5, however, the straight line formula is not universally used.

It was assumed above that the output of capital goods of each

Table 34

Comparison of Business Depreciation Charges derived from Income Accounts and those estimated from the Output of Capital Goods

(Unit: $1,000,000)

	DEPRECIATION CHARGES DERIVED FROM	
	Income accounts [1]	Output of capital goods
1919	3,411	3,988
1920	3,585	4,417
1921	3,632	4,663
1922	3,949	4,730
1923	4,044	4,859
1924	4,154	5,054
1925	4,386	5,263
1926	4,861	5,520
1927	4,877	5,774
1928	5,175	6,004
1929	5,498	6,280
1930	5,549	6,503
1931	5,481	6,492
1932	5,119	6,242
1933	4,879	5,894
1934	4,745	5,620
1935	4,721	5,464

[1] Table 29.

life class is a constant percentage of the total output in each year. Colin Clark suggests [12] that in Great Britain, during 1901–35, the shorter-lived types of equipment increased. If this were true also for the United States it would mean that the deflator derived on the above assumption progressively exaggerates the discrepancy between original cost prices and reproduction cost prices when the secular movement of prices is consistently upward or downward. When there are fluctuations in prices, however, (as there were) the exaggeration is lessened. It is highly doubtful, in view

[12] *National Income and Outlay* (Macmillan, 1937), p. 184.

of the movements of prices and the slow effect on the average age of existing capital goods even when shorter-lived types are increasing among new accessions, that this exaggeration is important.

Computation of the deflation indexes

As shown in the text of Chapter 10, the appropriate index is an harmonic mean of fixed-base price relatives with given-year values as weights.

Two indexes were computed, one representing the appropriate deflator for depreciation of construction, the other that for depreciation of other producers' durable goods. These were then combined (each being weighted, of course) to make up the deflator applied to the reported depreciation charges (Table 35).

Table 35

Indexes of Prices underlying Business Depreciation Charges, 1919–1935

(1929 prices: 100)

	CONSTRUCTION	OTHER PRODUCERS' DURABLE GOODS	TOTAL
1919	58.3	75.1	69.6
1920	60.1	82.3	75.2
1921	61.7	87.3	79.0
1922	62.8	88.9	80.4
1923	64.0	90.2	81.6
1924	65.5	91.7	83.2
1925	67.0	92.9	84.5
1926	68.7	93.9	85.9
1927	70.3	94.5	87.1
1928	71.9	95.2	88.2
1929	73.4	96.4	89.2
1930	74.7	96.9	90.1
1931	75.6	96.8	90.2
1932	76.2	96.3	89.9
1933	76.7	95.5	89.3
1934	77.2	94.7	88.7
1935	77.9	94.1	88.5

It was unnecessary to use prices prior to 1913. The section of the income tax law bearing on depreciation reported for tax purposes (the figures used by us) provides that capital goods acquired prior to 1913 be valued at 1913 prices (see Ch. 5).

A slight correction was made to take care of the fact that equipment purchased during a given year would be depreciated, on the average, for one-half the year only by the end of the year. A two-year moving average of the indexes was centered on the second year.

DEPLETION IN CONSTANT AND CURRENT PRICES

Constant prices

Depletion expressed in constant prices was assumed to vary with the output of minerals and timber. An index of this output was constructed by combining various indexes of mineral output and lumber production. Weights were derived from depletion charges in 1929. Depletion charges by companies engaged in agriculture, lumber, paper, and printing were assumed to stand for timber. The index, and the weights used, appear in Table 36. The index thus derived was multiplied by depletion charges in 1929 to yield a series in dollar terms.

Current prices

It was assumed that the desired current prices moved as did average replacement costs of producers' durable goods (Table 32).

DEFLATION OF OTHER ELEMENTS OF BUSINESS CAPITAL CONSUMPTION

Provision for fire and marine losses

The deflator was built up from the two major indexes in Table 32, each weighted by the value of corresponding property in existence in 1922 (see the note to Ch. 4).

Repairs and maintenance (public utilities)

A weighted arithmetic mean of the following indexes was used for deflating:

	WEIGHT
I.C.C., construction costs, steam railway	
Road	10
Equipment	10

	WEIGHT
Richey, electric light and power construction costs	4
Brill, cost of electric cars	2

The indexes and their sources are given in Table 32.

Development costs (mining)

These were expressed in constant prices by means of the American Appraisal Company index of construction costs, all types (Table 32).

Table 36

Estimate of Depletion in 1929 Prices, 1919–1935

(1929: 100)

	OUTPUT OF		INDEX OF DEPLETION IN 1929 PRICES
	Raw minerals [1]	Raw lumber [2]	
1919	65.1	91.9	68.6
1920	75.3	90.4	77.2
1921	59.2	72.6	60.9
1922	62.6	84.8	65.5
1923	85.9	99.6	87.7
1924	81.1	96.4	83.1
1925	83.1	103.0	85.7
1926	90.3	99.3	91.5
1927	91.7	92.9	91.9
1928	91.8	92.2	91.9
1929	100.0	100.0	100.0
1930	88.7	70.0	86.3
1931	75.1	44.0	71.1
1932	62.2	26.9	57.6
1933	67.2	37.0	63.3
1934	72.0	41.2	68.0
1935	77.2	52.3	74.0
Weight	.871	.129	1.000

[1] Based on the Federal Reserve index of mineral output for 1919–22, and that of Charles A. Bliss for 1922–35.

[2] Based on the Census of Manufactures, interpolated by annual data on lumber production compiled by the U. S. Bureau of the Census.

GOVERNMENTAL CAPITAL

PRICES RELATED TO DEPRECIATION OF GOVERNMENTAL CAPITAL

The index used to obtain the adjusted figures was based on the computations already made for the indexes used in deflating business depreciation. Construction was weighted much more heavily, however. The index thus derived appears in Table 37. A similar procedure was followed in obtaining current reproduction costs of governmental capital goods (also given in Table 37).

Table 37

Indexes of Prices underlying Depreciation Charges on Governmental Capital and of per unit Replacement Costs, 1919–1935

(1929 prices: 100)

	PER UNIT COSTS UNDERLYING DEPRECIATION CHARGES	PER UNIT REPLACEMENT COSTS
1919	66.9	112.2
1920	71.8	132.2
1921	75.4	103.5
1922	77.1	93.9
1923	78.7	106.0
1924	80.4	103.3
1925	81.9	100.1
1926	83.3	100.1
1927	84.6	100.6
1928	85.8	98.5
1929	87.0	100.0
1930	87.9	96.1
1931	88.4	89.3
1932	88.5	78.7
1933	88.3	80.6
1934	88.2	85.8
1935	88.2	87.0

DEFLATION OF MAINTENANCE CHARGES

Expenditures on maintenance of roads, streets, and sewer systems were expressed in 1929 prices by means of the Bureau of Public Roads index, price trend in highway construction, surfacing (*Public Roads*, June, 1936, p. 85). On the 1929 base the index is as follows:

1923	118.1	*1927*	111.4	*1931*	81.6
1924	116.8	*1928*	101.9	*1932*	70.3
1925	114.8	*1929*	100.0	*1933*	81.1
1926	111.2	*1930*	90.6	*1934*	92.7
				1935	91.9

CONSUMERS' CAPITAL

PRICES RELATED TO DEPRECIATION CHARGES ON CONSUMERS' CAPITAL

The deflating indexes were derived by following a method similar to that used in deriving the indexes needed to deflate business depreciation charges (Table 38). While the indexes of prices underlying depreciation charges on houses were based on per unit costs available for urban areas alone, they were used to deflate depreciation on farm dwellings as well.

The indexes of current reproduction costs used to express the depreciation charges in current prices are also given in Table 38.

Table 38

Indexes of per unit Replacement Costs and per unit Costs underlying Depreciation Charges on Consumers' Capital, 1919–1935

(1929 prices: 100)

	RESIDENCES		AUTOMOBILES	
	Per unit replacement costs [1]	Per unit costs underlying depreciation charges [2]	Per unit replacement costs [3]	Per unit costs underlying depreciation charges [4]
1919	104.1	46.4	128.5	109.1
1920	131.5	48.2	144.9	119.2
1921	100.5	50.3	129.3	125.1
1922	92.8	53.1	105.1	121.5
1923	104.1	56.7	98.0	113.0
1924	102.7	60.5	96.9	107.1
1925	99.7	64.2	95.0	103.2
1926	100.0	67.3	90.2	99.3
1927	100.2	69.9	92.4	96.4
1928	99.7	72.2	96.4	95.3
1929	100.0	74.0	100.0	95.7
1930	96.8	75.2	94.2	96.0
1931	83.8	76.1	89.2	95.2
1932	74.0	76.6	88.9	94.1
1933	71.6	77.1	87.9	93.2
1934	77.0	77.6	93.1	92.8
1935	77.0	78.3	91.6	92.7

[1] American Appraisal Company.

[2] Based on indexes of the *Engineering News-Record* and the American Appraisal Company: see text.

[3] Bureau of Labor Statistics composite of auto prices.

[4] Based on the B. L. S. index: see text.