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TRENDS IN HOUSEHOLD CAPITAL FORMATION

HOUSEHOLD CAPITAL FORMATION DEFINED

It is customary for both economists and the public to think of capital formation in terms of tangible business assets—"factories and machines," so to speak, used by business enterprises to generate output, sales, and profits. Empirical measurements of either gross or net capital formation have consistently used this frame of reference except in their treatment of housing.¹ Residential house construction has always been treated as a component of capital formation despite the fact that most new housing is neither sold to business firms nor used to generate output, sales, or profits in the customary sense.

The rationale for the inclusion of housing in capital formation appears to be twofold. First, there is an obvious incongruity in the alternative—treatment of expenditures on new housing as an item of current consumption. An individual house is evidently consumed over a very long period of time, and the "consumption" of housing in any period is clearly better measured by utilization of the existing stock than by the size of

¹ For the most part, economists have tended to treat the acquisition of consumer durable goods as current consumption, with some notable exceptions. Raymond W. Goldsmith's work has always recognized that consumer durable assets are just as much capital as business assets. See *A Study of Saving in the United States*, Princeton, 1955, and *The National Wealth of the United States During the Post-war Period*, Princeton for NBER, 1962. Other writers have devoted attention to the importance of consumer capital; for example, see Homer Jones, "Some Aspects of Demand for Consumer Durable Goods," *Journal of Finance*, May 1954, and Harry T. Oshima, "Consumer Asset Formation and the Future of Capitalism," *Economic Journal*, March 1961.

By and large, however, it is fair to say that the predominant tendency of writers dealing with capital formation has been to ignore the consumer (as well as the government) sector and concentrate on business enterprises. Certainly this is true when it comes to discussions of the cyclical variability of capital formation, and it tends to be true also in studies of secular trends.

increments to the stock. Further, urban consumers have a clear-cut market alternative to the purchase and use of a house, since there has always been a well-developed rental market for housing services. Thus a market yardstick is available for measuring the value of the services yielded by an owner-occupied house—the rental paid for a similar house owned by an individual investor or realty firm and occupied by a tenant. Since the stock of tenant-occupied housing clearly must be treated as a business capital asset, and additions to this stock as an item of capital formation, there is an evident and arbitrary distortion unless the stock of owner-occupied housing is treated in a similar fashion.

It seems plain that this rationale for the treatment of owner-occupied housing as capital applies equally well to other household tangible assets. If the crucial distinction between capital assets and current consumption is whether or not the product yields a flow of services over time, almost all goods and services must be regarded as capital assets. Literally nothing is consumed instantaneously. Food produces its “services” over a period of hours (until the consumer becomes hungry enough to eat again). Personal services can be thought of as capital assets which are not fully depreciated (consumed) until the service is needed again. To take some extreme cases: the services of a barber generate an asset (a well-cropped head or a clean-shaven face) that depreciates as the hair grows back; the services of a lawyer produce an asset (a feeling of satisfaction with a well-drawn will) that continues to yield income until the drawer decides to cut out his undeserving relatives. I can think of no element of output which, in the above sense, does not constitute a capital asset yielding a flow of real income.²

INVESTMENT VERSUS CONSUMPTION

The simplest way to look at the distinction between investment and consumption with respect to outlays for household tangible assets or services is to investigate the nature of the flow of benefits that accrue from these outlays. To the degree that such outlays result in an increased flow of real income via improvement in the efficiency of the production process, they are indistinguishable from investment in any other form of capital.

² This statement is partly the consequence of how output is defined. Thus if electric power is defined as an output, as it is when sold directly to consumers, the statement would be patently untrue. But electric power is more sensibly viewed as an input into the production of services (light, communication, movement) generated by a combination of capital inputs (light bulbs and lamps, telephones, generators, etc.) and other inputs.

In this narrow sense, a car, a washing machine, or a higher level of education may be just as "productive" an investment as a machine tool. And to the extent that the value of the flow of benefits can be measured in the market, both the flow of output and the rate of return on the investment can in principle be measured. The measurement is often complex, since more than one type of output is obtained from some kinds of household tangible assets and services. In some cases, there is both a flow of benefits that continues into the future as well as benefits that exist only for a short period of time.

It is well to be precise about the sense in which expenditures for tangible household assets like cars, houses, or appliances, as well as expenditures for certain services like education, may be regarded as investment outlays rather than as current consumption outlays. There is one sense in which, by any meaningful definition, such outlays must be treated as investments. The purchase of a car can be thought of as an investment which yields a flow of services—transportation from one place to another. Lacking a car, roughly the same service can be obtained by purchasing a train or bus ticket, taking a taxicab, or renting a car. Thus vehicle ownership is one way to obtain a flow of transportation services, and to this extent car purchases are just as much "productive" investments as laying railroad track or adding to a fleet of taxicabs.³

³ The return on this investment is another matter, and is not simple to calculate. In principle, the return is the flow of saved costs from not having to use alternative means of transportation. See F. Thomas Juster and Robert P. Shay, *Consumer Sensitivity to Finance Rates*, Occasional Paper 88, New York, NBER, 1964, and J. V. Poapst and W. R. Waters, "Individual Investment: Canadian Experience," *Journal of Finance*, December 1963.

A few attempts have been made to estimate the rate of return from household investment in tangible assets. For example, defining return to be the cost of using commercial laundromat services and investment cost to be the installed price of a washing machine and a clothes dryer, adjusting for the other costs associated with home usage, such as repairs, electric power, water, etc., and making a variety of alternative estimates about service life and frequency of use, Poapst and Waters ("Rates of Return on Consumer Durables," *Journal of Finance*, December 1964) calculate rates of return that range from 1 to 27 per cent, depending mainly on assumptions about frequency of use. No adjustment is made in these calculations for the saving of housewives' time, which would raise the rate of return appreciably. In the same article, Poapst and Waters calculate that the rate of return on an investment in a television set runs from a negative number to over 70 per cent, depending mainly on assumptions about family composition and on the relative utility derived from TV viewing versus the utility derived from the alternative of outside entertainment.

Much cruder, essentially illustrative calculations shown in Juster and Shay (*Consumer Sensitivity to Finance Rates*, p. 16) indicate that the typical rate of return to automobile investment and to investment in laundry equipment is in excess of 30 per cent.

It should be noted that the "pure transportation" element of an investment in vehicles is not related to the fact that the car may be a particularly comfortable and convenient way to get from one place to another. So are jet planes and luxury trains. Hence it is always a particular quality of transportation services that is being purchased, and a Cadillac is just as much an investment in transportation as a secondhand Ford. It cannot be argued that the "productive investment" aspect of vehicle purchase consists of "basic" transportation. If this was the case, any means of providing passenger service on trains other than cattle cars would be "unproductive" investment.

There is another sense in which a vehicle purchase may provide services over and above a particular quality of transportation. It is often alleged that many consumers buy cars because they enjoy the simple fact of ownership—Veblen's conspicuous consumption, in effect. Aside from the fact that the car is useful, the fact that it is parked outside the home is alleged to be an important reason why some people purchase cars and particularly why they purchase new rather than used cars. Thus ownership per se may convey a bundle of utilities. Even if pure ownership benefits represented the sole return from a vehicle purchase, it does not follow that car purchases become consumption unless these benefits are entirely associated with brand-newness. Ownership benefits still represent a flow of consumption services which are obtained by acquiring an asset. The flow of benefits may last as long as the car is owned, or it may stop when the car ceases to be "new"—e.g., when it gets the first scratch on the fender. The only difference between the transportation and ownership services are that the latter are harder (probably impossible) to measure, and they may in addition have a very short service life. Thus as a practical matter we may wish to assume that whatever ownership benefits accrue are completely consumed within one year, after which the flow of ownership services becomes zero. In this case, "investment" in the flow of ownership services might best be viewed as consumption during the year of purchase.⁴

⁴ One interesting difference between pure ownership services and transportation (use) services is that the size of the former is likely to be an inverse function of the proportion of those owning. Thus the value of these services depends on the behavior of other households in the community. In contrast, the value of transportation services does not depend on the behavior of others, although the costs of some of the complementary inputs used to obtain the service (particularly the input of time) clearly do.

Finally, it may be thought that a car purchase provides services through the very process of use. To many people "a ride in the country" is clearly viewed as consumption per se. Getting to the country by train or bus is not equivalent, since the benefit consists of getting there, not being there. On closer examination, however, this is really a specialized and quite expensive type of transportation service. One can always hire a ride in the country by renting a car, and a driver if necessary.

A similar analysis holds for the other tangible assets purchased by households. The only differences are that the relative importance of ownership services per se and what may be broadly termed "use" services probably varies a good deal among items. Laundry equipment, for example, is often put in locations such as alcoves or cellars, suggesting that it renders almost entirely use and not ownership services.⁵ The most important such asset—a house—probably has a quite small ownership component, although the flow of use services is a variegated bundle combining utilitarian aspects (shelter, warmth, space) as well as a good many others (beauty, convenience, etc.)

Expenditures for consumption services with an investment element may be analyzed in much the same way, although the flow of output is even more difficult to define. In the case of education, for example, there seem to be three distinct types of output. Educational outlays are productive investment in the narrowest sense to the degree that they increase the flow of future earnings. They are investment in a broader sense to the extent that they permit an individual to make better use of leisure time or to be a more socially useful member of the community. In both cases, educational inputs yield a flow of future outputs and hence constitute investment; the only difference is that the earnings return is easier to measure.

Beyond these benefits, however, education may also yield a flow of current services to the extent that people "enjoy" being educated or enjoy the environment in which education is provided. Adult education, for example, may be predominantly a pure consumption good. The students like the classes, enjoy a night out, and may get much the same kind of benefits as from a show or movie.

⁵ In other countries, or during earlier decades in the United States, this might not be the case. In a poor country, where practically nobody owns laundry equipment, ownership per se may be an important component of the total flow of laundry services.

Expenditures for other types of consumer services provide a similar combination of benefits. Health outlays, for example, have a narrowly defined investment component to the extent that they increase earnings either through increased longevity, reduced loss of work time through illness, or higher productivity. They have a more broadly defined investment component to the extent that they permit more effective use of time for nonmarket activities. And they have (for some people) a pure consumption component to the extent that visits to the doctor or medication have the effect of making the patient "feel" better without having any lasting physical effects.⁶

Finally, there are a few types of expenditures by business enterprises that are normally viewed as a cost of production, but which represent, to some degree, investment activities. The clearest illustration is business outlay on research and development, which can be thought of as an investment in knowledge designed to produce new products and processes. Such outlays are customarily expensed rather than depreciated, with a consequent tendency to underestimate both investment and net income.⁷

Fortunately for the concrete problems of measurement, most of the goods and services produced during any reasonably long time period such as one year depreciate fully (i.e., are completely consumed) within the period. Hence we can reasonably classify the output produced during any period into capital assets—those items which have not been fully depreciated or consumed, hence continue to yield services during one or more future periods—and consumption—those items which were fully depreciated, hence have yielded all their services, in the same time period as the one in which they were produced.⁸ If a time span of one year is taken as a reasonable period in which to measure "consumption"

⁶ This component is difficult to isolate, but evidently exists. For example, a patient who goes regularly to the doctor simply to get assurance that there is really nothing wrong with him can be thought of as simply consuming the services of the doctor's visits. Since the consumption good "being made to feel better" needs to be periodically renewed by continued visits, the effect of each visit must be thought of as having completely worn off by the time the next one is made. Hence this appears to be a pure consumption good with no investment component.

⁷ Expenditures for advertising, for employee training programs, and for periodic health checkups for employees are other examples of business outlays that are typically accounted as current costs but which are really investment in part.

⁸ Inventory change is a special case. Here the goods themselves are not long-lived, but changes in the amount stored constitute an increase in a source of potential consumption.

and "capital formation," most output currently classified as consumption would continue to be so classified, and similarly for products now classified as capital goods.

It is quite evident, however, that a considerable amount of reclassification is required by this frame of reference. The category of products generally labeled consumer durables—automobiles, household appliances, furniture, etc.—would all constitute items of capital formation; for these products "consumption" is appropriately measured as the flow of services yielded by the existing stock. The output of some semi-durables—clothing, for example—would also be treated as capital formation. This line of argument also suggests that a number of items now classed as consumer services would also require reclassification because they have a substantial capital component, most notably, expenditures for education and, to a lesser degree, health.

Although the validity of this general approach has been recognized by many, it has generally been argued that the practical difficulties of estimation make it impossible to formulate empirically meaningful estimates of consumption and capital formation consistent with the above definitions. In addition, some have argued that reformulation is inappropriate, and that capital formation is most usefully defined as relating solely to activities in the business sector.⁹ The argument essentially is that capital formation should correspond to saving that permits an increase in future output by improving the efficiency of the production process; outlays for household capital assets represent spending, not saving. Given this definition, capital assets cannot produce consumption services directly; they simply enable the production of a greater amount of goods and services per unit of input. Hence items such as automobiles are not capital assets unless they are used by business firms to improve efficiency. When owned and used by consumers for "pleasure," they simply represent a store of consumption services that yield a particular kind of real income (transportation services) through time.

Although one is free to define capital assets or capital formation in

⁹ E.g., see the remarks by F. A. Lutz in his comments on Ervin Miller's paper "Consumer Credit and Economic Growth," in Federal Reserve System, *Consumer Instalment Credit*, Washington, 1957, Volume 1, Part II, and by Kuznets in his summary volume, *Capital in the American Economy*, Princeton for NBER, 1961, p. 16. See also John Gorman, "Relationship of Balance Sheets and Wealth Estimates to National Income Accounts," *Measuring the Nation's Wealth*, Studies in Income and Wealth 29, New York, NBER, 1964, Appendix I-F.

any way that he chooses, it should be noted that the line of argument which excludes automobiles from the stock of capital assets applies equally well to owner-occupied housing, and for exactly the same reason—housing does not improve productive efficiency directly but simply yields a flow of consumption services of a particular (fixed) type.¹⁰ A further consequence of this narrow definition is that whether or not a particular product is a capital asset depends solely on the identity of the buyer: housing or automobiles owned by firms in, respectively, the real estate and construction industries would be capital assets, while the identical products owned by private individuals would not be. The most important consequence, obviously, is that a particular definition may be inappropriate for responding to a particular question.

While it is true that both common sense and our puritan traditions rebel at the thought of arguing that saving and investment are entailed in the purchase of a large automobile with glittering chrome and extended tail fins, the rebellion seems to me aesthetic rather than logical. No one denies that the installation of cushioned seats in passenger trains or the construction of luxury jet airliners constitutes investment, nor that installation of a lavish cocktail bar in an exclusive restaurant or polishing the stationary parts of a machine tool represents “productive” investment and saving. Nor would anyone (except the Bureau of Internal Revenue) deny that a privately owned automobile used solely to get to and from work constitutes a producer durable in the traditional sense of the term. Thus there seems no logic in the view that automobiles owned by business firms or individuals and used solely “for business” are investment, while those owned by consumers and used “for pleasure” are not.¹¹ Both yield an identical kind of service, both save the cost of

¹⁰ This statement needs to be qualified: there is probably some minimum level of housing below which production efficiency will suffer, and situations exist where the provision of adequate housing will facilitate a more productive use of resources. For example, the government of Israel has apparently found that the provision of good, rather than minimal, housing for incoming refugees speeds up their development as productive members of the community, and the Soviet Union has had to provide better-than-minimum housing in the eastern region in order to attract the labor force necessary for development in that area.

¹¹ In addition to the problem of distinguishing consumption from investment, there is another problem—that of distinguishing intermediate from final product. A car used solely for “business” evidently constitutes an investment, but, equally clearly, the transportation services yielded by this investment do not represent final output. The car is best viewed as a cost of earning income (even though it is not deductible as such for tax purposes), just as is payment of dues to a labor union or the purchase of a helmet by a coal miner (both tax deductible). Thus

alternative means of transportation, and both continue to yield a flow of services over an extended period of time.

A sensible view of this subject is that the appropriate definition of capital formation depends on the use to which the data will be put. If the question concerns cyclical variability, a definition limited to tangible assets may be more meaningful than one which includes certain kinds of services—particularly services that are provided from public funds. In addition, of course, the factors used to explain cyclical variability will be quite different for enterprise and household investments in tangible assets. On the other hand, if the question relates to trends in economic growth or productivity, a much more inclusive definition seems called for, one that includes all of the sources of capital formation that contribute to growth and productivity.

SECULAR TRENDS IN CAPITAL FORMATION— TANGIBLE ASSETS

A number of series have been selected for analysis of movements over time. These represent the most important components of gross capital formation in tangible assets. In the enterprise sector, two tangible asset series are used—outlays on producer durables (E_d) and on new structures (E_s). The series on producer durables is the standard series on business equipment in the National Income Accounts of the U.S. Department of Commerce. The enterprise construction series includes business structures as traditionally defined, all farm construction, and an estimate of the rental portion of new nonfarm residential construction.¹² Although a substantial fraction of farm construction should be classed as owner-occupied residential, the entire category is a relatively small one except

many consumption goods are not really consumption at all, but are simply costs associated with particular kinds of occupations or particular locations of employment. To some extent, even the suits of Madison Avenue executives (or the hairdos of their secretaries) are costs of holding a particular job, not consumption services desired for their own sake.

The measurement problem here is obviously formidable—probably insoluble. For example, executives are required by their jobs to be well dressed—but they may like being well dressed and might have spent as much on clothes even if their jobs did not require it. What is the proper proportion between the “purely business” and “purely pleasure” uses of clothes for executives? Simply to ask the question suggests the complexity, both analytical and empirical, of the problem.

¹² Gross investment in structures as defined in the National Income Accounts is thus distributed into the enterprise and household sectors on the assumption that nonfarm single-family dwelling units represent investment by households, while all other private structures represent investment by enterprises.

for the period before World War I. The rental portion of nonfarm residential construction is assumed to be coterminous with expenditures on multifamily structures throughout most of the period covered.

For the household sector, three series are used: expenditures on major consumer durables (H_d), expenditures on minor consumer durables (H'_d) and nonfarm owner-occupied construction (H_s). For the latter series expenditures on new nonfarm single-family dwelling units are taken as the best approximation to gross investment in structures by households.¹³

For household equipment, major durables have been distinguished from minor ones on the basis of several analytical objectives. One objective was a comparison of trends in those household assets that tend to be close substitutes for enterprise assets; another was analysis of the role of consumer credit in facilitating the growth of household tangible assets; and third was the construction of empirical estimates of the imputed net income and the flow of consumption services from household equity in tangible assets. All these objectives are served by a classification that separated out household tangible assets characterized by relatively long service lives, by the existence of commercial markets in which the services of similar assets could be purchased, and by unit costs high enough so that purchase with borrowed funds was a common method of acquisition.

¹³ Several major biases are involved in this assumption, which may or may not offset. First, farmers' investment in owner-occupied structures should be counted as investment by households; these outlays, which were as much as 20 per cent of outlays on nonfarm single-family house construction around 1900, have grown at a much slower rate than the comparable nonfarm category, or, for that matter, than enterprise investment in structures generally. Second, multifamily structures built by owner-occupiers should be in the household sector to the extent that they are used by the owner-occupier. Such outlays were of great importance during the 1920's, when the construction of two-family houses (probably owner-occupied for the most part) reached from 30 to 45 per cent of the number of single-family houses. Since then, two-family house construction has declined sharply in importance relative to outlays for single-family owner-occupied housing. Outlays for cooperatively owned multifamily dwellings, which should generally be classified as household rather than enterprise investment, have grown rapidly during recent years, although the amounts involved are still quite small. Third, single-family housing built as rental housing should be in the enterprise rather than the household sector; outlays for these structures were of much more importance in the early part of the century than they are today. Rough estimates prepared by Goldsmith (*Savings*, Tables R-25 and R-30) suggest that almost as many single-family units may have been built for rental as were built for sale to owner-occupiers in the period around 1900; during recent years, hardly any single-family housing would fall into this category. It is not clear whether the net result of these biases is to reduce or increase the relative growth of household investment in structures.

The final tangible-assets series consists of government civilian construction (G_s)—hydroelectric dams, schools, highways, and so on. Public construction is treated as an item of current expenditure in the Department of Commerce National Income Accounts, although there is even less reason to do this than in the case of household durable assets.¹⁴ Public expenditures on durable equipment (e.g., office equipment) are not included as capital formation mainly because, aside from expenditures on military hardware, the category is quite small and the data not very reliable. Although for some purposes outlays on military hardware might well be construed as investment, for purposes of this study it is not considered to be useful to do so.¹⁵

Substitution Between Household- and Enterprise-Owned Assets. Even those who generally regard household-owned assets as outside the scope of a useful definition of "capital assets" treat owner-occupied housing as a capital asset rather than as consumption. As noted above, the rationale is partly that the value of the services provided by owner-occupied housing can be readily estimated in the rental-housing market, partly that the extreme longevity of housing makes any other treatment seem intuitively unreasonable. But it might also be argued that owner-occupied housing is practically a perfect substitute for rental housing, and that the trend of capital formation in income producing assets would be seriously distorted if owner-occupied housing was treated differently from tenant-occupied housing. For example, suppose that two communities had opposite preferences, residents of one typically preferring to rent, the other to own. The level of capital formation would appear to be quite different in the two communities if new rental housing was treated as capital formation and new owner-occupied housing as current consumption, and the trend might be quite different if one of the communities experienced a gradual change in preference.

It seems evident that this is simply a limiting case, and that there is some degree of substitutability between almost all household tangible

¹⁴ This is a much-discussed problem in the literature on national accounts. For example, see Simon Kuznets, *National Income and Its Composition, 1919-1938*, New York, NBER, 1941; the article by G. Haberler and E. Hagen, "Taxes, Government Expenditures, and National Income" of *Studies in Income and Wealth* 8, New York, NBER, 1946; and, more recently, Kuznets, *Capital in the American Economy*. In their empirical work, both Kuznets and Goldsmith distinguish public investment from other outlays of public bodies.

¹⁵ Alternative ways of looking at outlays for military hardware have been thoroughly covered in the literature. See Kuznets, *Capital in the American Economy*.

assets and enterprise assets. Take the case of washing machines and clothes dryers. Although rental markets for the capital assets themselves are not well-developed,¹⁶ the services of both can readily be obtained in most parts of the country—the self-service laundromat is a fairly widespread institution, and commercial laundries still abound. If the use value of owner-occupied housing can be estimated from the cost of comparable services rented from enterprises, surely the use value of owned washing machines and clothes dryers can be estimated from the cost of buying laundry or laundromat services. In effect, household purchases of these items can appropriately be regarded as investment in a capital asset which yields net income to the investor—the flow of saved costs from not having to use a commercially available service.¹⁷ It is true, of course, that laundromat services are not precisely comparable to the services obtained from one's own equipment, but neither is the service obtained from a rental property identical to that obtained from an owned property. And laundromat services are probably as good a proxy for the services of owned laundry equipment as would be true for rental vs. owned housing.

Rental markets for other types of items are easy to find. One cannot easily rent furniture, but it is simple enough to rent furnished dwelling units. The difference between the market prices of furnished and unfurnished dwelling units must constitute the rental price of the furniture and furnishings. Rental markets for automobiles are widespread; although the relevant market (for long-term rather than short-term rentals) is relatively thin at present, long-term automobile rentals appear to be an enterprise-provided service whose demand is growing rapidly, especially among high-income families located in metropolitan areas. Further, markets exist in which at least some of the services of automobiles may be purchased from enterprises—buses, railroads, airlines, taxicabs. Again, the services of public transportation are not the same as the services provided by a privately owned automobile, but there is surely a strong element of substitution.

A similar situation exists in the case of communications and entertain-

¹⁶ Rental markets, while not widespread, do exist. For instance, these and similar products can be rented in the New York metropolitan area on a long-term basis provided that the renter wants more than a certain minimum value of equipment. The cost of renting is slightly higher than the cost of buying outright on instalment credit.

¹⁷ For a more extended analysis, see Juster and Shay, *Consumer Sensitivity to Finance Rates*.

ment equipment—radios, television sets, and so on. Television sets have long had a rental market, although mainly for very short-term rentals. Competitive if not directly comparable services are movies, theaters, newspapers, the legitimate theater, vaudeville shows, and others.

Even in extreme cases—dishes and cooking utensils, for example—the substitutability of household and enterprise assets is easily demonstrated. Although such items are hardly ever rented, their services are rented whenever one eats “out” rather than “in.” If dishes and utensils are capital assets when purchased by the restaurant industry, they can surely be treated as capital assets when purchased by households.

In all the cases just described, it may be supposed that the accumulation of household and enterprise assets that provide roughly comparable services have some tendency to offset one another. As a consequence, the trend of capital formation cannot be understood unless account is taken of the accumulation of household assets. Conceptually, it is hard to see why *all* household tangible assets should not be treated as components of capital formation and of the capital stock, although empirical estimates of their value, their return over cost, or the flow of services may be more difficult for some categories than for others. It is irrelevant whether or not market rental data can be easily obtained or have been obtained; what matters is whether or not markets exist in which the assets themselves can be rented on terms comparable to those involved in purchase, e.g., for a time span equal in length to the holding period typical for purchasers, or in which a reasonable approximation to the services can be purchased directly. If so, either rental costs or costs of the equivalent purchased service provide the appropriate measure of consumption.¹⁸

Rental Markets for Household Assets. It is an interesting exercise to examine the characteristics of household assets that have tended to be rented rather than purchased outright. Rental serves two main functions. First, it enables the renter to obtain the temporary use of an asset whose service is desired so infrequently that the present value of the stream of rental costs is less than the purchase price.¹⁹ Typical cases of this type

¹⁸ Empirical estimates of the consumption services rendered by household capital assets can be obtained by two different routes. If good rental or equivalent-purchase markets exist, the value of services can be calculated directly. If this procedure yields inadequate data, the sum of depreciation, operating expenses, and return on owner's equity constitutes an alternative estimate.

¹⁹ Possibly there is a third type of rental market for services that can only be produced by tangible assets plus a complementary labor input that is either very costly in terms of time or disagreeable for one reason or another. The time of a

are formal evening clothes, beach umbrellas, and a large stock of cocktail glasses. Households that require these kinds of services infrequently will choose to rent, while those that use such assets regularly will find it less expensive, in terms of both money and time, to purchase. Second, rental conserves liquid assets by permitting the user to purchase services without the necessity of acquiring any equity in the asset that provides the services. Thus a household may choose to rent housing space because it has insufficient liquid assets for the down payment on a house, or because the requirement of building equity in an owned house puts too big a strain on current income. Further, renting avoids the uncertainties associated with changes in the market prices of capital assets, as well as the risk of paying an extra set of transaction costs if a change in circumstances dictates purchase of a newer or better-located asset. For similar reasons, a household may rent laundry services by using a commercial laundromat instead of purchasing a washing machine.

On the other hand, households do not rent everyday clothing or such items as cooking utensils and dishes, except indirectly when they eat out. The reasons are twofold. First, rental arrangements involve continuing transaction costs, as well as the costs associated with the risk that the asset will not be properly maintained. If the purchase price of the asset is sufficiently low, these costs are an appreciable fraction of the purchase price and rental becomes very expensive relative to purchase. Thus no one rents cooking utensils, because the cost of simply keeping records would soon mount up to more than the purchase price. Second, the purchase price of these types of assets is typically a small amount in absolute terms; the absence of liquid assets does not inhibit purchase because only a relatively small fraction of current income is required to obtain the asset outright.²⁰

new mother, for example, is very costly for the first few weeks or months after the birth of a child because there is a great expansion in the total demand for her services. For this reason it may well be cheaper to use a diaper service than to "do your own," at least during the period of peak demand for services, since the alternative may be to hire a part-time nurse or the equivalent. Similarly, many housewives have a strong dislike for certain kinds of chores—ironing shirts or linens, for example. They may thus choose to send shirts and linens out rather than do them at home. In both these cases what is really being rented is labor input of a type that is especially onerous for one reason or another rather than the capital equipment ordinarily used along with the labor input to produce the finished service.

²⁰ Even though assets of the sort analyzed here can represent large outlays relative to weekly or monthly income for some households, it is generally true that they are available in a wide range of quality, hence also price. Even though

In sum, for certain classes of household durable assets, it appears that rental markets typically do not serve any useful function, hence do not exist at present and are unlikely to exist in the future. The main characteristic of these assets is their low unit cost relative to weekly or monthly income, which serves both to make the transaction costs of rental prohibitively expensive relative to the cost of outright purchase and to reduce the value of the liquid-asset conservation function of rental markets. However, even for those classes of household capital assets for which rental markets do not exist, it still remains true that households' asset accumulation acts as a deterrent to the growth of enterprise assets.

For classification purposes, it will be useful to distinguish two categories of household assets. The first category consists of the major durables, and includes automobiles, furniture, household appliances, and the entertainment complex (mainly television sets, high-fidelity equipment, radios, and pianos). Assets in this group are generally characterized by relatively high unit cost, the existence of direct rental markets for the item itself, a high ratio of credit purchases to total purchases, and relatively long service lives. These are also the types of assets for which household investment is most clearly a substitute for enterprise investment: over recent decades, household investments have risen dramatically as competitive enterprise investments—in railroad facilities, commercial laundries, movie theaters, ice plants, etc.—have either stagnated or declined.

The second category of household capital assets consists of minor durables: semi-durable home furnishings, tableware, glassware, books, toys, sporting equipment, automobile accessories, and so forth. These products are generally characterized by relatively low unit cost, lack of direct rental markets, infrequent purchase on credit, and relatively short service lives. While household investment in these types of assets competes with enterprise investment, the competition is entirely vis-à-vis enterprises that produce more or less equivalent services, and in many cases the competition is with *potential* enterprises that could provide the equivalent service but which are and have always been uneconomic, e.g., the rental industry for everyday clothes.

a suit of new clothes can cost as much as several hundred dollars, it is possible to buy new clothes for \$30 or \$40, to say nothing of the going market price for used clothing. Similarly, a set of dishes may cost anywhere from five to several thousand dollars. As a consequence, even households with very low incomes are able to acquire these assets outright, and purchase of a serviceable asset never requires a heavy drain either on liquid assets or on future income.

Empirical Estimates. The basic data are derived mainly from two studies by Raymond W. Goldsmith and a third by Goldsmith, Lipsey, and Mendelson.²¹ These data have been revised where necessary and updated to 1962, so that the series covers the entire period from 1897 to 1962. The sector definitions are intended to distinguish enterprise from household or government capital formation. The basic data do not quite do this, but they come close enough to ensure that the main outlines of the movements are correct.

As noted earlier, for example, expenditures on structures by households are not quite accurately represented by a series which consists of estimated expenditures on new single-family housing by nonfarm families plus additions and alterations on nonfarm single-family housing. Households do purchase multidwelling units and occupy one of the units themselves; on the other hand, business enterprises (i.e., individuals or firms that rent housing to others) sometimes build single-family dwellings for rental purposes. In principle, the owner-occupied share of multi-family dwelling units should be included in household capital formation, though single-family units built as investment and rented should not.²² Similarly, multidwelling units that are cooperatively owned should generally be viewed as owner-occupied rather than rental structures, depending to some extent on the particulars of the ownership arrangement. This category, while small, probably has had a rapid rate of growth in recent years. Finally, expenditures by farm households on the construction of new dwelling units belong in the household sector. As discussed, neither the direction nor the extent of the resulting bias is clear.

Similarly, the series on outlays for major consumer durables, while conceptually appropriate, may be overstated during the period prior to 1929. The consumer-nonconsumer allocation for the period 1897-1929 is based on data for 1929, 1935, and 1939.²³ Since the share of owner-

²¹ Goldsmith, *Study of Saving and National Wealth*; and Goldsmith, Robert E. Lipsey, and Morris Mendelson, *Studies in the National Balance Sheet of the United States*, Princeton for NBER, 1963, 2 vols., 1963.

²² Note that the distinction has to do with the use to which newly constructed housing is put. Actually, the relevant household series is net expenditures on owner-occupied housing rather than expenditures on newly built owner-occupied housing. The net series would generally be smaller than the other because some of the housing stock originally built as owner-occupied is always in the process of being converted to rental housing. Some transfers doubtless go in the opposite direction, as during the decade 1940-50, but the evidence suggests that the dominant trend of used asset transfers runs from the household to the enterprise sector.

²³ See Goldsmith, *Study of Savings*, Vol. 1, Table Q11.

occupied housing in the stock of residential structures appears to have been somewhat lower in the early part of the century than during the 1930's, it is possible that purchases by households constituted a smaller share of total expenditures on consumer durables at that time (when furniture was by far the most important item) than during the base period. Any bias here is unlikely to be serious, since enterprise purchases of the durables defined above as major household capital assets appear to have been quite small.

The data on gross fixed capital formation are shown in the Appendix, Tables A-1 and A-2. The basic series consist of expenditures by households on major durables (H_d), on minor durables (H'_d)—referred to as "other" durables in Tables A-1 and A-2—and on single-family housing (H_s), expenditures by enterprises on equipment (E_d) and on structures (E_s), and governmental expenditures on nonmilitary structures (G_s). Taken together, these series comprise most of the important components of gross capital formation in tangible assets, the latter being broadly defined to include all tangible assets that yield actual or imputed net income.²⁴

Before reviewing the evidence, a brief comment is in order on two conceptual questions. First, should gross investment or net investment data be used to measure trends in capital formation; second, should these trends be measured in current or in constant prices?

There can be no argument with the proposition that net investment is a more useful measure than gross investment for analysis of secular trends in capital formation. The problem is empirical, not conceptual. Gross investment can be measured by simply adding up annual outlays for capital goods, and the only conceptual problem is to define capital goods. Net investment measures require accurate estimates of depreciation for a wide variety of items; an accurate measure of depreciation in turn requires accurate estimates of both service life and the annual decline in economic value during each year of service life.²⁵ Reliable

²⁴ One possibly important exception is household investment in clothing; I exclude this series because clothing is unlikely to constitute a significant element in net capital formation even though it bulks quite large in gross capital formation.

²⁵ Growth rates for both gross and net *stocks* of fixed capital in the business sector have been estimated on the basis of a variety of assumptions concerning service life, price deflators, and time path of depreciation (see George Jaszi, Robert C. Wasson, and Lawrence Grose, "Expansion of Fixed Business Capital in the United States," *Survey of Current Business*, November 1962).

Gross stocks are defined as the undepreciated value of gross investments that have at least some remaining service life. The data indicate that there is no simple

estimates of either service life or the pattern of decline in economic value do not exist, and, even in principal, precise estimates of depreciation can only be obtained after a capital asset has been junked. Furthermore, there is only scattered evidence with which to estimate either changes over time in service life or in the time pattern of depreciation, and investigators are usually reduced to the assumption that both are constant.

The choice, then, lies in using either conceptually inappropriate series that can be easily and reliably estimated or conceptually appropriate ones whose empirical foundations are questionable. Given the problem to be investigated in this study, the decision was made to rely on the former and provide an occasional link to the latter.

As regards correction for price changes, both deflated and undeflated series have generally been presented. The focus of this part of the study is on trends in the capital formation-GNP ratio. This ratio in current prices reflects the proportionate share of total resource inputs going to capital formation: if the ratio falls, the society must be devoting relatively less of its total *input* to satisfying future needs and relatively more to

relation between the annual growth rate of gross stocks and that of net stocks, although it is rare to find substantial differences between the two. The following tabulation (business fixed capital, 1954 prices) summarizes some of the alternative growth rate estimates: during the period covered by these estimates, 1929-61, GNP grew at a rate of 3 per cent per year in real terms.

	<i>Structures</i> ^a		<i>Equip- ment</i>	<i>Structures and Equipment</i>	
	<i>A</i>	<i>B</i>		<i>A</i>	<i>B</i>
	Gross stocks of capital				
Bulletin F service life	0.8	1.5	3.0	1.6	2.2
Bulletin F service life less 20%	0.4	1.3	2.9	1.3	2.0
Net stocks of capital					
Bulletin F service life, straight-line dep.	0.7	1.7	2.8	1.5	2.2
Bulletin F service life, double-declining-balance dep.	0.8	1.8	2.8	1.5	2.2
Bulletin F service life less 20%, straight-line dep.	0.8	1.9	2.7	1.5	2.2
Bulletin F service life less 20%, double-declining-balance dep.	0.8	1.9	2.7	1.4	2.2

^a The A estimate uses deflators for the construction industry; B assumes that the construction deflators are biased, and uses the GNP deflator to estimate volume in 1954 prices.

satisfying present ones. The ratio in constant prices reflects the proportionate share of total *output* (quantity) going to future and current uses: if this ratio falls, the society must be devoting relatively less of its total output to satisfying future needs and relatively more to satisfying present ones.

The current and constant price ratios will differ only insofar as price movements are different for capital goods and for consumption goods and services. According to the usual measures, the price trends differ markedly and the two ratios diverge. Trends in the current price ratio will measure any movement in the share of current input, and in social cost as reflected by foregone consumption, going to capital formation. Trends in the constant price ratio will reflect not only movements in proportionate input or cost but also any change in the efficiency with which input quantities are converted into output quantities. Thus if capital goods prices are rising relative to other prices, a greater quantity of real saving (input) will be required to produce a given quantity of real capital (output). And in that event a rising current price ratio will be required to maintain a steady constant price ratio, meaning simply that society must save an increasing share of its total income to maintain the same division between capital goods and consumption goods output in real terms.

Whether current or constant price ratios are appropriate thus depends on the problem to be investigated. For example, suppose the question concerns unemployment: To what degree are the resources released by a relative decline in the output of one sector absorbed by a relative increase in the output of another sector? To answer this question the relevant flows should be measured in current, not constant, prices. It makes no difference (for this question) whether resources are released by a decline in relative output quantities, relative productivity unchanged, or by an increase in relative productivity, relative output quantity unchanged. Similarly, it makes no difference whether resources are absorbed by an increase in relative quantity with relative productivity unchanged or by a decline in relative productivity with relative quantity unchanged.

In addition, for problems where the constant price ratio is the conceptually correct one, a further empirical difficulty arises. The accuracy of a constant price measurement depends largely on the accuracy of

the price index used for deflation. If, as is often argued (see below, pp. 37-45), capital goods price indexes are more seriously biased than other price indexes, ratios of capital formation to GNP in constant prices will necessarily be biased in the opposite direction. For example, if it were assumed that true (unbiased) price indexes all tend to move roughly together over long periods of time, it would follow that movements in the ratio of capital formation to GNP (constant prices) are more accurately pictured by measurement in current prices than by measurement in allegedly constant prices. Given the direction and extent of the possible bias, it is a moot question whether current or constant price ratios provide a more accurate measure of the true constant price movements.

Interpretation of the Evidence. A strikingly different picture of long-term trends emerges when gross capital formation is broadly rather than narrowly defined, as can be seen from Charts 1-4. Charts 1 and 2 show outlays in current and 1929 prices, respectively, for the categories of tangible capital assets discussed above and for gross national product. Both household sectors, as well as the government sector, show more rapid growth than does GNP and much more rapid growth than their counterparts in the enterprise sector. The fastest rate of increase is for major household durables, the least rapid for enterprise structures. The relative rates of increase are about the same in both current and constant prices, although absolute growth rates are markedly lower for the constant price data.

Charts 3 and 4 show ratios of gross capital formation in tangible assets to gross national product for alternative definitions of the former. Confined to assets of business enterprises, the ratio shows a pronounced secular decline when expressed in current prices; the decline is even more pronounced for the constant-price data. Counting household investment in structures as part of capital formation (which conforms to the standard definition of investment), the ratio does not decline quite so rapidly, although the decline is still quite marked, especially for the constant-price data. But when major consumer durable outlays and government civilian construction are treated as part of gross capital formation, the ratio of capital formation to GNP shows practically no trend in constant prices and, if anything, an upward trend in current prices. Adding in consumer outlays on other durables makes little difference to the trends, and these data are not shown.

Examination of the movement in component parts is illuminating. Charts 5 and 6 contain estimates for equipment, structures, and the sum of both components in the enterprise sector, Charts 7 and 8 show similar estimates for the household sector, and Charts 9 and 10 show estimates of gross investment in tangible assets by the three major types of users—enterprises, households, and government. The disparities in long-term trends are striking, even granting that some of the data constitute very rough approximations. As a ratio to GNP, gross capital formation in the enterprise sector shows a persistent secular decline, moderately so in current prices and strongly so in constant prices.²⁶ The decline is due mainly to the fact that enterprise investment in new structures shows a very marked decline; enterprise investment in equipment shows no secular trend in current prices and a modest rate of decline in constant prices. In contrast, capital formation in both structures²⁷ and equipment for the household sector has a strong upward trend relative to GNP, although the upward trend in equipment is very steep in the early part of the century (probably because of the rapid buildup in automobile purchases) and appears to have leveled off in recent years. And public

²⁶ The disparity would apparently be even stronger for net investment trends in at least one important area. Based on Goldsmith's estimates (*Study of Savings*, Tables Q6, Q8, P6, and P8, and *National Wealth*, Tables B19, B21, B111, and B113), the ratio of net to gross investment appears to have risen secularly for household durables but declined for enterprise durables. For the decades 1900–1909, 1920–29, and 1949–58, the ratios of net to gross investment in durables for the two sectors are as follows:

	1900–1909	1920–29	1949–58
Household durables	.271	.292	.329
Enterprise durables	.391	.184	.320

It seems probable that the net-to-gross investment ratios for structures have also behaved similarly; that is, that the relative growth of net investment in the household and enterprise sectors has been even more disparate than that of gross investment. The net-to-gross investment ratio is influenced by the growth rate of gross investment itself, being higher when the growth rate is higher, as well as by changes in average service life, in the time distribution of depreciation, etc. Gross investment in household structures has grown at a much more rapid pace than gross investment in enterprise structures; hence the disparity in net investment growth rates should be in the same direction but even more so unless it has been offset by other differences in the two categories.

²⁷ The long-term upward trend in household construction is actually even stronger than shown here. Recent revisions of the data indicate that single-family house construction had been underestimated by a considerable amount for the period after World War II. (See *Construction Volume and Cost, 1915–1964*, a supplement to *Construction Review*.) The estimates of single-family house construction in this report are thus too low during the post-World War II period by amounts that range as high as 30 per cent for some years.

investment in structures shows a strong upward trend relative to GNP, although it appears to have leveled off by 1930.

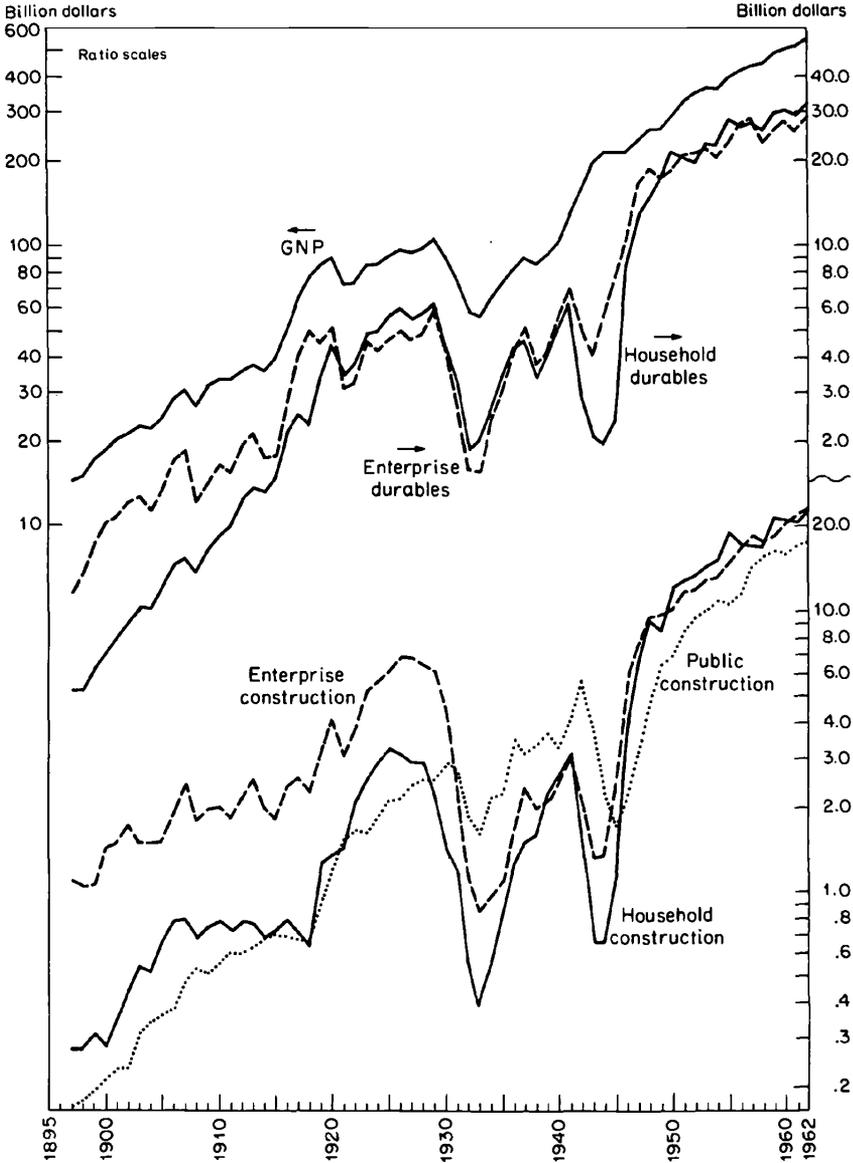
The above data, although subject to serious deficiencies, provide an interesting and I think essentially accurate insight into the changing forms of saving and capital formation in the economy of the United States during this century. If capital formation and saving are defined to include only "productive" investments in tangible assets by business enterprises, total savings (gross) have been declining sharply as a fraction of total output; the decline would be even sharper in net savings because depreciation has been an increasing fraction of gross capital formation and gross savings. But either this definition or the traditional one (which includes household investment in structures as part of capital formation), however appropriate during the early part of this period, seems clearly inappropriate during recent decades.

There is, after all, no particular reason to suppose that the most productive forms of investment will always consist of tangible capital assets by business enterprises, nor even that it will consist of tangible assets at all. Within the enterprise sector itself, there is evidence of a marked shift away from structures toward equipment. For the economy as a whole, tangible capital formation in the public and household sectors seems to have become relatively more important, and tangible capital formation in the enterprise sector relatively less so. The data suggest, therefore, not that the fraction of output devoted to gross capital formation in tangible assets has been declining somewhat, and to net investment and saving declining markedly, but that the fraction of output going to gross capital formation has been either steady or increasing; the corresponding net figures would probably continue to show some tendency toward secular decline.²⁸

²⁸ Kuznets' view in *Capital in the American Economy* that capital formation has shown a secular decline relative to GNP is based largely on analysis of net capital formation in constant prices, and on a definition of capital formation that excludes consumer durables; Kuznets' definition of capital does include government structures and, in some variants, military hardware. Further, his data cover several decades prior to 1900, and his estimates indicate that, relative to GNP, capital formation during the latter part of the nineteenth century was somewhat higher than during the first part of the twentieth century. Hence Kuznets' judgment that a secular decline in the capital formation-GNP ratio has taken place is influenced not only by his exclusion of consumer durables from the concept of capital formation but also by the lengthier time span that he covers, which includes several decades prior to the period covered in this study, and by the fact that his measurements are in constant prices.

CHART 1

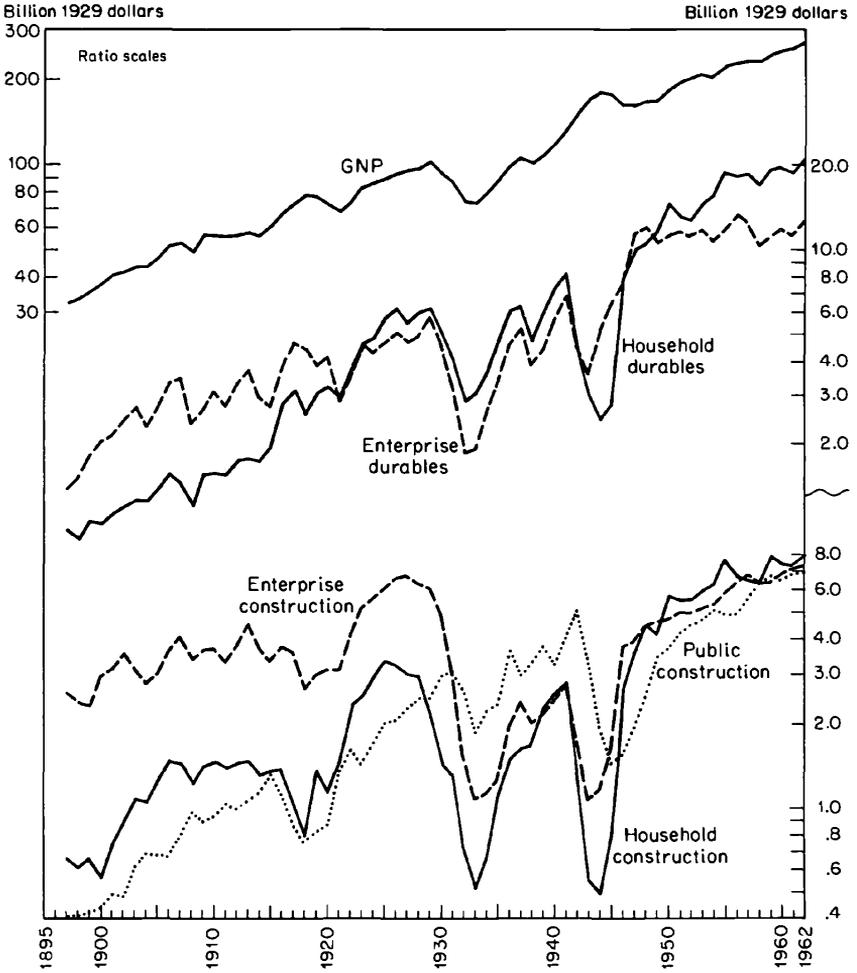
GNP AND SELECTED COMPONENTS OF GROSS FIXED CAPITAL FORMATION, IN CURRENT PRICES, 1897-1962



Source: Table A-1.

CHART 2

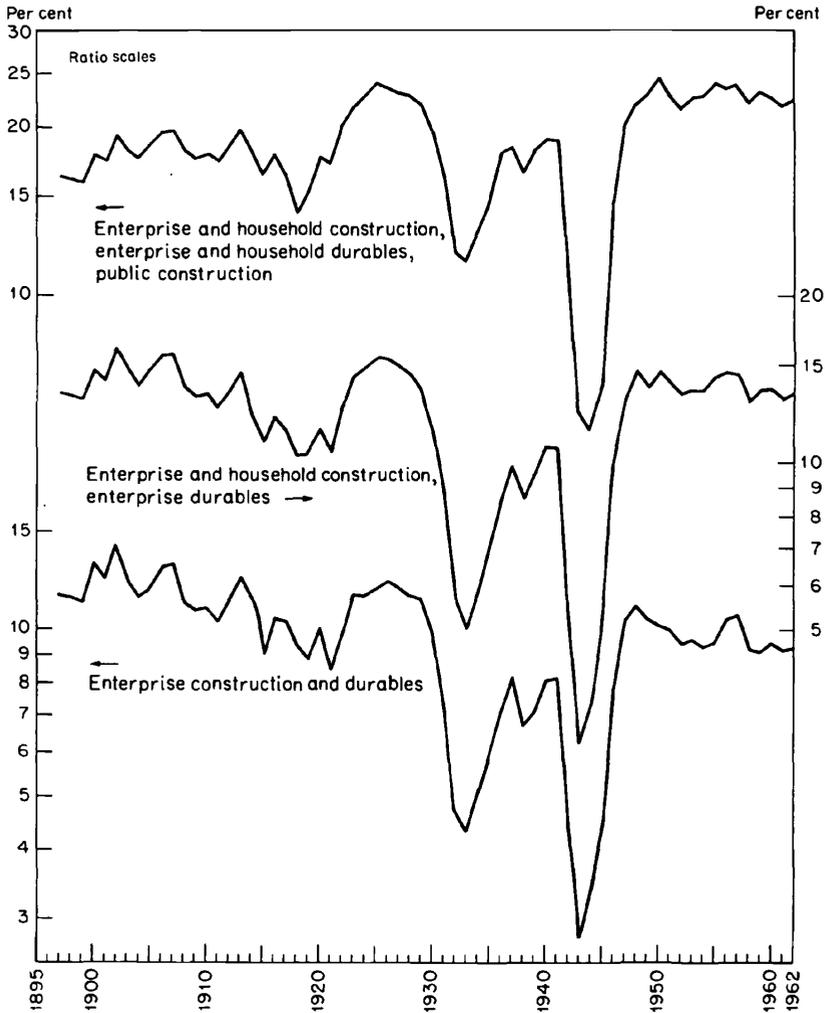
GNP AND SELECTED COMPONENTS OF GROSS FIXED CAPITAL FORMATION, IN 1929 PRICES, 1897-1962



Source: Table A-2.

CHART 3

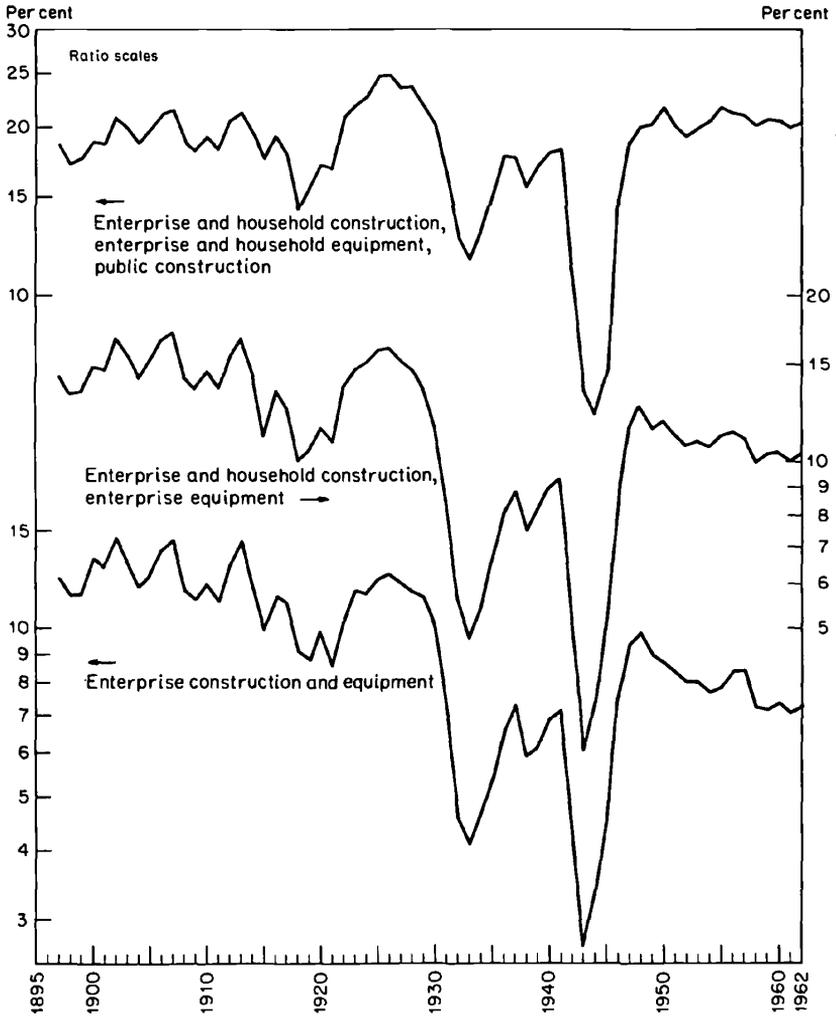
RATIOS OF GROSS FIXED CAPITAL FORMATION TO GNP, IN CURRENT PRICES, 1897-1962, ALTERNATIVE DEFINITIONS OF CAPITAL FORMATION



Source: Based on Table A-1.

CHART 4

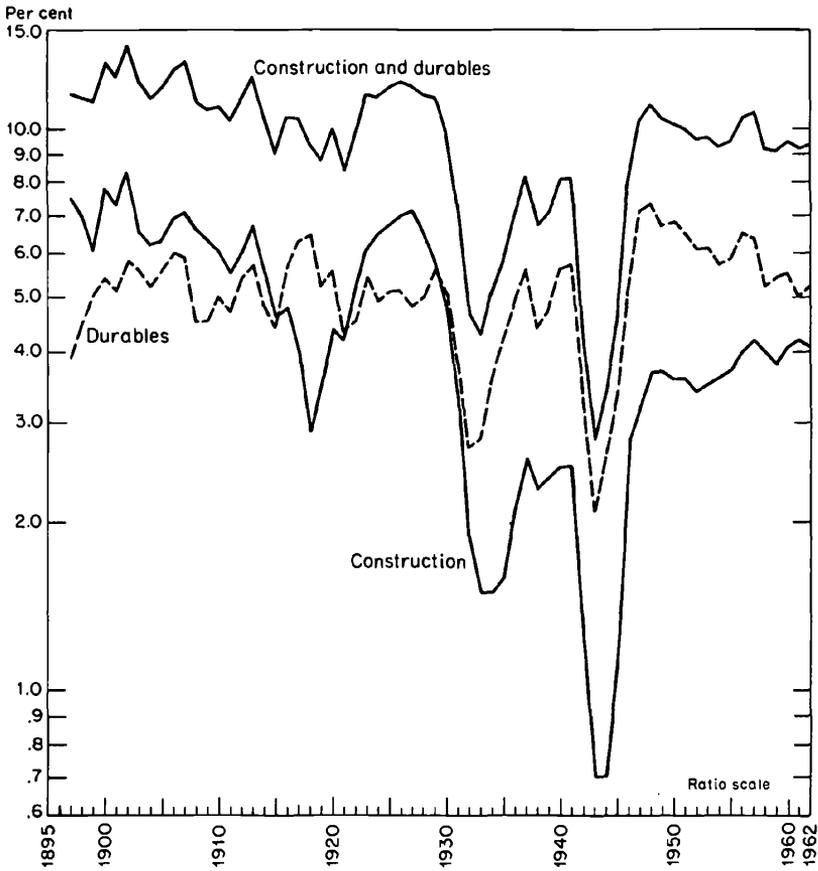
RATIOS OF GROSS FIXED CAPITAL FORMATION TO GNP, IN
1929 PRICES, 1897-1962, ALTERNATIVE DEFINITIONS
OF CAPITAL FORMATION



Source: Based on Table A-2.

CHART 5

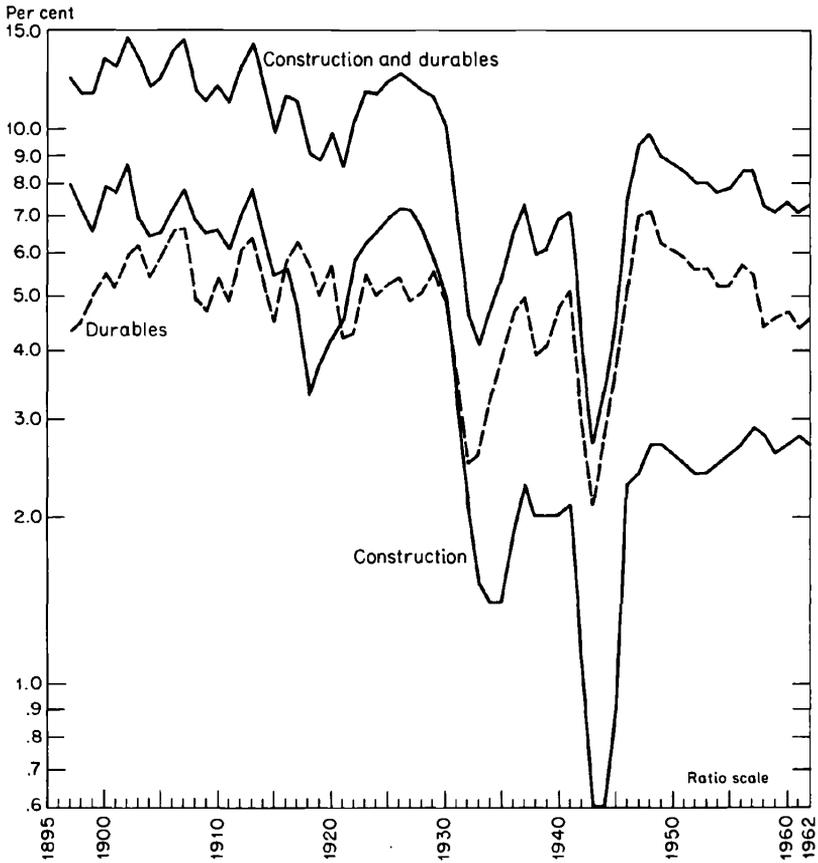
GROSS FIXED CAPITAL FORMATION IN THE BUSINESS ENTERPRISE SECTOR AND ITS MAJOR COMPONENTS AS RATIOS TO GNP, IN CURRENT PRICES, 1897-1962



Source: Based on Table A-1.

CHART 6

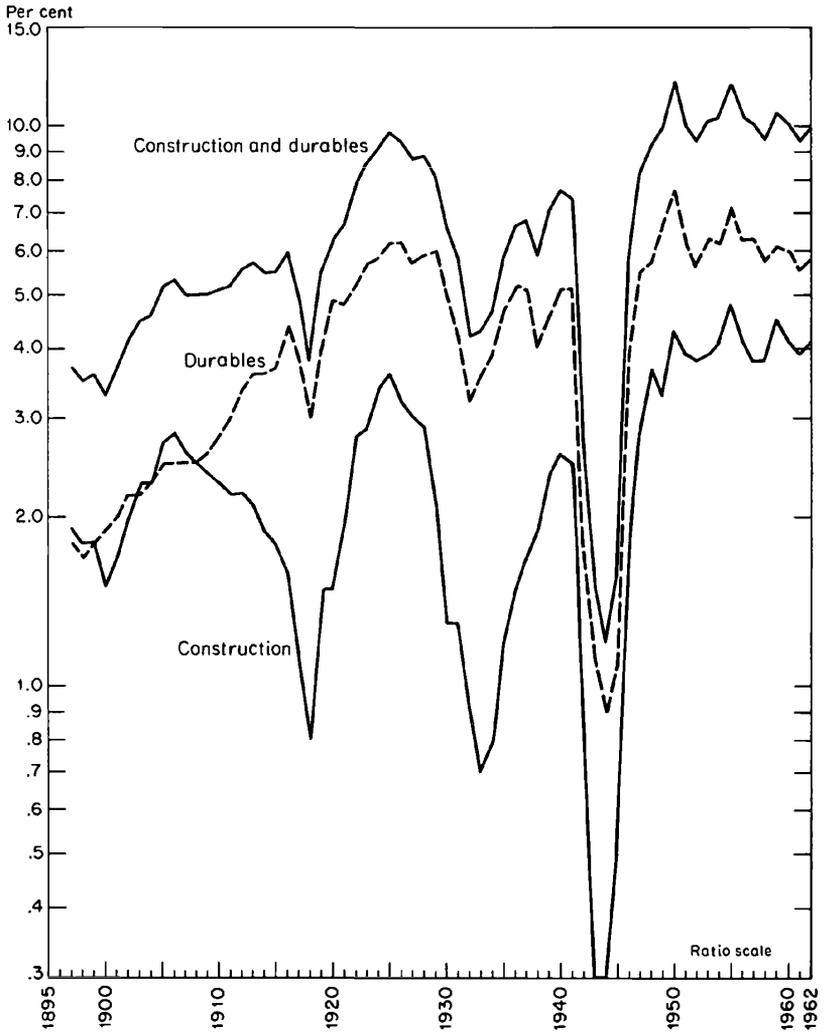
GROSS FIXED CAPITAL FORMATION IN THE BUSINESS ENTERPRISE SECTOR AND ITS MAJOR COMPONENTS AS RATIOS TO GNP, IN 1929 PRICES, 1897-1962



Source: Based on Table A-2.

CHART 7

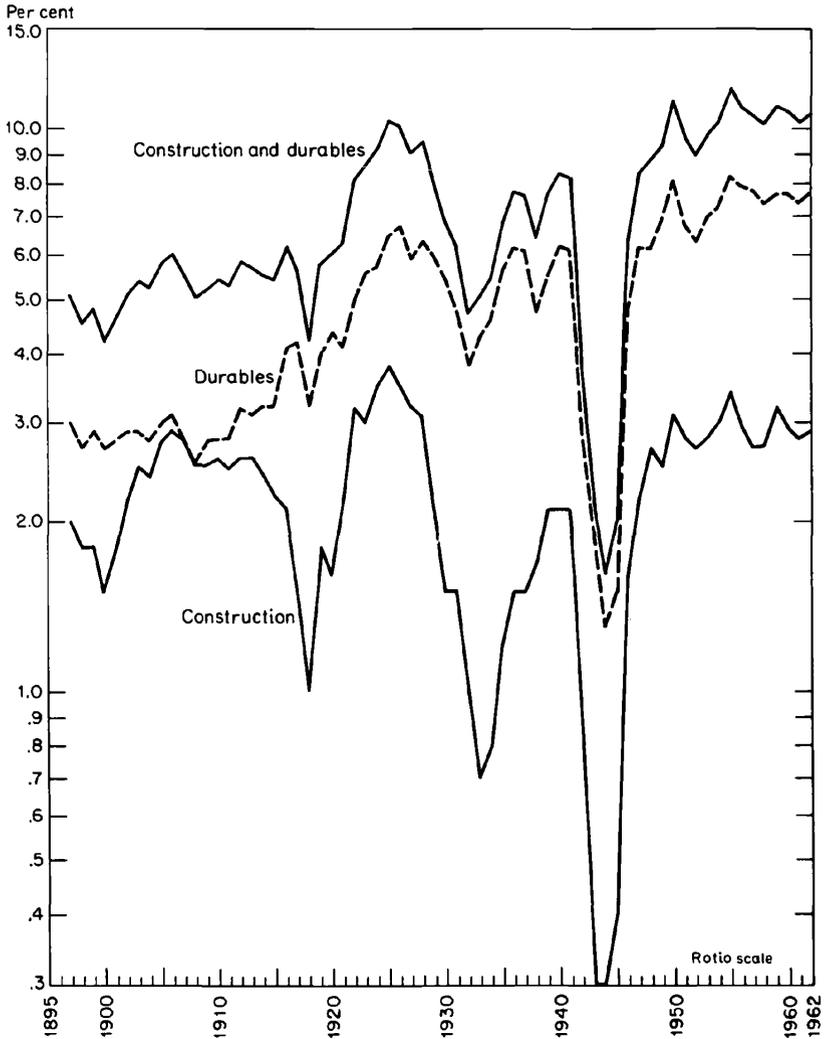
GROSS FIXED CAPITAL FORMATION IN THE HOUSEHOLD SECTOR
AND ITS MAJOR COMPONENTS AS RATIOS TO GNP, IN
CURRENT PRICES, 1897-1962



Source: Based on Table A-1.

CHART 8

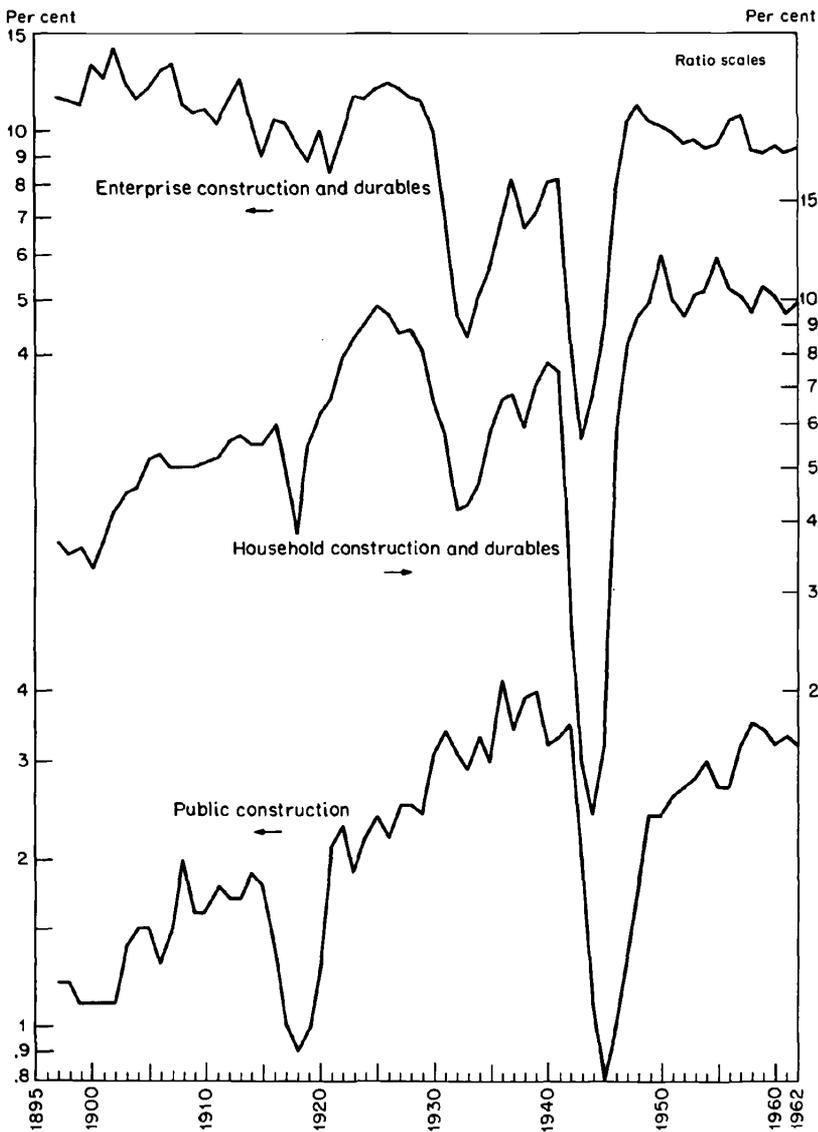
GROSS FIXED CAPITAL FORMATION IN THE HOUSEHOLD SECTOR
AND ITS MAJOR COMPONENTS AS RATIOS TO GNP, IN
1929 PRICES, 1897-1962



Source: Based on Table A-2.

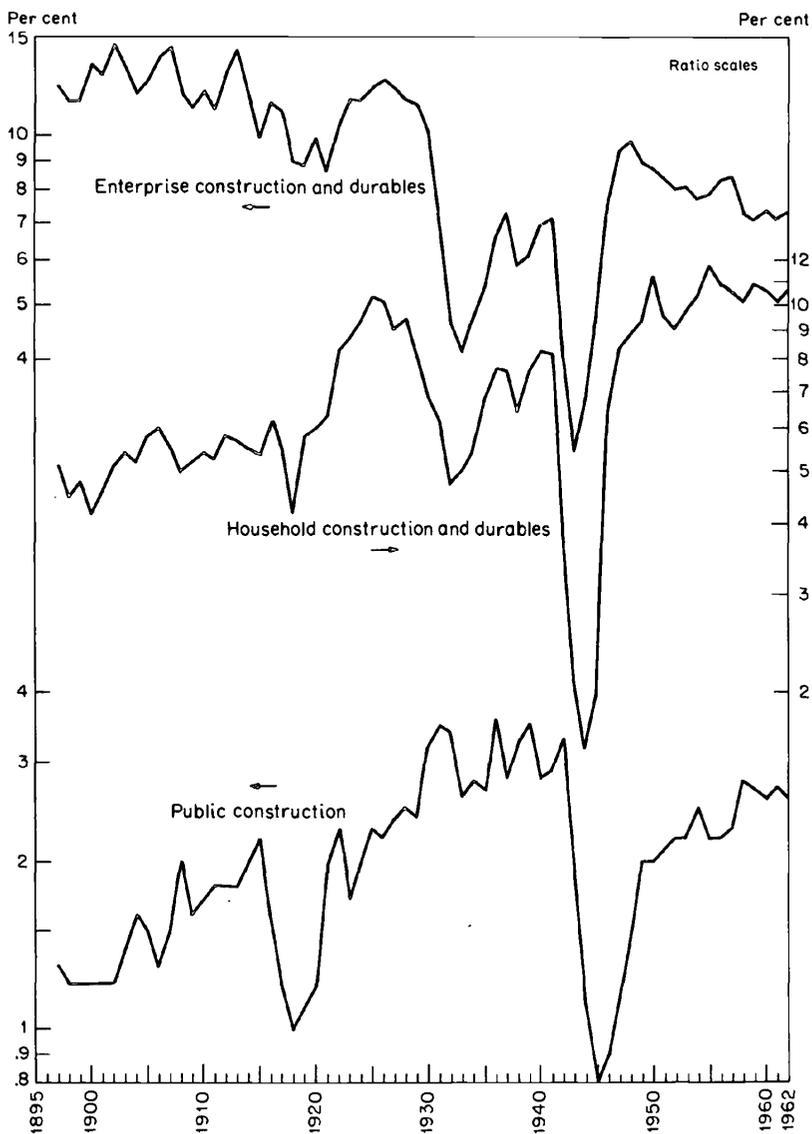
CHART 9

MAJOR COMPONENTS OF GROSS FIXED CAPITAL FORMATION
AS RATIOS TO GNP, IN CURRENT PRICES, 1897-1962



Source: Based on Table A-1.

CHART 10

MAJOR COMPONENTS OF GROSS FIXED CAPITAL FORMATION
AS RATIOS TO GNP, IN 1929 PRICES, 1897-1962

Source: Based on Table A-2.

Bias in Estimates of Real Volume. The view that the rate of capital formation in tangible assets may not have been declining at all in the United States during this century is not only supported by the above findings but is also suggested by the probable bias in the price indexes used to convert the series into constant dollars.²⁹ It has frequently been argued that quality changes in both structures and equipment are not adequately reflected by the price deflators, and that part of the apparent rise in prices of capital goods really represents an improvement in quality. If the price indexes of capital goods in general tend to show too large an increase relative to price indexes for other goods and services, the trend of the gross capital formation-GNP ratio will have a downward bias when expressed in constant prices.

Construction Price Indexes. Construction price indexes are viewed with suspicion by almost every serious student of price behavior. The dominant attitude toward the reliability of these indexes is illustrated by the following series of quotations from *Government Price Statistics*, a comprehensive study of a variety of price indexes by a task force of economists headed by George J. Stigler.³⁰

The Department of Commerce "composite" construction cost index . . . is the closest substitute for a comprehensive construction price index now available. It is a very distant substitute, being defective in almost every possible way. This is the inevitable result of the fact that the skimpiest of resources have been devoted to it. It depends entirely on secondary sources . . . and these are more than ordinarily defective. . . .

The gravest deficiency of the index originates in the character of the individual cost indexes used for deflation. . . . For the most part they are . . . indexes of wage rates and building material prices weighted together in accordance with their importance in the cost of a unit of construction. . . . Over any considerable period of time this [procedure] tends to impart a strong upward bias. . . . The only reason for any doubt that such an upward bias exists . . . arises from the many other deficiencies of the component indexes which impart other biases of unknown direction.

²⁹ The price indexes used for deflation are from Goldsmith's *Study of Saving or National Wealth*, or from the basic sources used in these studies. The indexes in these studies are in turn based on a variety of sources.

The price index problem was an important one in both these studies, and the alternative indexes were carefully reviewed and evaluated. There is every reason to suppose that the indexes selected for use represent the best ones available for the purpose. Whether the indexes are accurate is an entirely different question, since the "best available" may be quite unsatisfactory.

³⁰ Price Statistics Review Committee, *The Price Statistics of the Federal Government*, New York, NBER, 1961, Appendix B, pp. 87-88.

These other deficiencies are extremely serious. We merely list what seem to be the more important ones. (1) Most of these indexes are compiled . . . as a byproduct. . . . (2) The indexes are not prepared in order to provide appropriate coverage for the categories of construction they are used to deflate. . . . (3) The bill of materials . . . is usually incomplete, and in some cases grossly so. (4) Weights by which various indexes of wage rates and materials are combined are usually based on periods in the remarkably remote past, and their accuracy even for the period to which they relate is dubious. (5) . . . The wage rates and prices . . . do not represent actual transaction prices. . . . (6) The geographic coverage and weighting . . . are rarely suitable and comprehensive. (7) The timing of the cost indexes is not . . . appropriate for deflation of the construction activity estimates, which represent an allocation over time of contracts or other valuations established at an earlier date.

For the most part, the objections to the available cost indexes are methodological: cost indexes assume no or an arbitrary (usually small) change in productivity per man-hour, and they make no allowance for the shifting of material inputs so as to reduce costs as the prices of particular materials rise. These methodological deficiencies suggest that cost indexes typically overestimate the actual rise in construction prices. In addition, there is empirical evidence that some construction prices, especially for heavy-engineering projects, have not risen as much as the cost indexes suggest, although there is a vigorous disagreement about the existence of any real bias in the index for residential house construction.⁸¹

Heavy-Engineering Construction. Perhaps the most convincing evidence that construction cost indexes seriously overstate the rise in construction prices is the behavior of those few indexes which purport in principle to measure price changes in a standard type of construction output. One such index, compiled by the Bureau of Public Roads, is the so-called composite mile construction price index. This is designed to measure the price at which a specified composition of highway can be built, and is based on the actual prices included in competitive bids. Somewhat similar data are compiled by the Interstate Commerce Commission for the construction of railway lines, telephone and telegraph lines, and pipelines.

There are marked differences in trends when these output price indexes are contrasted with the cost indexes. The Department of

⁸¹ See R. A. Gordon, "Differential Changes in the Prices of Consumers and Capital Goods," *American Economic Review*, December 1961.

Commerce composite construction cost index, and all three of the Boeckh construction cost indexes (for residential housing, apartments, hotels and office buildings, and commercial factory construction), rose roughly fivefold between 1915 and 1956.³² Over this same time span, the *Engineering News Record* construction cost indexes (which are completely unadjusted for productivity increases) rose even more. But the indexes compiled by the Bureau of Public Roads and the ICC rose by much smaller amounts; the BPR index went up only two and a half times, while the ICC indexes went up about three and a half times. Thus if the BPR and the ICC indexes are correct, the real volume of heavy-engineering construction has increased much more rapidly than the cost indexes would indicate.

House Construction. Taken at face value, the cost indexes suggest that the real volume of single-family house construction during the 1950's was only a bit more than twice as great as it was during the 1920's. Comparing the same two periods, the level of single-family housing starts roughly tripled, suggesting that the average house built during the 1950's represents considerably less real capital investment than the average house built during the 1920's.

Independent evidence on the trend in capital investment per house is conflicting. On average, houses contain somewhat fewer rooms and have less square feet of floor space than they used to; the apparent reasons are the downward trend in family size and the tendency for the family unit to consist of only two generations (parents and children) rather than three (grandparents, parents, and children). On the other hand, part of the reduction in space per house may be spurious: central heating has eliminated the necessity for a heating unit in each room (in recent years even radiators have disappeared into the wall), better insulation and improved design enable the central heating unit to be put into a much smaller space, and washers and dryers put into an alcove have replaced laundry tubs and wash lines in cellars.

Moreover, there are some obvious respects in which the quality of housing has gone up (proportion with indoor toilets, with hot water, with more than one bath, with garage) and no clear-cut evidence of any respect in which it has gone down. There is of course disagreement about

³² The data are from *Construction Volume and Cost, 1915-1956*, a supplement to *Construction Review*. The Commerce composite index and the Boeckh indexes all behave in much the same way because they all use the same ingredients: the only differences are in the relative weights attached to component indexes.

the trend in other aspects of housing quality. There are those who argue that plaster walls, thick beams, and cellars have been replaced by inferior dry-wall construction, thin beams, and the minimum foundation required by law. But the fact that plaster walls are much more expensive is no guarantee that they are better in any meaningful economic sense. The fact that construction techniques have moved toward less use of costly materials is equally no guarantee that longevity has been reduced or that economic usefulness has declined.

As a consequence, specialists in this area are far from agreement about the existence or extent of bias in the cost indexes for house construction.³³ Grebler, Blank, and Winnick argue that the long-term trend of construction prices is faithfully reflected by the Boeckh construction cost index for residential houses. In contrast, Margaret Reid argues that the construction cost index seriously overestimates the rise in housing prices. Grebler, Blank, and Winnick based their judgment largely on comparison of the Boeckh index with what they call a house price index; the two show very similar trends. But the house price index is calculated from a raw index of house prices compiled from owners' recollections of what they paid at the time of purchase relative to their judgments about the current market value of the property, adjusted by an estimate that the net effect of depreciation and additions would be accurately reflected by a $1\frac{3}{8}$ per cent per annum decline on remaining value. While each of the ingredients in this estimate seems reasonable enough, too much weight should not be placed on the behavior of the composite index.³⁴ Reid bases her judgment largely on the methodological defi-

³³ See Leo Grebler, David M. Blank, and Louis Winnick, *Capital Formation in Residential Real Estate*, Princeton for NBER, 1956, and Margaret Reid, "Capital Formation in Residential Real Estate" (review article), *Journal of Political Economy*, April 1958; also, Grebler, Blank, and Winnick, "Once More, Capital Formation in Residential Real Estate," *Journal of Political Economy*, December 1959, with reply by Reid.

³⁴ It should be noted that a reliable index of house prices is a very difficult series to construct. House prices are presumably determined by characteristics such as location, size, durability, aesthetic appeal, and so on. Over time, houses undergo changes in value for at least two opposite reasons. On the one hand, they depreciate both because expected service life diminishes and because of obsolescence. On the other hand, they tend to appreciate (especially if land development is viewed as part of structure value) because owners add improvements or over-maintain. In addition, land values change with the characteristics of neighborhoods as well as with changes in demand, and it is often difficult to disentangle the structure and land development values from pure land values. Thus simply to compare the price at which a specified property sold in 1950 with the price at which the same property sold in 1960 may not tell anything at all about what has

ciencies of the cost index, plus the fact that several implications of the index—that housing quality has gone down on average, and that the demand for housing is relatively inelastic with respect to income—seemed to her inconsistent with independent evidence.

On the whole, the evidence suggests that the cost indexes for heavy-engineering construction (commercial building, highways, etc.) seriously overestimate the extent of the real price rise in such activities. On a qualitative level, it is known that these activities use more and better equipment than they formerly did, and that a considerable change has taken place in technique. On the quantitative level, indexes which purport to use a standardized output as a basis for measuring price changes (the BPR and ICC indexes) show much smaller increases than do the construction cost (input) indexes.

It is not so clear that house construction prices have also risen much less than the construction cost indexes suggest. There is some evidence which goes in this direction (the quality of housing has clearly improved in at least some measurable respects, while the cost indexes imply that quality has declined substantially), but the evidence is conflicting and difficult to assess. In addition, there has been a good deal of change in the bill of material for house construction, presumably involving substitution of cheaper for more expensive material. Modern houses probably make more efficient use of a given amount of space than do older

happened to house prices. The neighborhood may have improved or deteriorated, the owner may have added on more than depreciation took away, and so forth.

A house may normally go through a number of phases with respect to its market value during a period when the true "house price" index remains absolutely stable. When a house is first built, it is likely to have a lower value than when it is five years old. In value of house, the value of improvement in the land should be included; it is a rare new homeowner who can get by with no improvements in the form of shrubbery, grass, fencing, sewerage, sidewalks, and so forth, to say nothing of the improvement due to the fact that most of the inevitable bugs (leaks, etc.) have been eliminated when the house is five years old. Thus it might be anticipated that the typical brand-new house appreciates in value for some period of time because the owner usually cannot avoid making net investment in the house and property. In addition, there is a continuous flow of improvement made in many if not most houses, especially after a new owner has moved in: attics or cellars are finished off; patios are added; kitchens are modernized or remodeled; permanent storm windows are attached; rooms are paneled. There is, of course, no guarantee that the owner of any given house will make net investments which exceed the rate at which the house depreciates, and it would be very difficult to determine whether there has been net investment or net disinvestment in any given property over any extended period of time. Because it is extremely difficult to concoct a good house price index from the kind of data available, the best expedient is likely to be some kind of input price adjusted for changes in the specifications of materials, wage rates, and productivity.

houses, and technological improvements have not been entirely lacking (prefabrication, smaller but more efficient heating units, better installation). On the other hand, the prices of construction materials have risen more than other raw-materials prices, union restrictions have probably retarded technological progress to a greater extent in house construction than in other industries, and construction wage rates have risen more rapidly than other wage rates. On balance, there is probably some upward bias in the cost index for residential housing, although probably not as much as in the cost indexes for other types of construction.

Some of the changes in house construction during recent decades are doubtless a consequence of changes in the taste of house buyers—for compactness, avoidance of multilevels, etc. To the extent that changes in taste, reflecting, for example, family composition or desired types of living arrangement, are responsible, the problem is insoluble: families in the 1920's would prefer a 1920's type of house to a 1950's type, while families living in the 1950's would prefer their house to the typical 1920 house.

Equipment Price Indexes. Just as was true with respect to the construction cost indexes, there is broad agreement among economists that price indexes for industrial equipment overestimate the extent of the real price rise.³⁵ The basic reason is that adjustment of the standard price indexes to account for quality change in equipment is either nonexistent or inadequate. Again, this is difficult to document: if it could easily be documented the standard price indexes would not be used and better ones would have been constructed. It is known, however, that the procedures used to adjust equipment price indexes for quality change consist in pricing discrete (clearly identifiable) improvements in quality or in equating the degree of quality change with the degree of cost change, not in pricing the effectiveness with which a particular piece of equipment is able to accomplish a specified task.³⁶ Clearly, a machine capable

³⁵ See *Price Statistics*, pp. 35–39.

³⁶ It is by no means agreed that an equipment price index should attempt to price effectiveness in performing specified tasks. Edward Denison, in "Theoretical Aspects of Quality Change, Capital Consumption, and Net Capital Formation," *Problems of Capital Formation*, Studies in Income and Wealth 19, Princeton for NBER, 1957, argues strongly that as a practical matter the incorporation of cost-increasing quality improvements is as far as index makers ought to go. Such an index provides the answer to a question which is both useful and interesting: What would it have cost, in the base period, to produce the actual stock of capital existing in the given period? That such an index may not provide the answer to another question—What would it have cost in the base period to produce a

of turning out 200 widgets per hour is twice as productive as one capable of turning out 100 widgets per hour, labor input constant. If the first machine costs less than twice as much as the second, the real price of machines has gone down; but the procedures customarily used to incorporate more efficient equipment into industrial-equipment price indexes would not generally show a decline.

I do not suggest that the problem of pricing productive equipment is easily solved. But it does seem to be the case that the procedures used to construct these indexes have a built-in tendency to overestimate the extent of price increase in any case where persistent technological change takes place.³⁷ Since the relevant industry sectors are characterized by persistent technological change, the bias in the equipment price indexes is probably sizable.

One interesting attempt to measure the extent of biases in equipment price indexes is Griliches' study of automobile prices.³⁸ The procedure consists of estimating the price that consumers were willing to

capital stock with the equivalent ability to contribute to production?—is a defect only in the sense that one index cannot provide an answer to all possible questions of interest. Thus, according to Denison, the fact that the real capital stock is "just being maintained intact," using a cost-based measure of quality change, does not mean that the productive ability of the capital stock is also "just being maintained intact." Since technical improvement is persistent, maintaining the capital stock intact will ordinarily result in an increase in its productive ability, other things equal.

It is interesting to note that the distinction between a cost-based measure of quality change and a productive-efficiency measure may account in some part for the difference between those who view technical change as being embodied in capital or labor inputs and those who view it as being disembodied—entirely dissociated from particular inputs. If all technical change was embodied in better-quality capital goods, but capital goods price indexes reflected only quality changes associated with higher costs, it would be impossible to tell the difference between a world where technical progress was truly of the disembodied kind from one where it was all embodied in capital goods. That is, the hypothesis that there is a disembodied rate of technical progress equal to x per cent per year is in certain circumstances empirically indistinguishable from the hypothesis that there is no disembodied technical progress at all but rather a y per cent per year quality improvement in capital goods not measured by cost-based estimates of quality change. See Dale Jorgenson, "The Embodiment Hypothesis," *Journal of Political Economy*, February 1966.

³⁷ The equipment price indexes are also likely to be deficient in measuring the cyclical sensitivity of price changes, but for different reasons. Most price indexes are based on list prices. Much of the price response to changing market conditions takes the form of changing discounts, changing premiums related to delivery dates, changing standards with respect to tie-in sales, etc., rather than changes in listed prices.

³⁸ Zvi Griliches, "Hedonic Price Indexes for Automobiles: An Econometric Analysis of Quality Change," *Price Statistics*, pp. 173–196.

pay for particular quality-associated characteristics of automobiles—weight, horsepower, presence or absence of automatic transmissions, and so on. The price weights were obtained by regressing the prices of various kinds of automobiles on the characteristics of each vehicle. By holding characteristics constant over time, Griliches could then estimate the extent to which prices in a given year were different from those in a previous year for a homogeneous product. To the extent that the regressions do in fact hold the relevant dimensions of quality constant, this procedure will provide an accurate measure of the true price change. Taking the results at face value, it appears that the standard (BLS, CPI) automobile price indexes badly overestimate the extent of the price rise in automobiles. Based on 1929 = 100, the standard auto price indexes show a figure for 1962 of just under 250. Griliches' data begin in 1937 rather than 1929, and extend up to 1960. From his figures it is possible to estimate the implied rate of quality improvement that is "not accounted for" by the standard price indexes. Assuming that there was no quality change not accounted for in the price index between 1929 and 1937, and extrapolating the trend in unaccounted quality change up to 1962, the result is obtained that, based on 1929 = 100, the "true" 1962 price index for automobiles was roughly 130. Thus instead of auto prices having more than doubled between 1929 and 1962, adjustments for quality change suggest that they may have risen by only about 30 per cent.³⁹

The accuracy of this quality adjustment depends entirely on the validity of the regression weights estimated from the cross sections. It is interesting to note, however, that the quality-adjusted auto price index shows a price increase that is not far from the increase shown by an index of household durables prices. The standard household durables price index was only a little higher in 1962 than in 1929, due mainly to the rapid rate of innovation and the introduction of new durables which tended to decline in price. If the household durables price index is correct, either the rate of technological innovation in automobiles has been much less than in household durables and appliances or else the

³⁹ This estimate should not be viewed as a lower limit to the true price rise. That is, these results do not suggest that prices "actually" rose by between 30 and 150 per cent, the lower limit being the quality-adjusted index and the upper limit the BLS or CPI index. The 30 per cent figure must stand on its own merits, and the true rise in prices may have been lower or higher than that, depending on the accuracy of the estimating procedure.

standard price index badly overestimates the extent of price rise because it underestimates the extent of quality change.⁴⁰

On the whole, the bulk of the evidence suggests that practically all of the capital-goods price indexes contain more or less serious upward biases, relative to other price indexes. The evidence is by no means conclusive; much of it consists of a general presumption that the procedures typically used in compiling price indexes fail to make adequate allowances for certain kinds of quality improvements, and a few concrete cases where this presumption seems to be borne out.⁴¹ If this view is correct, it follows that the growth rate of real gross capital formation in tangible assets is higher than the above figures would indicate, and hence that the ratio of gross capital formation to GNP has not declined as much as the figures suggest and may in fact even have increased. My own view is that the bias is probably sizable rather than small, but the present state of firmly tested knowledge in this area does not permit more than hunches and guesses.

⁴⁰ Gordon ("Differential Changes") remarks on the fact that the price index of industrial equipment seems to have risen much more rapidly than the price index of consumer durables over the period 1929-56, and infers that the industrial equipment price index may therefore be an overestimate of the true price rise. He notes that the price index of consumer durables changed between 1929 and 1956 by about the same amount as the price index of consumer goods generally, suggesting that there is therefore no reason to suppose that a serious bias exists in the consumer durables index. But he did not break down the consumer durables price index into its two major components—automobiles and other equipment. If this had been done, Gordon would have noted that the reason consumer durables prices rose only as much as other consumption goods in general was that the prices of household durable goods and appliances rose by only 20 per cent or so while auto prices more than doubled.

⁴¹ One clear implication of this discussion is that extensive empirical research to investigate the existence and extent of the bias in capital goods price indexes deserves a high priority. The most appealing research procedure seems to be the technique originated by Andrew Court and elaborated by Griliches and others—examination of cross-section price differences to measure the implicit prices attached to various quality or performance dimensions, and use of these weights to estimate the prices at which a homogeneous quality or performance product would have been sold.

A large amount of the necessary data probably exists—mainly in the records of the producing companies. Some of the necessary data can be obtained from public sources; for example, value estimates have been obtained in recent censuses for a large number of houses, and the same data obtained a substantial number of the quality characteristics associated with housing values—number of rooms, floor space, type of construction, number of baths, etc.

INVESTMENT IN INTANGIBLES

As noted earlier, the appropriate concept of capital formation depends on the uses for which the measurement is sought. For analysis of cyclical changes, it is reasonable to restrict the concept to tangible assets whose rate of acquisition depends on movements in income, sales, profits, and so forth, as well as on the existing stock of assets. But for analysis of long-term trends such a restriction may be misleading.

Quite a wide range of economic services can usefully be regarded, either in whole or in part, as involving the formation of capital. The most important of these relate to investment in people, that is, to the formation of human capital. Increases in human skills, increases in the stock of knowledge, or increases in productive working lives through either increased longevity or reduction in illness are economically productive activities with an effect on future output. In a society where these and related forms of investment have increased in importance over time, it seems inappropriate to restrict the measure of capital formation to include only tangible assets employed in the production process or used to create a direct flow of services.

As with tangible capital assets purchased and used directly by households, there are both conceptual and empirical problems involved in broadening the coverage of capital to include investment in intangibles. These problems are least formidable for investment in knowledge, which can be represented by research-and-development outlays. For the most part this activity is carried out by profit-seeking business enterprises, and it may be supposed that such outlays yield a return, at the margin, equivalent to the return on the more traditional forms of business investment.⁴² There are of course some important differences. The economic fruits of many kinds of investment in knowledge cannot easily be restricted to the original investor, and knowledge itself (as distinct from its embodiment in a product or a person) cannot easily be marketed. Further, owners of capital funds are likely to be less inclined to finance an investment in knowledge than one in tangible assets. However, all these are primarily reasons for supposing that the private rate of return

⁴² About 70 per cent of estimated total research-and-development outlays is spent by business firms, according to figures compiled by the National Science Foundation, although only about one-third of total outlays come from firms. The largest single category of research and development represents business expenditures financed by the federal government, and the next largest consists of business expenditures financed internally. See notes to Table 1 for sources.

to investment in knowledge may be lower than the returns to the community as a whole, hence that there is too little such investment relative to alternative uses of resources, rather than supposing that this activity is better viewed as a form of current consumption and not investment. The essence of an investment activity—that output is permanently raised provided the newly created asset is maintained—is clearly present in activities that increase the stock of accumulated knowledge.

The costs of acquiring skills through both formal and informal education are clearly, to some extent, an investment-type activity. The costs of formal education are of two sorts: direct (teachers' salaries, operating expenses, depreciation on school buildings, etc.) and indirect (the flow of earnings forgone by those attending school). The returns, as a minimum, are the differences in lifetime earnings realized by those with varying amounts of formal education. Becker's work suggests that the monetary rate of return in formal education may be of the same order of magnitude as the rate of return on enterprise investment, providing some empirical support to the view that costs of education are sensibly regarded as investment. Schultz has provided rough estimates of the magnitude of educational outlays for census years.⁴³

Informal education (on-the-job training, in Mincer's terminology) is also an important type of investment in intangible assets.⁴⁴ Many business firms, of course, engage in formal training programs for their employees, while the employees as a rule also invest by forgoing some current monetary return in hope of earning a higher return in the future, just as is true in the case of formal education. And people can be thought of as investing in on-the-job training by choice of profession—educators are paid less than truck drivers to begin with, but the expected value of their lifetime earnings is a good deal higher.

The other important form of investment in persons consists of outlays for health. The productive aspect of such investment is a combination of increased longevity, reduced loss of time through illness, and higher productivity while at work due to the enjoyment of a higher average level of health.

⁴³ Gary S. Becker, *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*, New York, NBER, 1964, and Theodore W. Schultz, "Capital Formation by Education," *Journal of Political Economy*, December 1960.

⁴⁴ Jacob Mincer, "On-the-Job Training: Costs, Returns, and Some Implications," *Journal of Political Economy*, October 1962.

Even a cursory examination of the available evidence suggests that the forms of investment in intangibles (mainly persons) discussed here are all activities whose relative importance has increased markedly over time. Outlays for research and development and for education are good examples of this phenomenon; both have shown marked increases over time, and the investment components of each are clearly discernible and likely to be the dominant element. For example, expenditures on research and development have grown from practically nothing prior to World War I to the point where they are now about equal to government civilian construction.⁴⁵ Similarly, investment in education (as defined by Schultz) amounted to more than \$40 billion by 1962 compared to a little over \$10 billion just after World War II and less than \$1 billion prior to World War I. By the late 1950's, investment in education exceeded residential construction, consumer purchases of automobiles and major appliances, outlays on producer durables, and in fact any single category of gross investment and tangible assets (Table A-3).

Although the empirical estimates on which these findings are based are admittedly quite crude, and the conceptual problems are considerably more serious than for investment in tangible assets, it seems indisputable that the relative importance of intangible investments has increased greatly over the past few decades, and that intangible assets, however defined, are now one of the most important forms of investment in the United States economy. Thus the conclusion we came to above—that capital formation in tangible assets seems to have very little long-term trend in current prices if household investments are included—needs to be modified. If outlays for research and development and costs of education are included in gross capital formation, we find that the ratio of gross capital formation to GNP has shown a steady increase since the turn of the century, and has moved from slightly over 20 per cent in the first decade of the twentieth century to somewhat over 30 per cent during the late 1950's and early 1960's. Table 1 sets out these estimates for selected years; the figures, while crude, do provide a meaningful indication of orders of magnitude.

⁴⁵ Estimates compiled by the National Science Foundation indicate that outlays for research and development roughly quadrupled between 1952 and 1962, reaching a level of over \$16 billion by the latter year. Rough estimates for earlier periods, compiled by Terleckyj, indicate that research-and-development outlays during the 1920's averaged only about \$200 million per year. See Appendix, Table A-3.

TABLE 1

Ratios of Gross Investment to GNP, Selected Categories of Tangible and Intangible Assets and Selected Years

Year	Tangible Assets			Intangible Assets ^a	Total
	Enterprises	Households and Government	Total		
CURRENT PRICES					
1900	13.2	4.5	17.7	2.4	20.0
1910	10.9	6.7	17.6	2.6	20.3
1920	10.0	7.7	17.7	3.0	20.6
1930	9.9	9.6	19.5	5.8	25.4
1940	8.1	10.9	19.0	6.9	25.8
1950	10.2	14.4	24.6	7.0	31.5
1960	9.5	13.3	22.8	10.3	33.0
1929 PRICES					
1900	13.4	5.4	18.8	2.4	21.1
1910	12.0	7.1	19.1	2.6	21.7
1920	9.9	7.2	17.1	3.0	20.0
1930	10.1	10.1	20.2	5.8	26.0
1940	6.9	11.1	18.0	6.9	24.8
1950	8.7	13.2	21.9	7.0	28.8
1960	7.4	13.2	20.6	10.3	30.9

Source: Based on Table A-3.

^aIncludes only investment in research and development and in education.

The data show the nature and extent of the shifts in the distribution of gross capital formation that have taken place since the beginning of the twentieth century. Not only have gross outlays on tangible assets by households (houses and major durables) and government substantially outstripped those by business enterprises, but investment in intangibles now seems to be of the same order of magnitude as enterprise investment in tangible assets. The latter proposition is more debatable because it is less clear that the empirical estimates for investment in intangibles

correspond to an analytically appropriate definition of such investments. However, no amount of redefinition to exclude the current consumption component of educational outlays (or the current-expense component of research-and-development outlays) can alter the basic trend in the "true" investment components of these series. From something like two-thirds of total gross investment at the turn of the century (about three-fourths of gross investment in tangible assets), enterprise investment in tangible assets has declined in relative importance to the point where it is now less than one-third of total gross investment (and only about two-fifths of gross investment in tangible assets).