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Part Seven

ADEQUACY OF ESTIMATES
AVAILABLE FOR COMPUTING
NET CAPITAL FORMATION

WENDELL D. HANCE

OFFICE OF PRICE ADMINISTRATION

This paper is necessarily in considerable part simply a means of bringing together observations made by the pioneer estimators. The National Bureau of Economic Research is responsible for, and Simon Kuznets is the author of, the basic methods, measures, and compilations in this field. Mr. Kuznets' monumental work, *Commodity Flow and Capital Formation*, blazed a trail of preeminent importance in economic statistics, a trail now being extended and improved in the Department of Commerce.

The National Bureau's publication, *Capital Consumption and Adjustment*, by Solomon Fabricant, affords the complementary estimates necessary for derivation of Mr. Kuznets' 'approximate' measures of net capital formation. No one could be as well aware as these two notable statisticians of the weaknesses that inhere in the measures. Their works contain most of the observations that can be made concerning the adequacy of their measures of gross capital formation and capital consumption. The writer is, accordingly, deeply indebted to both.

Adequacy of Estimates Available for Computing Net Capital Formation

WENDELL D. HANCE

NATIONAL INCOME by type of product can be defined, if international trade is disregarded, as the sum of the values of new consumer goods and services and new producer goods of all kinds, less the value of the current expiration of usefulness of producer goods; i.e., the value of 'consumption' plus the value of 'net capital formation'. National income may be built up by analysis of the net yields of the various goods and services produced by the economy, classifiable in either of these two components. However, estimates of net capital formation are of more interest to economists for their own sake than as terms required in order to derive such totals. The average level of net capital formation in various periods, its secular trend, and its cyclical fluctuations are regarded as facts of peculiar significance.

In view of the frequent reference by many economists and statisticians to the concept of net capital formation (NCF) and to measures designed to give substance to it, a critical guidebook to estimates of NCF and related quantities is an important desideratum. Examination of estimates of the two quantities entering into the subtraction that yields NCF in the form of durable goods raises a wide range of questions, both theoretical and statistical. Outstanding among the latter are those concerning the comparability in scope of the estimates of gross capital formation (GCF) and capital consumption (CC). Do the two sets of estimates match in terms of their breadth of coverage, i.e., of the various classifications, by type, by ownership (final holder), by producer, of durable goods newly produced and of corresponding durable goods being used up? With respect to a given product, do the estimates of value produced match qualitatively those of value used up? How do the components of each estimate compare with the appropriate concept?

This paper is directed toward these questions. The aim is observation and summarization of points bearing on the merits of the subtraction of estimates of capital consumption from estimates of gross capital formation. The points relate to inclusions and exclusions characteristic of each set of estimates that violate a consistent set of definitions of GCF and CC for which justification can be found on grounds broader than statistical expediency alone.

The investigation of the adequacy of the measures of the variant

of GCF most suitable in the measurement of NCF can be conducted decisively only if the definition is precise. The present purpose therefore calls for an attempt to justify the definition to be accepted.

A critical review of capital consumption estimates requires consideration of the peculiarities of data whose use does not ensure complete comparability of scope for estimates of GCF and CC. This can best be done in the course of a systematic survey of methods of accounting by their final holders for goods entering into GCF. A special problem arising in connection with such basic data as relate to the using up of natural resources receives attention here, although discussion of it is in the nature of a digression.

The adjustment for price changes of accounting data bearing on capital consumption and the choice of method for allocating capital expenditures among time periods as charges against revenues are of great theoretical as well as statistical importance but are not discussed here.

I The Concepts of Gross Capital Formation and Capital Consumption

A Variants of capital formation

Net capital formation in the most inclusive sense, designated here as Variant A, is the net change in the stock of future services between the start and end of a given period of accounting. It makes the cleanest possible distinction between that portion of the net product of the economy actually realized as final benefits within the period of reckoning and the remainder which is the net change in the stock of future contributions to final benefits. Practically speaking we would include in Variant A the value of the net change in the inventories of (1) all kinds of produced goods, including (a) producer goods of all grades of durability and (b) all kinds of goods in the hands of ultimate consumers, and (2) unextracted natural resources. Variant A includes in (1a) that portion of the value of maintenance and repair work on all types of durable goods performed within a period which is imputable to the yield of benefits from such work to be derived subsequent to the end of the period.

It is analytically desirable as well as practically necessary to distinguish between the value of gross additions to the stock of durable goods and their value used up or lost in a given period. In what immediately follows, therefore, the variants of capital formation referred to are variants of gross capital formation, and it will be

understood that complementary variants are indicated for capital consumption.

The capital formation concept under discussion is one subsidiary to the concept of production. Only that part of the net change in the stock of future benefits brought about through the actual inputs of productive factors, i.e., produced in the given period, is wanted in the concept of capital formation. New discoveries of natural resources at values exceeding the value of opportunity cost incurred in prospecting, it is generally agreed, do not constitute value produced.¹ Although discoveries give rise to effective additions to the stock of future final benefits, unknown resources can be regarded as a part of the inventory at the start of a period of reckoning just as are unexploited known resources.

Several less inclusive definitions of capital formation, useful for various purposes, can be set up. A series of variants can be defined by way of successive exclusions. The following components and subdivisions of Variant A exemplify possible steps in restricting the scope of capital formation:

Stocks of goods of the several grades of durability in the hands of ultimate consumers

Perishable

Moderately durable

Semidurable

Highly durable

Stocks of goods of the several grades of durability held by governmental agencies and private nonprofit agencies, other than those mainly concerned with the production of goods and services of the type produced by private business agencies

Stocks of goods of the several grades of durability held by governmental and private nonprofit agencies devoted to satisfying kinds of wants chiefly met by private business

Stocks of goods of varying durability held by private business

The series of exclusions may be carried forward at some stage in terms of broader categories, for example:

Maintenance and repair of durable goods held by all agencies

New producer durable goods of low durability

Intangible durable goods that actually represent the fruits of production rather than part of the capital value of future monopolistic rents on tangible goods exceeding amounts sufficient to justify their cost.

One variant commanding special interest for divers reasons, here

¹Cf. Mr. Kuznets' 'Uses of National Income in Peace and War', *Occasional Paper 6*, National Bureau of Economic Research, 1942, p. 3, footnote.

designated Variant B, may be taken as covering only the following:

a) Physically tangible new producer durable goods reaching their final holders, including those going to public agencies, excluding residences as well as all repairs and maintenance, however durable. For this variant durable goods are to be considered as including only types having an average life of three years or more.^{1a} New durable goods are to be understood as including major alterations, i.e., improvements of old durable goods other than mere repairs, however durable.

b) All other new producer goods (so-called 'inventory goods')

c) New residences and major alterations of old residences

This paper is concerned mainly with Variant B exclusive of the net change in inventories listed under (b) above. For convenience this remainder is designated Variant B₁. It is substantially Variant B, including further only the net increase in claims against foreign countries, that has so far been adopted for use in measuring net capital formation.² An obvious reason lies in statistical convenience; however, explanation of the special importance attached to Variant B actually lies deeper.

^{1a} This criterion has been taken over from the National Bureau for the final products analysis work now being carried on in the Department of Commerce. In practice there has been an inevitable and justifiably common sense tendency not to take the criterion so seriously as to break up unduly groups of commodities falling in the same category according to some other criterion, such as type of benefit furnished, e.g., clothing, sporting goods, auto parts and supplies. Lack of positive information sometimes disallows a clear-cut distinction according to average durability. Since the basis for the particular criterion of durability adopted is completely pragmatic, there is no reason why other equally pragmatic and more insistent considerations should not be permitted to modify the definition of durability. The use of more or less conventional categories is helpful for many purposes.

² See Mr. Kuznets' *National Income and Capital Formation, 1919-1935* (National Bureau of Economic Research, 1937), pp. 34-9. It is pointed out that estimates of net capital formation could be made only according to Variant I (IV in his *Commodity Flow and Capital Formation*). Of Mr. Kuznets' variants, this is the closest to Variant B₁ above.

In 'Uses of National Income in Peace and War', Mr. Kuznets defines "real investment or capital formation as . . . (1) the value of producers' durable equipment reaching the business and public enterprises that use it, at cost to them; (2) the value, at cost, of all new construction including major repairs and alterations; (3) net additions to stocks of commodities held as inventories by business enterprises; (4) changes in net claims by individuals, firms, and public units in this country against individuals, firms, and public units in other countries".

B Basis for a variant of GCF restricted to new producer durable goods

The desirability and the justifiability of setting out a variant including new producer durable goods, but excluding durable repairs and maintenance on them, may be questioned. It is appropriate, therefore, to consider at this point whether there is any analytical basis for setting up a concept of capital formation that distinguishes new producer durable goods from durable repairs and maintenance of old. For this purpose a still more restricted variant is the proper subject of discussion, i.e., Variant B₂ of GCF, confined to new producer durable goods (item (a) of Variant B).

It is true that from a business standpoint there is merely a difference of degree between scrapping particular durable goods and substituting new on the one hand, and maintaining the old in operating condition on the other. The one is, within limits, readily substitutable for the other, and under varying economic conditions numerous substitutions in either direction can be made. Actually, however, new types and designs of capital goods introduce a difference in kind between these alternatives. Substitution instead of maintenance furnishes an especially significant nexus of analysis for the economist, since the peculiar factor differentiating the maintenance of capital by repair and its maintenance by replacement is the virtual exclusion of technological changes under the former and the possibility of incorporating the latest technological advances under the latter. Even under conditions of no technological change the possibility of choice is significant.

The extent of capital maintenance by replacement relative to repair has, for example, important implications for business cycle analysis. The value of new structures (movable as well as fixed) passing into the hands of producers is especially significant as an indicator of the expansion of productive capacity. One definition of capacity might be set up in terms of quantities of durable goods available and the requirements of such goods per unit of output. This suggestion may be exemplified by a simple situation where there is only one type of durable aid (equipment) to production and only one type of product. Then capacity may be defined as the periodic output per capital equipment unit (i.e., the reciprocal of the technical coefficient of production for equipment, which is defined as the quantity of equipment per unit of periodic output) multiplied by the number of equipment units in existence. But the

creation of new structures leads directly to the augmentation of these multipliers in addition to the probable introduction of reduced technical coefficients. Thus varying accretions in aggregate productive capacity occur with the creation of new durable goods whether or not there is technological change. The actual amount of increase depends on rates of scrapping which are flexible within wide limits. No amount of repairs to existing structures can swell productive capacity of existing plant beyond its maximum potential output when new. On the other hand, it is conceivable that under certain conditions the entire output of new structures can become effective additions to capacity, if scrapping can be reduced to zero by sufficient maintenance and repairs. Of course, the actual maximum expansion of total effective capacity measured in terms of all resources would probably require scrapping the most expensive capital assets.

For these reasons, at least, it seems clear that a variant of GCF that measures the addition of distinguishable new structures to the capital inventory is desirable. These reasons are independent of the technical requirement of a variant usable for the computation of net capital formation in the course of deriving a measure to fit into the definition of net national product. As for the measurement of capital consumption, the productive capacity argument above suggests that estimates of the scrapping or retirement of producer durable goods would be of considerably greater value in some types of problem than estimates of capital consumption of the types now available.

C The proper inclusiveness of valuations in the measurement of GCF

The definition of gross capital formation has so far been considered solely in terms of breadth of coverage, that is, the types of product that should be included. Something more is needed if a definition of any variant of GCF is to be complete. For example, let us consider the valuation to be used for any particular unit or block of durable goods falling in Variant B₂ of GCF. The producer of the equipment finds his product possessing value to the extent of the sales price because, under conditions of adequate foresight, the capitalized value of rents appropriable through possession of the equipment is equal to or exceeds not only that price but also the sum of the price and *all other* penalties incident to the acquisition. Thus conceptually a closer approximation to the economic

values brought into being by the production of producer durable goods ordinarily can be found than that afforded by the evidence of explicit transactions. There will be no question about the propriety of including in the value of a new durable good not only the purchase price but also all other costs obviously incident to the acquisition, such as costs of transportation and installation. Moreover, certain other costs incurred by a firm and attributable in the marginal cost sense³ to the acquisition of new equipment are just as properly part of the value in place of new equipment. In fact, when opportunity cost is involved, the inputs of certain factors on which the economic cost is fixed rather than variable are imputable to the acquisition of durable goods, as well as to other operations.

D Definition of capital consumption

A first approximation to a definition of what is meant by current consumption of durable goods may be made under the assumption of stationary conditions with no accidental losses. Under these conditions capital consumption may be defined as the decline during a given period in the capitalized value of the future rents obtainable from (a) the stock of durable goods completed before the start of the period, and (b) additions to the stock of durable goods from the dates of their first availability for production to the end of the period. This is a gross decline, just as the value of new durable goods completed in the period is a gross addition. The algebraic sum of the two is the net change in the stock of capital—positive or negative net capital formation.

Under conditions of correct foresight and changing production or demand functions or changing quantities of production factors, but with unchanging interest rates, the definition suitable for stationary conditions can be taken over with one important modification; namely, depreciation under such changing conditions includes not only declines in value resulting from wear and tear, the sole capital-consuming forces operating in the hypothetical stationary state, but also declines resulting from those gradually operating forces whose effects are referred to as 'normal obsolescence'. These forces of normal obsolescence include the gradual changes in the arts of production, in desires for final products, and in the quantities of productive factors; theoretically they can be

³ As distinguished from the arbitrary allocation of certain costs over units of output as practiced in some cost accounting.

taken fully into account in estimating the capitalized value of future rents obtainable from an asset.

Finally, under true dynamic conditions, where final adjustment to the future cannot often be achieved because future events are so difficult of prediction, changes in capital values that are a function not only of the expiration of the given period but also of changes in the evaluations of prospects for future periods take place. There is rather general agreement that the concept of periodic national income should be defined to exclude changes in values of old assets other than reductions in the values of durable goods attributable to wear and tear and normal obsolescence. Upward changes in the values of old assets, that is, capital gains, are not due to inputs of production factors during the period, i.e., cannot be regarded as values *produced*. They take place because of downward changes in the rate of interest at which future rents that assets will earn are discounted, and because of upward changes in estimates of future rents obtainable. Capital losses are corresponding downward value changes, due to increases in rates of discount and downward revision of estimates of future rents obtainable, rather than to the passage of the current period proper.⁴ These types of value change have nothing to do with the absolute decline of service potential during the current period. The appropriate valuation to be placed on this current decline is accordingly the change in the capitalized value of future services between the beginning and the end of the period exclusive of the change due to the revision of expectations regarding (a) the net rents to be received from the asset subsequent to the close of the period, and (b) the interest rate at which the future rent series should be discounted; that is, capital consumption should be differentiated from what may be described as capital adjustment.⁵ The consumption of durable goods in any period may be defined, then, as the decline in the current value of durable goods attributable to the current expiration of service potential.⁶

⁴ Accidental losses are usually distinguished from capital losses traceable to changes, actual and expected, in the environment in which an enterprise operates. The distinction is between losses realized in the period from the standpoint of the community and the socially unrealized capital losses represented by other valuation changes not arising from the expiration of the current period.

⁵ The distinction is that so well formulated by Mr. Fabricant; see *Capital Consumption and Adjustment*, Ch. 2, pp. 7-20.

⁶ Mr. Fabricant has formulated a definition for use in defining the net value of the national product: "Capital consumption . . . is the current value of durable goods used up in production" (*ibid.*, p. 19). The method of depreciation apparently pre-

E *Accidental losses as capital consumption*

So far capital consumption has been defined regardless of accidental losses. The current value of capital consumption in the form of accidental loss is simply equal to the value of the assets immediately before their loss. It may be wondered whether accidental loss is not really analogous to capital adjustment from the standpoint of defining capital consumption attributable to a given period. However, it must be realized that in the case of accidental loss the decline in service potential due to the loss is fully realized in the period in the course of which the loss occurs, and hence, in this decisive respect, resembles capital consumption as already covered by the definition set forth above. In fact, this definition may be taken without modification to include accidental loss.⁷

ferred by Mr. Fabricant is that which allocates the original value of an asset equally per unit of output. Such a procedure seems to imply limitation of the concept of depreciation to 'user cost' (see J. M. Keynes, *General Theory of Employment, Interest, and Money*, Harcourt Brace, 1936, pp. 66-72).

It is generally believed, and abundant confirmation can be had in terms of prices, that much if not most of the maximum of service available in a period is simply lost through non-use, rather than left in the good for future exploitation. It may be true that many business men anticipate a cyclical pattern in the prospective utilization of assets. Even so, and notwithstanding the appropriateness of the use of a 'natural' period, i.e., a full cycle, rather than a period so arbitrary as the year, for adequate determination of profitability, the value decline with the passage of time, aside from changes in the estimated present value of future rents obtainable from assets, goes on, and service capacity not exploited is simply lost, without offsetting absence of user cost. The allocation of only a part of capital cost is more in accord with economic fact, and that part is appropriately measured by the cost of use as against non-use, whether or not the owners of assets take account of the cyclical environment.

⁷ See Mr. Kuznets' estimates of net capital formation. These involve the offsetting of the value of actual losses due to fire in a period against GCF.

It may at first seem puzzling that the deductions from GCF to allow for capital consumption should include (1) depreciation, which might be thought of as allowing for retirement on the accrual basis, and at the same time (2) the value of current losses rather than the value of risks incurred, that is, losses allowed for on the accrual basis. The essential point is that a definition establishing the concept of capital consumption in a period can have economic meaning only if it is actually at bottom the notion of change in capitalized value of future earnings (properly restricted to exclude unwanted effects). That is, 'depreciation accrued' in a period more or less crudely measures decline in capitalized value exclusive of the effects of the probability of accidental loss. This decline is an economic fact rather than a technicality of record-keeping. Likewise, value of actual loss measures the actual current decline in the capitalized value of future earnings. In the case of ordinary use or holding, the decline is gradual because of the character of market forces and the durability of the asset during successive outputs. In the case of accidental loss, the decline in value occurs all at once because the realization of future earnings is nullified by the accident.

F *Natural resources in capital consumption*

Gross capital formation has been defined above to include only *produced* additions to the stock of future benefits. Must the definition of capital consumption for the purpose of establishing a measure properly comparable to that of GCF cover only the consumption of durable goods included in GCF? Is there any compulsion to exclude the value of natural resources consumed in a period from the measure of capital consumption to be so used? A categorical answer is not possible; an estimator is at liberty to define his concept of capital consumption as he chooses. He may wish the concept to be completely inclusive, in which case he may hold that one must look beyond GCF to the total of wealth at any point of time, a total that includes the value of natural resources in excess of the value of the developments thereof. That is, a full account of real capital change in a given period could be made only by taking into account the consumption of natural resources notwithstanding the exclusion of new discoveries from GCF for the period. On the other hand the estimator may well satisfy his purpose adequately with a definition of capital consumption excluding the using up of natural resources.⁸ In any case, however, a separate category will be desired for the consumption of durable goods whose creation constitutes gross capital formation.

The discussion in Section II of the comparability of measures of capital consumption is based upon a definition of capital consumption that excludes natural resources as such but includes capital represented by the development of natural resources. The outline of accounting methods for durable goods and of the characteristics of the basic data available for direct use in measuring capital consumption leads naturally to comment on the relationship between accounting for depletion of natural resources in the calculation of enterprise profits and the problem of estimating the real value of natural resources used up.⁹

⁸ Mr. Kuznets follows the latter alternative. Having excluded discoveries from GCF, he evidently feels compelled to exclude drafts upon natural resources from capital consumption. See *Occasional Paper 6*, pp. 3-4, footnote. Although Mr. Kuznets uses Mr. Fabricant's measures of capital consumption with the intention just indicated, these measures seem to have been regarded by their author as covering not only the expiration of the value of developments of resources but also the value of the reduction of unextracted mineral inventories.

⁹ See Sec. II D, below.

II General Character of the Data Available for Measuring Gross Capital Formation and Capital Consumption

A Basic data on capital formation, Variant B1

Two broad categories of data provide bases for estimating the flow of new producer durable goods. From values of building and other construction work, new residential, public, and commercial construction completed and new industrial plant can be estimated annually. Continuous estimates of the values of other new producer durable goods, i.e., equipment, can be derived from production data.

1) In the case of construction, the values of projected construction in terms of building permits issued serve as the basis for estimating the values of new residential structures completed. From statistics of construction contracts awarded the values of most other types of construction can be estimated, except work done on force account. Finally, accounting or budgetary data on expenditures for new construction can be obtained for certain agencies, chiefly governmental bodies and public utility corporations. Since these cover both contract and force account work, they are used in estimating total construction for the accounts of these agencies. Various adjustments and manipulations of the basic data, founded on certain assumptions, are necessary in order to get estimates that include all new construction (wherever located and whatever the size of the project), have proper meaning (i.e., represent construction activity, or construction work completed), and cover the total cost of new structures.

2) The value of manufactured output compiled in the *Census of Manufactures* is the basis for estimating the flow of new durable goods other than fixed structures. The commodity data reported by the Census must be classified into the following categories:

- A Unfinished (all construction materials, and all other commodities exclusively bought by business except durable goods in finished form)
- B Finished (commodities ready for distribution solely to ultimate consumers, and producer durable goods)
 - i Consumer perishable goods
 - ii Consumer semidurable goods

- iii Consumer durable goods
- iv Producer durable goods
- C Mixed (commodities, except durable goods, in finished form, i.e., in form purchased by ultimate consumers, partly purchased and consumed by business)
 - i Consumer perishable goods
 - ii Consumer semidurable goods
 - iii Unfinished portions used up in business

Further classification is necessary to segregate producer durable goods exclusive of those going to ultimate consumers and consumer durables actually going to producers and hence properly regarded as producer goods. In general, the values so obtained are manufacturers' sales values of output. Certain adjustments, made in order to approximate the final values of goods when transferred to final holders, are designed to allow for changes in manufacturers' inventories of finished goods (finished in the present sense), for exports and imports of goods classifiable as final products, and for transportation and other distributive margins between fabricators' sales values and cost to final holders. The sum of the final values so estimated for producer durable goods constitutes the equipment component of GCF.

Only to a limited extent do the data constituting the estimates come directly from the final holders of durable goods.

Various breakdowns can be obtained from these data and procedures. Construction estimates can be shown according to kind, e.g., buildings, roads, and according to general types of final holders, e.g., commercial, factory, public utility, public. The flow of equipment is available by kind of product in great detail at the stage of production, also in some detail by producing industry. But for most equipment no great detail of final values is possible. Much equipment at producers' values can, of course, be classified by type of final holders through scrutiny of the possible uses. But it is not possible to go far in deriving totals of new structures and of equipment having comparable inclusiveness for subclassifications by type of final holder; for example, not even for the major subgroups of manufacturing.

B Basic data on capital consumption

Since actual data on current capital consumption can be obtained only from the holders of durable goods, a survey of their nature is

a necessary step in ascertaining the comparability of measures of GCF and CC. Discussion of methods of accounting for durable goods classifiable in Variant B₁ of GCF forms part of a wider discussion of possible accounting methods for all producer durable goods. Such an inclusive outline is introduced here.

In general ultimate consumers do not keep systematic records of their holdings of durable goods. Governmental agencies necessarily keep some records, but these are highly incomplete in coverage of agencies, kind of property, and the types of data (e.g. maintenance, depreciation). A similar statement is applicable to private agencies exempt from federal income taxation. The records of private business, although somewhat more complete, are seriously wanting in uniformity and suffer from major omissions. The available data are confined chiefly to business corporations. In fact, virtually the only data derived from the records of holders of durable goods directly useful for estimating periodic capital consumption are those on depreciation and depletion reported by all corporations to the Bureau of Internal Revenue (BIR) and published in *Statistics of Income*, those reported in published statements, and those reported to and compiled by regulatory authorities.¹⁰

C Methods of accounting for acquisition and dissipation of durable goods

The following outline of methods of accounting for durable goods applies for the most part, then, to business enterprises alone.

Acquisitions of durable goods are accounted for according to some one of the methods described under either of the following two headings:

1) By offsetting values of durable goods acquired in each period against gross revenues of the same period

a) This is the method known as maintenance accounting when followed for new durable goods that are replacements for existing

¹⁰ As defined by the BIR the term 'corporation' in the Internal Revenue Code includes associations, joint stock companies, and insurance companies, both stock and mutual. As for associations, "it is immaterial whether such organization is created by an agreement, a declaration of trust, a statute or otherwise". It includes all 'trusts' except those of the traditional kind, which are "... created by will or by declaration of the trustees or the grantor, the trustees of which take title to the property for the purpose of protecting or conserving it as customarily required under the ordinary rules applied in chancery and probate courts". See U. S. Treasury Department, Bureau of Internal Revenue, *Regulations 103—Income Tax—Internal Revenue Code, 1940*, pp. 662-6.

assets. In this case the values standing on the books for old assets are simply not written off. It is the method used with few exceptions for the non-separable durable products of repair and maintenance work. An important use is found in the accounting of railroads for replacement rails and ties and other renewals.

b) When applied to accounting for other producer durable goods, the method is referred to simply as charging capital expenditures to income.

It is followed by most companies owning oil and gas wells in accounting for 'intangible development cost' in their federal income tax records.¹¹ The BIR requires that certain types of outlay in other mining industries, in the nature of capital expenditures, be charged to the expense of the period.¹²

Capital expenditures on other types of durable goods are often charged to income. In addition to the erratic charging of improvements to income, there is a considerable tendency toward using this method of handling expenditures for relatively short-lived durable assets such as tools, dies, fixtures, and patterns, which often may be intended primarily for particular models or orders and may be of doubtful or uncertain usefulness otherwise. There is, perhaps, a greater tendency to charge expenditures to income when the outlay per unit or the total outlay in a transaction is low, such as for tools, accessories, attachments, office equipment, furniture. Certain types of expenditure on durable goods as a matter of general business practice may be charged against income as they occur, such as furniture and fixtures in the banking business.

The method of maintenance accounting or charging capital ex-

¹¹ These costs are "... expenditures for wages, fuel, repairs, hauling, supplies, etc., incident to and necessary for the drilling of wells and the preparation of wells for the production of oil or gas ...", in general, everything not accounted for in the acquisition prices of durable goods that are prescribed by the BIR as bases for depreciation, i.e., assets that have salvage value, including materials going into fixed structures as well as equipment. Taxpayers were given, in 1918 and again in 1925, the option of charging to expense or to capital account, subject to the restriction of no subsequent change in method for a given property. A new taxpayer must choose at the time of the first return. See U. S. Treasury Department, Bureau of Internal Revenue, *Regulations 103—Income Tax—Internal Revenue Code, 1940*, pp. 116-8.

¹² These are "Expenditures for equipment (including its installation and housing) and for replacements thereof, which are necessary to maintain the normal output solely because of the recession of the working faces of the mines, and which (1) do not increase the value of the mine, or (2) do not decrease the cost of production of mineral units, or (3) do not represent an amount expended in restoring property or in making good the exhaustion thereof for which an allowance is or has been made ...". See *ibid.*, p. 116.

penditures to income is one that accounts at once for acquisition and, however arbitrarily, for using up or expiration of usefulness.

2) By setting up values, usually cost to the holder, to be carried on the books subject to eventual write-off, with or without periodic or occasional adjustment

a) The principal method under this heading is depreciation accounting, i.e., periodic reduction of original cost values and corresponding offsets to revenues, usually according to a general rule which, given original cost, estimated salvage value less cost of removal, and estimated period of usefulness, determines the charge for each year. The BIR, while willing to countenance any other ". . . recognized trade practice, such as an apportionment of the annual sum over units of production . . ." ¹³ strongly favors the method of equal annual installments. A description of the method is not complete without reference to the handling of net positive values that may be standing in account books for assets when abandoned, or the excess of book value over the difference between the amount realized from the sale and the cost of disposal.

One method, favored by the BIR, is that followed as a phase of the 'group plan' of depreciation. When carried out systematically it consists in grouping a firm's assets into several classes according to the length of prospective economic life, and applying an average depreciation rate (straight line formula) to the assets of each group. The method assumes that any individual retirement is already covered by the depreciation reserve, just as, for an insurance scheme, any individual casualty is covered by the insurance reserve, having been actuarially taken into account in the computation of premium rates. Accordingly, the book values of assets retired are charged against the depreciation reserve. In the group plan these values are the original values, since the scheme does not call for a separate depreciation allowance account for each asset.

On the same basis, when assets are depreciated individually, residual book values may be written off against the depreciation reserves in the aggregate if there are corresponding offsets through the building up of the aggregate reserve by charges for depreciation on other assets over periods of use beyond the expected useful lives assumed in the rates. This method, although frequently used in corporate records, is not permissible for income tax computation.

The usual method of treating residual book values at retirement

¹³ See *ibid.*, p. 93.

consists of charging them against the income of the period in which retirement occurs. The BIR requires this plan when the asset in question has been the subject of separate depreciation allowances.

Residual book value at retirement may be canceled against surplus. This is the surplus adjustment method, favored by those who wish the final net profit figure exhibited for a given fiscal period to be free from the effects of entries that are essentially no more than corrections of entries made in earlier periods.

b) Other methods involve the cancellation, at the time of retirement, of original book values

i) With corresponding charges against the revenues of the periods in which retirements occur. The pure retirement accounting method is prescribed by the BIR when depreciation is not allowable because useful life is unpredictable.¹⁴

ii) With corresponding deductions made in installments from the revenues of two or more periods subsequent to actual retirement. This method is known as suspense accounting. Although examples are frequently found in published financial data of public utility corporations, suspense accounting is not permitted for federal income tax computation.

iii) With charges to revenues periodically that are intended to represent a smoothing out of the series of periodic charges against revenues that would be had if the pure retirement method were followed. This is the retirement reserve method.¹⁵ The reserve is credited periodically with amounts charged against revenues. Book values of assets are removed from the books by offsetting them against the reserve. The determination of the amounts to be charged as periodic expense may be more arbitrary than by any depreciation formula, since no rules are established at the outset that substantially if not completely determine the charges for any period on account of a given durable asset or group of assets. Unless a substitute formula is set up, the determination of the total charge to expense must be made separately for each period. Such a substitute formula may be simply a prescription of equal charges in

¹⁴ If circumstances arise that positively indicate a short further life of such an asset, it may be written off over that remaining life through depreciation charges deductible in computing taxable net income. Such a circumstance would be, for example, an order of a regulatory commission authorizing abandonment by a specified date, or a similar decision of a board of directors when no authorization is needed.

¹⁵ The retirement reserve is regarded as a surplus reserve rather than as an asset valuation reserve since it is not determined in such a way as to measure the progress, on the average, of a group of assets from acquisition toward the scrap heap.

every period for a specified number of periods or the determination of periodic charges by application to periodic gross operating revenues of a percentage held fixed through time.

Pure retirement accounting is required by the BIR for assets whose useful lives are so much a matter of conjecture that the deduction of annual depreciation charges for the computation of taxable net income is not permitted. The principal and by far the most important kind of asset to which this restriction applies is railway roadbed. Street and electric railways and electric and gas utilities for many years followed retirement methods of accounting. In the last several years most of them have changed over to depreciation accounting in their corporate records, and all are now required to use depreciation accounting for income tax records.

c) Expenditures on some types of item, usually when the cost per unit is low, are often handled on an inventory basis. That is, the expenditures are carried to deferred charge accounts which are adjusted periodically by charges against income sufficient to reduce the balances to levels dictated by the results of actual inventory taking. This is in effect a method of retirement accounting. There is a tendency to handle small tools, containers, etc., in this fashion.

d) The expiration of values of durable goods due to accidental losses covered by insurance is charged against revenues by the insured in the form of periodic insurance expense rather than retirement loss. A difference between book value written off and value recovered gives rise to the adjustment of surplus or of net income. The collective effect of variations in actual losses from the rate assumed in the determination of premiums gives rise to adjustments in insurance company reserves. In any period, actual losses are measured by insurance company entries for losses, i.e., charges against reserves; expectation of loss, or risk, is measured by premium rates.

e) The acquisition and development cost of mines, quarries, and oil and gas wells is apportioned equally over the estimated total output so that periodic adjustments of asset values are made proportional to output. Depletion and amortization accounting of this sort is strictly analogous to depreciation accounting except for the method of allocation among time periods. However, federal income tax regulations permit deductions for depletion on two other bases. Depletion may be computed on the basis of discovery value in the case of mines other than coal, metal, sulphur, and oil and gas wells. Discovery value is the "fair market value . . . at date of discovery

or within 30 days thereafter . . ." if the property is not acquired by purchase of a proven tract, and ". . . if the fair market value is materially disproportionate to cost".¹⁶ In the case of oil and gas wells, and coal, metal, and sulphur mines, depletion computed as a percentage of gross income for the period, subject to certain restrictions, may be deducted in deriving taxable net income. Percentage depletion is not limited in cumulative amount to the ordinary cost basis for depletion or to a 'discovery value' basis.¹⁷

The fact that total depletion through time is not necessarily limited to the cost of development raises an important issue concerning the acceptability, in estimates of national income produced according to distributive shares, of estimates of profits as affected by such depletion charges. It is convenient in the same connection to consider the suitability of accounting depletion data for estimating the total value of natural resource depletion. A digression dealing with these matters is introduced here, after which the accounting data available for the measurement of current capital consumption are discussed.

D Digression on accounting depletion and the estimation of national income

In connection with the estimation of national income by distributive shares, the question has been raised whether accounting estimates of net profits in mining industries (including oil and gas production), calculated according to federal internal revenue laws and regulations, should be allowed as a deduction from the profit share of income produced in mining. It may further be asked whether a rejection of tax depletion charges for the purpose of distributive share estimates of national income should imply the necessity or desirability of a similar rejection of tax depletion charges as a usable basis for estimating capital consumption in the form of the extraction of natural resources of limited potential supply.

A class difference seems to exist between the mining industry and other industries with respect to divergences between tax and book net income arising from charges for depreciation and depletion. Inspection of the reports of individual mining corporations reveals a substantial tendency in computing book net income to use de-

¹⁶ Regulations 103, p. 102.

¹⁷ The cost of developments having an (average) durability of three years or more should but actually does not for the most part enter into existing measures of GCF (see below, Sec. III A).

pletion deductions much smaller than those allowable for income tax computation.¹⁸

The essential difference in taxable net income for mining compared to other industries lies in the fact that total depletion recoverable, unlike depreciation, is not limited to cost or fair market value as of March 1, 1913. Bureau of Internal Revenue regulations permit the use of 'discovery value' if the 'fair market value is materially disproportionate to cost',¹⁹ also for certain mining industries 'percentage depletion' calculated by applying percentages fixed by law to gross income (gross revenues from the sale of minerals at prices exclusive of transportation). Percentage depletion, moreover, is not limited in cumulative amount recoverable to the amount of any of the three bases permitted for computing depletion per unit of output. The Treasury apparently regards these provisions as so liberal as in effect to give mining industries a subsidy. Evidently taxable net income in mining is to some extent not properly comparable with the same item for other industries.

From our standpoint, the measurement of capital consumption, there are two questions. First, should the estimates of capital consumption cover elements, i.e., values of natural resources, never shown in GCF? There is no question, of course, concerning the inclusion of development costs in GCF and of amortization of development costs in CC. Second, are the data on depletion charges sufficiently good to serve as bases for estimating the value of natural resources used up in production?

Undoubtedly most exploited bodies of natural resources possess net economic value. Also the intra-marginal quantities of such resources withdrawn for use in production partake of those values; in fact, the former have value because the withdrawals are sufficiently important under certain conditions for prices to be paid to cover costs of withdrawal and premiums that include pure rent. If all economic goods are to be accounted for, the value of natural resources used up in production must be included. However, any estimator is at liberty to define his aggregate net value concept so as to include as an offset to the value of durable goods produced only the value of produced durable goods used up. Or he may choose actually to include values of natural resources used up as an offset to values of final products, not as a component of the consumption or negative component of the net output of new pro-

¹⁸ See Fabricant, *op. cit.*, pp. 91-7.

¹⁹ See *Regulations 103*, p. 102.

ducer durable goods, but rather as a separate item of social capital consumption.

The problem of profits estimation requires attention to capital maintenance from the standpoint of the business firm. Such capital maintenance demands, in the first instance, recovery of the original investment (cost), assuming no change in prices. But the social value of natural resources as measured by net economic rents may depart widely from the sum of private investments made to acquire the rights to derive incomes by exploiting natural resources. Therefore the depletion charges appropriate from the standpoint of breaking down enterprise net revenues into the two components, return of investment and net income on investment, may not be acceptable as measures of the values of natural resources used up in production.

We have, then, set forth a distinction that makes possible rejection of unrevised allowable depletion charges as determinants of profits in mining industries, even though they might be acceptable for measuring values of natural resources, in combination with values of mining developments, used up in production. Allowable depletion charges may afford as good a basis for measuring the value of natural resources used up in production as do accounting depreciation charges for measuring the values of produced durable goods used up in production, perhaps significantly better in certain respects.²⁰ In other words, the two sets of data may be of the same order of badness. However, only through careful study of the economic conditions of mining industries could it be hoped to get some notion of the direction and general magnitude of error inherent in any estimates of the value of natural resource consumption founded on charges for depletion made under federal income tax regulations.

Since students are interested in breakdowns of GCF, CC, and NCF by type of holder, it is desirable to distinguish between the share of each on private account and on public account. These breakdowns would call for isolation of the part of the value of privately owned natural resources and developments used up that may be regarded as the return of investment to private firms. This would be done automatically by adjusting depletion data in order to derive profits estimates for mining industries having the proper meaning.

²⁰ That is, so far as percentage depletion produces estimates of resource use approximating the values that could ideally be imputed to the resources as well as to the factors employed in the production of the resources.

E Accounting data and the measurement of current capital consumption

Comprehensive data on accounting depreciation and depletion charges for income tax records are available for all corporations subject to federal income taxation. From these, estimates can be made to cover most of the remainder of the business economy. Data arising from other capital accounting range in availability down to nonexistence. For maintenance and repairs, rather good data exist covering the important public utility industries, and considerable recent sample data have been brought together for industrial concerns.²¹ Some accounting data are available on other capital expenditures charged to income, chiefly 'intangible development cost' of oil and gas well drilling. Few data exist on actual retirement charges.

In what senses do periodic accounting data, i.e., charges for depreciation, depletion, maintenance and repairs, retirements, capital expenditures, and accidental loss, measure current capital consumption? Capital consumption current in a period is defined above as the decline in the current value of durable goods attributable to the current expiration of service potential. Charges against income for the cost of new capital, replacements, or maintenance, cannot be presumed, in the light of the arbitrary character of their determination, to bear the same relation to this definition as do depreciation charges. The objection to charges by the pure retirement method is equally strong. In a perfectly stationary economy where there would be no changes in the age composition, no price changes, and no accidental loss of capital equipment, the sum of the three measures could be taken as a satisfactory over-all measure of periodic capital consumption. However, these conditions do not prevail. It is obviously necessary, if the measurement of capital consumption is to be founded upon accounting data, to adopt a variant of GCF comparable to whatever measures of capital consumption can be constructed. Depreciation and depletion charges are the sole body of such data directly relating to current capital consumption.

As a practical matter, then, since no adequate data are available for measuring the consumption of consumers' movable durable goods and their durable repairs and servicing, they may be eliminated from GCF. If this category is assumed to include movable

²¹ See *Survey of American Listed Corporations* (various issues), a Work Projects Administration study sponsored by the Securities and Exchange Commission.

durables in the hands of governments, the problem of the consumption of naval vessels, military equipment, etc., is also removed. Measures of maintenance and repairs may be eliminated for lack of a reliable basis for estimating the rates of expiration of the values produced by such work. Thus we are left with GCF substantially in the form of Variant B₁, defined above. This category is still somewhat more inclusive than components passing into the hands of business firms for which accounting data on depreciation and depletion are available. Plausible estimates have been inferred for most noncorporate business from data for corporations. Synthetic measures, based on estimates of the types of GCF concerned and assumptions concerning the length of useful life, have been constructed for nonfarm residential construction, for farm fixed structures and equipment including dwellings, and for equipment and new construction for the account of governmental agencies. Corresponding segments of gross capital formation constitute the principal nonbusiness components of Variant B₁ of gross capital formation.

The data on capital consumption are available in detail by industries which are the final holders of durable goods. For important major divisions, primarily certain public utility industries, comparable data on the acquisition of new durable goods and on capital consumption can be obtained. Additional breakdowns, of manufacturing industries for example, thus far do not appear feasible because of the few details by final holder available in estimates of GCF.²²

III Defects in Estimates of Gross Capital Formation and Capital Consumption

A Gross capital formation

Critical discussion of the gross capital formation and capital consumption estimates used by Mr. Kuznets in computing net capital formation should in the first instance be undertaken in the light

²² This statement applies to direct estimates of GCF made by following the goods produced through to their holders. Data on capital expenditures by manufacturing industries have been used in 'indirect' estimates of periodic capital expenditures of certain manufacturing industries. See Lowell J. Chawner, 'Capital Expenditures in Selected Manufacturing Industries', *Survey of Current Business*, Dec. 1941, pp. 19-26; see also his 'Capital Expenditures for Manufacturing Plant and Equipment—1915-1930', in *ibid.*, March 1941.

of the definitions basic to the estimates, those pertaining to his Variant IV of capital formation. Variant B₁ does not differ from the durable goods components of his Variant IV. The former includes major alterations to old durable goods on the grounds that new structures (fixed or movable) are in fact created to the extent of those improvements, and that special interest attaches to the production of new structures. Mr. Kuznets' Variant IV likewise includes major alterations and excludes repairs.²³ Thus, commentary on the estimates in comparison with the concepts to which they have been related is applicable with slight and obvious modification to their comparison with Variant B.

1) Attention may be paid first to gaps in the estimates of new construction. Since Mr. Kuznets' estimates of capital formation used in his later volume, *National Income and Its Composition* (National Bureau of Economic Research, 1941), were based, for the construction component, on *Construction Activity in the United States, 1915-1937* (U. S. Department of Commerce, 1938), the shortcomings in those estimates may be noted. The estimates of construction by type in Mr. Kuznets' *Commodity Flow and Capital Formation* (National Bureau of Economic Research, 1938), based on substantially the same sources, embody the same defects as well as others, notably failure in some cases to measure activity.²⁴ The following omissions are noted in the Department of Commerce bulletin:

a) Value of construction for the account of miscellaneous private utilities, including water supply, piers and docks, steam companies, toll bridges, and other public utilities under private ownership except railroads, street railways, subways, pipe lines, electric utilities, gas production and distribution, and telephone and telegraph communications. It is thought that this omission may have been as much as \$100 million in some years.²⁵

b) Miscellaneous private works, other than buildings and miscellaneous private utility construction, such as roads and other improvements on private estates, waterfront improvements by private companies, construction other than buildings in connection with

²³ See *Commodity Flow and Capital Formation*, pp. 5-9, 469-71.

²⁴ Actually it is estimates of construction projects completed that are wanted for inclusion in GCF. Changes in inventories should therefore include changes in the value 'in place' of construction work in process. Work is now being done in the Department of Commerce to derive estimates of construction completed.

²⁵ See *Construction Activity*, p. 14.

golf courses, and a number of other types of work for which no suitable statistics appear to be available, also roads, dams, and earthworks for private subdivisions, etc. It is thought that these omissions constitute not more than a small fraction of total non-residential construction.

c) Other construction work, including work on force account, e.g., oil and gas well-drilling, mining and forestry development, building additions and alterations (not contract, or not requiring permits in the case of residences).

2) The following shortages exist in estimates of producer durable goods other than fixed structures:

a) Output for own use of durable goods and their parts except durable repair work, other than fixed structures.²⁶ This omission covers a wide variety of force account durable goods output: tools, dies, patterns, jigs, fixtures, drawings, models, machines, samples, etc. For some manufacturing industries such items must be quite insignificant. No doubt they are important in certain of the metal working industries. Although there are no data to indicate the magnitude of production of finished commodities for use within the producing establishments,²⁷ ". . . it may be surmised that the volumes . . . are insignificant, at least for nonfarm business establishments."²⁸

b) Understatement of the flow of producers' durables resulting from the method of allocation according to preponderant use.²⁹

3) There are certain other minor omissions from Mr. Kuznets' Variant IV:

a) Elements that constitute part of the total cost of producer durable goods to their ultimate holders but are not invariably or ordinarily taken into account in accumulating the total values of

²⁶ See *Commodity Flow and Capital Formation*, p. 276.

²⁷ Largely because the *Census of Manufactures* compiles totals from reports of manufacturers' value of product 'for sale or interplant transfer' only. A guess has been hazarded by George Terborgh as to the value of output of equipment for own use. See his 'Estimated Expenditures for Durable Goods', *Federal Reserve Bulletin*, Sept. 1939. Terborgh assumed that production of equipment for use within the same plant accounted for 15 per cent of total charges to equipment accounts in mining and manufacturing.

²⁸ *Commodity Flow and Capital Formation*, p. 276.

²⁹ This defect, recognized by Mr. Kuznets, was introduced in *Commodity Flow and Capital Formation* by the classification of passenger automobiles entirely as consumers' durable goods. For the estimates of durable goods flow now being prepared in the Department of Commerce an allocation has been made between producers' and consumers' durable goods.

producer goods at their destinations after manufacture, transport, and distribution. Such things as engineers' and architects' fees are obvious cases in point. Although specific allocations may not or perhaps cannot ordinarily be made, certain other firm costs are properly allocable to new durable goods acquired, such as cost of services of staff analysts and engineers for forecasting and estimating durable goods requirements, planning and arranging productive setups to accommodate new machinery, equipment, etc; purchasing, and perhaps other activities required in connection with acquisitions of capital goods. Because of allocation difficulties, costs of these types are probably on the whole not charged to capital account and hence are omitted from charges for depreciation and depletion. These are further examples of capital expenditures charged to income but properly chargeable to the account of tangible business assets.

b) Overstatement of the value of contract, custom, and repair work for others. Classified by Kuznets as 'repairs and servicing of durable goods', this item probably includes some work constituting production of new finished producers' durables. Such work probably amounted to not more than \$100 million for 1929.

4) Errors of inclusion may also be discussed under (a) new construction, and (b) other new producer durable goods.

a) Construction contract data (Dodge) have the defect of covering more than new structures and additions to and improvements of existing structures. If the adjustments of the data made to cover all areas, all sizes of contracts, and such items as engineering and architectural fees, not included in the reported values of contracts are accurate, the figures would be excessive according to the definition of Variant IV by the amount of contracts for repairs to existing structures, including replacements of parts not regarded for purposes of capital accounting as distinct from the structures into which they enter. Repairs are covered in the contract data if two or more trades are involved, and if the contract value is greater than a specified minimum. Accordingly there is a conceptual overstatement of new building construction; it is regarded, however, as quantitatively unimportant.³⁰

This objection does not apply to new public utility buildings, for which estimates are based on actual reports of capital expenditures,

³⁰ *Construction Activity*, p. 7.

so far as the criteria used in capitalizing expenditures are consistent with the definitions advanced above.

Construction estimates for residences, based on building permit data, also include major repairs as well as alterations and new structures. This factor may or may not be offset in the estimates of residential construction by failure to adjust perfectly for other imperfections in the basic data. Estimates of farm construction of all kinds are similarly inclusive.

A further difficulty with construction data lies in two sorts of duplication. First, capital expenditures reported include some expenditures represented in values of contracts. Second, capital expenditures reported include expenditures on equipment, whose value of output is covered in the equipment component of GCF. These duplications have not yet been completely eliminated in the computation of total GCF.

b) There seems to be an error of inclusion, not accepted as such in *Commodity Flow and Capital Formation*, in the totals of new producer durable goods other than construction. The list of producer durable goods includes several items of parts for sale as such, including parts for machinery, farm equipment, locomotives and railroad cars, aircraft, etc. In some cases the classification does not permit breakdowns between accessories, which it may be possible to assume to be additions to finished movable durable goods, and parts that to some extent at least are simply raw materials for use in repairs. To the extent that the latter is the case, such elements should properly be allocated to the category used for durable contract and repair work, 'repairs and servicing of durable goods'. In this case the establishment manufacturing repair parts for producer durable goods is simply doing part of a job of repair for sale, instead of an entire repair job which would obviously be classifiable as repair work to be counted as part of repairs and maintenance in a variant of GCF broader in scope than Variant IV. Possibly this inclusion could be justified on the ground that it offsets a certain error of omission. The omission is that part of the contract component of contract and repair work on account of producer durable goods which consists of new durable goods that properly should be classified in Variant IV. However, Kuznets' position is that ". . . especially among producers' durable commodities, parts have a rather long life; and the total of several machines may be treated as a combination of parts since they are ordinarily replaced piece by piece until only the framework of the machine survives. It there-

fore seemed advisable to treat parts of producers' durable commodities for sale as such as finished durable commodities . . ." ³¹

We may ask what justification there is for distinguishing between durable repairs and maintenance and durable parts used for replacement other than that of mere convenience. The basis for distinction between Variant B₁ and other versions of GCF set forth in this paper calls for the inclusion of such parts only in a variant more inclusive than that intended to measure the flow of new producer durable goods.

B Accounting estimates of capital consumption

Estimates of capital consumption may be defective, that is, they may not cover everything that should be included in GCF, or they may include certain components for which the corresponding asset item should not enter into GCF. There are two classes of defects in existing measures: (1) those arising from the peculiarities of the available business accounting data; (2) the incompleteness and the inadequacies of the procedures for estimating the consumption of durable goods held by other agencies than those business enterprises for which we have data.

Estimates of the depreciation on residences must be based upon estimates of new residential construction. Estimates of the consumption of farm structures and equipment and of producer durable goods held by governments must likewise stem directly from estimates of GCF for the accounts of these agencies. Accordingly there can be no question in these instances of the proper comparability of GCF and CC. As for business depreciation, pertinent to the first type of defect it has already been noted that (1) some capital expenditures are charged directly to income, (2) some are charged to income in entirety at retirement, (3) some are so charged only to the extent of undepreciated book values, ³² and (4) some are charged in the course of the periodic adjustment of deferred charge accounts used as records of durable supplies. Income deductions of these types are frequently shown in juxtaposition to depreciation in published statements or even, in the case of (3), in combined aggregates. ³³ They are, however, not classifiable as depreciation in

³¹ *Commodity Flow and Capital Formation*, p. 14.

³² In the cases of (2) and (3), such charges should be understood to include uninsured accidental losses, and any excess of book value of lost assets over insurance recovered.

³³ Numbers (1), (2), and (4) obviously indicate omissions with respect to the measurements of current capital consumption. Item (3) bears a different relation to the concept. What this shows in the first instance is that errors, shown up *ex post* in the

computing taxable net income. Usually, if not invariably, they are reported in 'other deductions' or in 'losses' on the face of the income tax return, and are classified as 'other deductions' in *Statistics of Income*.³⁴

Certain further technical points may be noted concerning the suitability of accounting data for measuring capital consumption: 1) The data include depreciation on values in excess of original cost new, when assets have been transferred to new holders and recorded, for purposes of federal income tax accounting, at values greater than the depreciated values on sellers' books.³⁵

If depreciation is to be viewed as a decline in the 'current value' of durable goods, the desired estimates of depreciation may seem more closely approximated by depreciation charges calculated from bases revised from original cost through later transactions. This may be true only if the revised bases represent competitively determined prices for produced durable goods as such, rather than a price for an enterprise as a whole based on the earning power, not simply of particular durable goods, but actually of a going concern, perhaps with established business relations, locational advantages, a good working force, etc.

From the standpoint of this paper, even the first type of valuation change is inappropriate because the problem of correcting for price change has been ruled out of consideration. Further, it is inconsistent with Mr. Fabricant's method of converting depreciation from accounting prices into current prices which involves the assumption that depreciation bases are always original cost new. Finally, the relationship, extremely crude as it is, between the fluctuating current prices of newly produced goods and the revaluations of old assets in business income tax records involves grossly excessive time lags which disallow any supposition that the prices

undepreciated balance at retirement or the excess of book value over net yield from disposal, have been made in the allocation of depreciation charges among time periods. Therefore, unlike the other items, item (3) has a highly uncertain implication and in fact necessarily small significance for the measure of capital consumption for a given short period.

³⁴ Statements by officials of the BIR support this observation.

³⁵ The BIR does not permit goodwill as a part of the basis for depreciation of tangible assets acquired in the purchase of a business; however, it does permit the use of values higher than original cost. In the case of public utilities, for example, the basis would be determined in the light of valuations according to reproduction cost less depreciation when available, or according to the vendor's book value if ascertainable and acceptable, or if not, by negotiation.

implicit in depreciation bases revised from original cost are systematically closer to current prices than are original cost prices.

2) Depletion charges in federal income tax accounting may include, in addition to development cost, the spreading over output of other elements, chiefly representing capital gains. These may be (a) the acquisition cost of a resource so far as applicable to the resource *per se* rather than the development, (b) 'discovery value', and (c) taxes and other carrying charges on properties while unimproved and unproductive. Percentage depletion in effect involves similar inclusions.³⁶

3) A statistical ambiguity arises in the use of Bureau of Internal Revenue data on charges for depreciation and depletion. There are two versions, the preliminary and the final. The latter are determined after the auditing of the returns. Amounts of such charges disallowed are reported as a lump sum for all corporations.³⁷ The revised depreciation deductions may be presumed to be more reliably established than those originally reported.

Depreciation data are more susceptible to direct change as a result of legislation or of administrative action than are the data basic to the estimation of GCF. Legislation has produced important changes in deductions from income for depletion. More recently administrative action has substantially affected the depreciation deductions allowed.³⁸

4) Another statistical point, of opposite effect, is the inclusion of some depreciation and depletion charges in 'cost of goods sold'. In recent issues of *Statistics of Income* it is pointed out that this item includes depreciation and depletion ". . . only to the extent that these deductions are reported as part of such costs". However, the income tax return form prescribes on its face a deduction to be derived on a depreciation schedule which calls for a final total of depreciation necessarily including amounts that may be charged into the cost of goods sold in cost accounting systems. The Bureau of Internal Revenue assures us that depreciation included in the cost of goods sold is negligible.

5) Depreciation may be deducted, in computing taxable net income, to amortize the cost of intangible assets such as patents, trade-

³⁶ See *Regulations 103*, pp. 97, 311, 321. Questions raised by this situation are discussed in Sec. II D.

³⁷ See *Annual Report of the Commissioner of Internal Revenue*, various years.

³⁸ See Treasury Decision 4422 (1934), and Fabricant, *Capital Consumption and Adjustment*, pp. 84-6.

marks, copyrights, licenses, and franchises whose use or usefulness is definitely limited in duration.

6) Incomparability in estimates of GCF and capital consumption may exist so far as depreciation is charged on assets not actually classified as durable in estimating GCF. The opposite type of situation is covered under other headings above. This omission may be more than negligible, but is doubtless not large.

7) Capital consumption in the form of producer durable goods cannot be inclusively estimated without taking into account accidental losses. NCF has so far been computed without allowance for such losses other than fire losses covered by insurance.

8) There are excesses in the breadth of scope of the corporate accounts that underlie *Statistics of Income*. Depreciation data include charges on some assets located outside the continental boundaries of the United States (excluding Alaska). Such durable goods are not included in the national stock of durable goods, the additions to which constitute gross capital formation according to Variant B1. Domestic business concerns carrying on operations outside the United States³⁹ must file income tax returns on the basis of all operations, foreign as well as domestic, subject to important exemptions in the case of operations in United States possessions.

9) In considering the merits of accounting estimates of depreciation it should be emphasized that the underlying records are often if not usually highly imperfect. The depreciation aggregate for corporations is in large part a sum of charges for enterprises that are, or in the past have been, derived on a highly indefinite basis rather than from meticulous record-keeping and careful forecasting. This fact is strongly reflected in the controversies between the Bureau of Internal Revenue and taxpayers over income tax depreciation deductions.⁴⁰

Existing estimates understate capital consumption because producer durable goods held by certain classes of agencies are not cov-

³⁹ That is, not through the medium of foreign subsidiaries. However, a foreign subsidiary "organized under the laws of Canada or Mexico and maintained solely for the purpose of complying with the laws of such country as to title and operation of property", when the entire capital stock is held directly or indirectly by irrevocable election be included with the parent in a consolidated return. See *Regulations 103*, p. 403.

⁴⁰ See A. B. Hossack, 'Accounting Procedures for Capital Assets and Depreciation', *National Association of Cost Accountants, Year Book, 1936*, pp. 121-37.

ered. Foremost among these omissions is the depreciation on streets, roads, highways, and sewers. As has properly been pointed out,⁴¹ the assumption, forced by lack of data, that the using up of these types of government-owned durable goods is measured by maintenance outlays is quite unsatisfactory. Obviously maintenance work does not completely offset the expiration of usefulness of these assets resulting from wear and tear and obsolescence. The economic life of a highway or street pavement, subject as it is to the wear and tear of use and the elements, may be predicted as reliably as that of many business-owned durable goods on which depreciation charges are figured. Furthermore, it is common knowledge that facilities of these types frequently become obsolete. The old pavement is eventually scrapped and replaced. Sometimes sewers cannot be improved; instead the old structure has to be abandoned. In both cases entries are made to the account of GCF (IV); corresponding entries should be made to the depreciation account. The correct estimate of depreciation on these types of public capital goods must clearly be enormous, a substantial addition to existing measures of capital consumption.⁴²

Second, the following gaps in the coverage of noncorporate business, ranked roughly in the probable order of quantitative importance, may be noted:

- 1) Service industries: personal, business, auto repair and service, other repair service, custom manufacturing industries, services allied to transportation, amusements, professional service, private education, and other service industries, except motion picture production.
- 2) Finance, real estate, and related businesses, except for rented business real estate held by individuals.
- 3) Oil and gas wells.
- 4) Transportation: taxicabs, buses, etc.
- 5) Other utilities: gas, radio broadcasting, aviation and allied activities, etc.
- 6) Fisheries (also corporations so classified).
- 7) Forestry (also corporations so classified).
- 8) Illegal enterprises other than those operating under the guise of corporations.

Third, there are other important omissions outside the range of

⁴¹ Fabricant, *op. cit.*, p. 123.

⁴² *Ibid.*, p. 137, note.

corporations subject to federal income taxes and complementary noncorporate private businesses, consisting of other private agencies, nonprofit associations, and tax exempt corporations:⁴³

- 1) Churches.
- 2) Corporations, funds, foundations, organized and operated exclusively for religious, charitable, scientific, literary, or educational purposes; civic leagues or organizations operated exclusively for the promotion of social welfare; local associations of employees net earnings of which are devoted exclusively to charitable, educational, or recreational purposes; hospitals.
- 3) Labor, agricultural, or horticultural organizations.
- 4) Fraternal beneficiary societies, orders, or associations; voluntary employees' beneficiary associations.
- 5) Mutual savings and cooperative banks; nonprofit mutual domestic building and loan associations; mutual nonprofit cemetery, ditch, irrigation, telephone, local life insurance, farmers' or other mutual casualty companies; teachers' retirement funds of a purely local character.
- 6) Cooperatives: agricultural marketing or purchasing, and affiliated credit corporations; etc.
- 7) Banks provided for by the Federal Farm Loan Act.
- 8) Business leagues, chambers of commerce, real estate boards, boards of trade.
- 9) Clubs organized and operated exclusively for pleasure, recreation, and other non-profitable purposes.
- 10) Corporations organized for the exclusive purpose of holding title to property, collecting income therefrom, and turning over the entire amount thereof, less expenses, to organizations exempt from taxation.

Finally, certain omissions and discrepancies not pointed out earlier should be noted. Neither GCF nor CC covers orchards, an important type of agricultural capital. GCF includes nothing for the cost of growing timber, although deductions for timber depletion are made for income tax computation. The estimates include no allowance for depletion of the soil, for obsolescence of agricultural capital in the form of farm improvements other than structures, or for the loss of such capital through soil depletion and erosion. The values of new farm improvements other than structures are not covered in GCF.

⁴³ See *Regulations 103*, pp. 228-41.

IV Summary

A Summary of defects—prospects for their measurement

It is evident that the lack of correspondence between estimates of gross capital formation and of capital consumption can be explained largely by the fact that they have been derived from sources of quite different types. Net capital formation derived from these estimates is essentially a byproduct. In essence, the procedure consists of (1) constructing plausible estimates of capital consumption where possible, and (2) taking as the minuend to be used in deriving NCF the variant of GCF having the same general order of scope, suitably adjusted for price changes, as the estimate of capital consumption. No detailed effort has been made to construct supplementary estimates of capital consumption to fill the gaps or to fit the scope of gross capital formation to the somewhat obdurate estimates of capital consumption.

The deficiencies in the estimates of gross capital formation and of depreciation and depletion necessary for measuring capital consumption may be summarized with comment on prospects for correction. There seems to be no reliable way of estimating force account output of new durable equipment. Estimates have been made of oil, gas, and mining development outlays.⁴⁴ Some progress can be expected with respect to agencies not at present covered and other imperfections in construction estimates. In that field such omissions are more or less offset by the inclusion of major repairs. A clearer distinction between durable parts for replacement and output of new parts for assembly or of attachments and accessories that are additions to stocks of durable goods may be possible. Refinement should also be possible for (1) consumer type durables going to business and other agencies, (2) producer type going to consumer and other agencies, and (3) contract, custom, and repair work. Estimation of expenditures in connection with the acquisition and installation of producer durables does not seem feasible. The same might be said of the value (cost chargeable to capital account) of orchard and timber growth. Probably only a few details in the cost of agricultural improvements other than structures and equipment can be estimated.

Rough estimates are possible of at least major components of the

⁴⁴ See *Capital Consumption and Adjustment*, p. 50, and Table 10, and George Terborgh, 'Estimated Expenditures for Durable Goods', *Federal Reserve Bulletin*, Sept. 1939.

depreciation or depletion not calculated because capital expenditures were charged to income or because deferred-charge accounting was used. Little can be done about retirements or about expenditures made in connection with the acquisition of durable goods but not charged to capital account for allocation to periodic revenues through charges for depreciation and depletion. If estimates of capital consumption are based on accounting data from *Statistics of Income*, the erratic influence of write-ups and write-downs, which arise exclusively from the exchange of old producer durable goods in the case of income tax accounting, cannot be eliminated. The systematic upward bias arising from the depreciation (or 'amortization') of intangible assets can only be guessed at.⁴⁵ Estimation of depreciation and depletion charges on property outside the United States does not seem possible; however, they are probably quite small. For only a few of the kinds of noncorporate business not at present covered does any basis for estimating depreciation exist. When possible, such estimates at best would be flimsy, but the quantities involved are no doubt small. Very rough estimates may be feasible for private agencies exempt from federal income taxation. Lack of data makes any possible estimate of the depreciation of a most important element of government-owned durable goods almost wholly a matter of conjecture. Estimation of at least some accidental losses other than those by fire should be feasible.⁴⁶ Soil depletion and the obsolescence of agricultural improvements other than structures are not likely subjects for measurement; however, there is no corresponding element in GCF for the former, and for the latter such a component need not be included for purposes of a working definition.

The importance of certain of the disparities between GCF (IV) and CC can be adjudged from data on value of output. Statistics on manufacturing output of final products and on construction for various types of agency are available in breakdowns that to some extent are helpful for this purpose.

B Expenditures on new durable goods charged to income

Some light on the degree to which the content of GCF IV is not represented in depreciation data can be had by examining the

⁴⁵ It has been asserted that intangibles amounted to about 5 per cent of all fixed assets in 1934. An upper limit of \$200 million is suggested for depreciation of intangibles in that year, if the average rate of depreciation for intangibles is taken as equal to that on tangibles. See Fabricant, *op. cit.*, p. 30, footnote 1.

⁴⁶ See *ibid.*, pp. 56-8.

detailed compilation of manufactured commodities recently prepared in the Department of Commerce.⁴⁷ This compilation differs little from that presented in *Commodity Flow and Capital Formation* in terms of the classification of commodities into 'finished' and 'unfinished', and the former into producer durable, consumer durable, etc. A detailed check of the list of products makes possible the segregation of three special classes of items: (1) predominantly replacement parts (when indicated), (2) commodities going almost entirely to business concerns covered in the depreciation estimates but for which depreciation is probably not booked, and (3) products going either to business not covered in existing business depreciation estimates or to nonbusiness private agencies. For the most part, items of class (1) are not given separately or cannot be distinguished from parts for new assemblies. The latter are of course chiefly classified as 'unfinished', but to a small extent are no doubt present in 'finished'. It is thought that the allocations to class (2) are on the whole quite conservative. Most of the true components of class (3) are of course indistinguishable.⁴⁸

The value of output of class (2) durables was estimated for each biennial census year, 1929-39, on the basis of the census values for the components of the 1939 total for which separate data are available for the earlier censal years. Such items accounted for 77 per cent of the 1939 total. The average value of the estimated output of class (2) durables in the censal years 1929-39 is \$640 million. Inasmuch as these products may be assumed to be of low average durability, this figure is a close approximation to the average annual total of accounting depreciation that might be accrued on the stock of such durable goods, and presumably is not covered in existing estimates of depreciation based on actual accounting depreciation data. The total of class (1) durables is so incomplete that it is not worth while to do more than cite the total of \$46 million for 1939. Group (3) exclusive of aircraft and aircraft

⁴⁷ See William H. Shaw, 'The Gross Flow of Finished Commodities and New Construction, 1929-41', *Survey of Current Business*, April 1942, pp. 13-20. This report is based on the compilation referred to in the text.

⁴⁸ Class (2) as compiled for this paper includes all the commodity group 'tools', most of 'all other subsidiary durable equipment', well over half of 'durable containers', a considerable portion of 'machine tools', and scattered items, the largest of which is office and store furniture. The class (2) components of the machine tools group include a large item consisting of jigs, fixtures, dies, etc., and many products of small total value each, such as drills and cutters. Group (3) includes a substantial part of 'professional and scientific equipment', and scattered items, e.g., barber shop and beauty parlor furniture.

products averages \$80 million for the censal years. From 1929 to 1939 the aircraft commodity group ranges in censal years from a low of \$33 million in 1933 to a high of \$225 million, and averages \$89 million. The sum of the average for (2) and (3) exclusive of aircraft⁴⁹ gives a closer approximation than the figure for (2) alone to the probable extent of omission from depreciation estimates due to noncoverage of certain types of holders and to the use of other methods of accounting than depreciation.

C Depreciation on account of tax exempt agencies

A rough idea of the gap in depreciation estimates due to the non-coverage of tax exempt private agencies can be obtained through the estimates of construction activity made in the Department of Commerce.⁵⁰ These estimates include separate figures for three types by function of private construction, for which the owning agencies are entirely or predominantly exempt from federal income taxation: ⁵¹ religious and memorial, educational, and hospitals.

These three classes of ownership fall far short of exhausting the list of agencies eligible for exemption. The additional omissions probably more than offset any taxable agencies that may be included in the preceding three categories.

Estimates of total private construction activity, 1920-36 cumulative, amount to \$88.0 billion for all private construction including public utility, and to \$41.5 billion for nonfarm residential. For this period total construction in the three tax exempt classes was \$4.1 billion. Fabricant's accounting estimates of the depreciation on nonfarm residences, 1919-35, are based on an average depreciation rate not far from 2.5 per cent per year (straight line formula). If retirements implied by the procedure are disregarded, the increase in depreciation during the period arising from new residential construction should be approximately \$1.0 billion a year. Calculating depreciation on tax exempt construction at a 2 per cent rate, the

⁴⁹ The aircraft group is not actually counted in (3) because of the importance in it of military output.

⁵⁰ *Construction Activity in the United States, 1915-1937*; also, table prepared in the Bureau of Foreign and Domestic Commerce, dated February 1942: 'Construction Activity in the United States, by Function and Ownership, 1929-1941'.

⁵¹ The writer has verified this presumption by consultation in the Income Tax Unit, Bureau of Internal Revenue. Hospitals are, in terms of number, at least 60-70 per cent tax exempt, including most of the large hospitals in the principal cities. A larger proportion of total educational institutions than of hospitals are tax exempt; furthermore, it may be supposed that the non-tax-exempt educational institutions individually own less property than the tax exempt.

addition to annual depreciation for the period on account of new tax exempt construction should be approximately \$0.1 billion. The proportion of nonfarm residences existing in 1920 to residences constructed in 1920-36 was no doubt larger than the proportion of existing tax exempt property at that time to subsequent tax exempt construction. Hence, the retirements implied in any synthetic accounting estimates of depreciation would offset the increase due to new construction more for residences than for tax exempt property. Fabricant's accounting estimates, based on residential construction estimates which differ from those of the Department of Commerce, range in 1920-35 from a low of \$0.7 billion for 1920 to a high of \$1.7 billion for 1933.

Gross capital formation in the form of construction for the account of these three largely tax exempt agencies has varied substantially relative to residential construction. During 1920-36 the proportion was 10 per cent, whereas during 1937-41 it was only 6 per cent. Accordingly, the additions to calculable depreciation on account of these agencies should be relatively low for the last few years.

On the basis of the total, \$4.7 billion of construction for the account of tax exempt agencies for the period, the total of accounting depreciation for all agencies in the latest year is probably understated by roughly \$100 million. This figure might well be doubled to cover depreciation on the property of these agencies constructed before 1920 (after allowance for retirements of such structures), depreciation on structures owned by other agencies exempt from federal income taxation, and depreciation on other durable assets held by all tax exempt agencies.

D Natural resource development costs charged to income

Natural resource development costs are largely missing from both GCF and CC. Intangible development costs in the oil and gas well industry to a very large extent have been charged to income for the purpose of federal income tax computation.⁵² Such wells as a rule enjoy high production for a relatively short time, and may thus be regarded as possessing rather low durability. Hence, the average annual value of intangible development is a good indicator of the omission from depreciation because of capital expenditures charged to income. A substantial amount of development

⁵² The writer has been so informed by the Natural Resources Oil and Gas Section, Income Tax Unit, Bureau of Internal Revenue.

expenditures in other mining industries are charged to income. Estimates of all natural resource development costs charged to current operations during 1919-35 average \$260 million annually.⁵³

V Conclusion

In the course of choosing a definition of gross capital formation suitably restricted for the purpose in hand, the distinction between new durable goods and durable repairs to old was justified on grounds other than statistical convenience. It was suggested that alterations of old durable goods, unlike repairs that simply restore the old structure, are properly regarded as constituting new durable goods. It was proposed that the concept of consumption for a period be defined as "the decline in the current value of durable goods attributable to the current expiration of service potential".

There are numerous elements of incomparability between economic estimates of gross capital formation and accounting estimates of capital consumption from which economic estimates are derived. Several, at least, are sufficiently large to constitute ample evidence supporting the description of the estimates of net capital formation, derived from the estimates under discussion in this paper, as approximate.

Certain changes can be made relatively easily in the estimates of gross capital formation and capital consumption to improve comparability, in lieu of adopting more restricted variants that would have similarity of scope:

Additions to measures of gross capital formation

Mining development

Oil and gas well intangible development

Other construction not now covered

Additions to measures of capital consumption

Allowances for past capital expenditures charged to income (oil and gas wells, mining); also producer durable goods manufactured for sale or interplant transfer

Allowance for past capital formation for accounts of tax exempt agencies

⁵³ Fabricant, *op. cit.*, p. 50, Table 10. Estimates of construction activity and GCF do not include mining, petroleum, and natural gas development work. The option to charge as expense does not apply to that part of the value of oil and gas well development represented by expenditures having a salvage value, i.e., derricks, tanks, pipe lines, and other physical structures. See *Regulations 103*, pp. 116-7.

Subtractions from measures of capital consumption
 Audit reductions of reported depreciation

However, the measures would remain quite imperfect after these few revisions. An expedient that could be embraced for ensuring comparability is the method necessarily used in estimating the depreciation on residences and government-owned producer durables. That is, depreciation in accounting form can be estimated for every ascertainable type of product classified according to assumed lengths of useful life. This has in fact been done as a step in the derivation of price indexes for the conversion of accounting depreciation charges, which are in terms of cost or revaluation prices, to prices current during the period of measurement.⁵⁴

There is perhaps no adequate basis for the acceptance of over-all capital consumption estimates based on actual accounting data in preference to estimates more synthetically derived. However, a great disadvantage of synthetic estimates is the difficulty of breakdown by type of asset-holder. Since accounting depreciation data are important as such in conjunction with profits data for analysis of the sources and uses of business funds, and since comparable measures of the uses are needed, breakdowns of GCF by type of holder as represented in industry breakdowns of accounting charges for depreciation are strongly desired. Consequently, it is desirable to work toward the extension and refinement of the breakdowns of GCF by type of final holder, which would permit the calculation of net capital formation according to variants of more restricted scope on the basis of more comparable estimates of gross capital formation and capital consumption than can now be used.

⁵⁴ See Fabricant, *op. cit.*, Ch. 10.

INDEX

- Accidental losses, 246, 267
 Accounting methods for acquisition and dissipation of durable goods
 cancellation, at retirement, of book values, 253-4
 charging capital expenditures to income, 251
 depreciation accounting, 252-3
 insurance expense, 254
 inventory basis, 254
 maintenance accounting, 250
 periodic adjustment of asset values, 254
 suitability for measuring consumption, 265
 Agriculture
 contribution to national income, 173-5
 share in national income, 104, 115
 Air raid damage, 69
 Alternative cost for armaments, 92-3
 ALTMAN, O. L., 122n
 Armament delivery, 59, 63
 Armament depreciation, 59
 Armament expenditures
 Canada, 73-4
 capital, 63-4, 65, 67
 civilian disinvestment, 54-5, 61
 comparison over time, 78
 comparison with total expenditures on final products, 84
 current, 63
 current vs. capital, 62-3
 definition, 47-8
 'delivered', 61
 economic impact, 50
 factor cost, 65-6
 for different countries, 52
 foreign transactions, 57-9
 Germany, 74-7
 Great Britain, 71-3
 gross, 69
 hidden, 53, 61
 idle resources, 60-1
 impact on current production, 62
 impact on national wealth, 62
 Japan, 77
 margin available for expansion, 79
 market prices, 65-6
 opportunity cost of resources, 51, 55
 payments for human resources, 61
 privately financed, 57, 61
 ratio to national income, 46, 52-3, 65, 79
 reported figures, 49
 timing, 59-60
 unit of measurement, 52-3
 United States, 68-71
 valuation, 55-6
see also Impact, armament
 Armament exports on commercial basis, 58-9, 91
 Armament facilities privately financed, 57, 61
 Armament imports, 58, 63, 91
 Armament stock, 59
 Armed forces, 15-16, 55, 61, 63, 84, 90, 92

 Bad debts, 50, 65, 66
 BAKER, O. E., 100n
 Balance, 110-3, 125, 133, 134, 137
 Balance of international payments, 175
 coverage, 145
 treatment of gold and silver, 145-6
 BALL, C. R., 100n
 BANGS, ROBERT, 56n, 87n
 BARGER, HAROLD, 156, 157n, 161n, 162n
 BEAN, L. H., 104, 105, 113n, 123n
 BENEDICT, M. R., 108n
 Benefits, distribution of, 2
 BENEY, M. A., 157n
 BLACK, J. D., 105, 106, 108, 113n, 116n
 BLAISDELL, T. C., JR., 122n
 BLOCH, KURT, 77n
 BOLLINGER, P. H., 123n
 BOWLEY, A. L., 125
 BROWN, A. J., 73n, 79n
 Buildings, 50
 Business and professional families, mean income of, 221, 224
 BYE, R. T., 112n