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The Accounting Framework and the Estimates

The estimates of total capital formation and stocks in the United States, by sector, presented in this study were made within an economic accounting framework. Using a systematic framework of economic accounts ensures consistency with the national income and product and sector income and outlay estimates, and facilitates analyses of investment and stocks in relation to income and product and to the components of the accounts on a similarly consistent basis. Although it does not eliminate errors from the estimates, it reduces the likelihood of errors because of the double-entry nature of accounts.

Our expansion of the concepts of saving, investment, and wealth beyond those underlying the official U.S. national income accounts necessitated our modifying the latter to a considerable extent. These modifications will be described in the first section of this chapter with reference to the set of accounts presented in the tables. The sources and methods underlying the capital formation and stock estimates and price deflators relative to the Appendix B tables are summarized in the second section.

The Accounting Framework

Our economic accounts involve three major modifications of the U.S. Department of Commerce system. First, the broad concept of investment developed in Chapter 1 requires the expansion of the national saving-investment account and its deconsolidation by major sector. That is, since we include nonbusiness tangible capital formation as well as the intangible investments of all sectors, investment is no

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longer confined largely to the tangible capital formation of the business sector. Accordingly, capital accounts are set up for each sector, and the income-outlay account of each sector is limited to the current outlays, including rental values of capital used by the nonbusiness sectors but excluding the formation of capital, which is shifted to the capital accounts. By including intangible and human investments in the capital accounts we depart from the paradigm of business accounting. Research and development financed by business is typically charged off as a current expense. So are the human investments, as for training and health. In part, this is done because—to the extent these are embodied in workers and accrue to their benefit—they do not "belong" to the firm and are removed whenever the workers decide to change jobs. But from the broader socioeconomic viewpoint, it is clear that all outlays that expand monetary or nonmarket income over several accounting periods should be capitalized.

Second, the scope of the income and product accounts has to be broadened to include not only rental values of nonbusiness capital, but also the imputed portions of capital formation which are charged to current expense or are otherwise not included in the official estimates.

Finally, the capital stock estimates of the Commerce Department, which do not yet cover all sectors and all types of capital, have been expanded for our purposes to include all wealth, tangible and intangible, human and nonhuman, resulting from the total investments of all sectors. In order to implement financial analysis, the capital accounts could also be expanded to include flows of funds, and the wealth statements enlarged into complete balance sheets. We do show a combined national balance sheet below in order to demonstrate its relationship to the wealth estimates. But since our emphasis is on "real" rather than financial analysis, we confine the capital accounts and wealth statements to productive capital outlays and stock. But the financial flows and levels could easily be added to the capital accounts and balance sheets, respectively, for those who wish to do so.

Our system is close to the United Nations revised standard system of national accounts, except that we include, and they exclude, intangible capital formation and stocks. And, with the same exception, it is closer to the Federal Reserve Board's flow-of-funds accounts than it is to the Commerce Department system, although the Federal Reserve Board does not yet include public capital formation in the capital account for the governments sector.[1]

1. For discussions of various systems of economic accounts, see Richard and Nancy Ruggles, *The Design of Economic Accounts*, New York, NBER, 1970; and John W. Kendrick, *Economic Accounts and Their Uses*, New York, McGraw-Hill Book Co., 1972.

The main features of the seven basic sets of accounts are reviewed below, with detailed notes on the derivation of the various entries in the tables provided in Appendix A. Contra-entries to each line in the accounts are indicated in the tables by the table and line numbers in parentheses.

THE PRODUCTION ACCOUNT

Before looking at the sector accounts, it is useful to examine the expanded national income and product account (Table 2-1) in order to get an overview of the adjustments made to the conventional accounts. With respect to GNP, it will be noted that the domestic investment components are much larger than in the official accounts—43.1 per cent against 15.7 per cent in 1929, and 50.6 per cent against 16.2 per cent in 1966. In large part, the greater absolute and relative size of gross investment was due to reclassifications of items from current consumption to investment. In the case of gross tangible nonhuman investment (line 31), the Commerce Department still includes only business and institutional investment, plus new residential construction for owner-occupancy, whereas we also include the tangible investments by the nonbusiness sectors (households and governments) in new structures, durable equipment, additions to inventories, and natural resource development. Gross tangible human investment (line 37), the cost of rearing children to working age, is also a deduction from the Commerce Department's personal consumption expenditure estimates.

Gross intangible investment (line 38) consists of outlays for education and training, health and safety, labor mobility, and research and development (lines 39–42). All of these are human investment except R&D, which is largely directed toward new and improved products and processes. We therefore classify R&D as nonhuman intangible investment, although it also acts to improve the productivity of human investment and capital by adding to knowledge and know-how. To the extent that R&D and certain other investments are charged to current expense by business, our investment estimates require an upward adjustment to the official GNP estimates (see Table 2-la).

Net exports (line 43) are the same as in the official accounts, comprising net foreign investment and unilateral transfer payments.

Both personal and government consumption (lines 29 and 30) begin with the official estimates, less the categories reclassified as investment, plus imputed rental values of the services provided by the tangible nonhuman capital stocks owned by each of the two nonbusiness sectors. The adjusted consumption estimates are below the official

U.S. estimates to the extent that the imputed rentals are less than the tangible capital outlays of each sector, and because of the deduction of the intangible capital outlays. But GNP and gross national income are enlarged by the imputed rental values which are not now included except for owner-occupied residences. As shown in the reconciliation table (2-1a), the aggregate estimates are also larger to the extent of foregone earnings of students and of the frictionally unemployed, which are counted as part of intangible investments in education and in labor mobility, respectively.

As a result of the various additions, our adjusted GNP estimates are 23.5 per cent higher than the official estimates for 1929, and 34.3 per cent higher for 1969. (See Table 2-1a and Chart 2-1.) Note, however, that the adjustments were made purely for the sake of consistency with the expanded investment and capital estimates. In another project we have imputed values for all nonmarket production (indicated by parenthetical stub entries in the sector accounts). Other investigators have made further adjustments in an attempt to provide a still closer approximation to NEW (net economic welfare), as Samuelson has dubbed it in the latest edition of his textbook.[2] That was not our objective in making the adjustments shown in Table 2-la, although these items make a modest contribution to broader welfare-oriented measures.

Turning to the debit side of the production account, which comprises factor costs (national income) and other charges against product, adjustments were made for the additions to product just noted. Thus, labor compensation is increased by the imputed value of nonmarket services involved in eduation and mobility (line 7), and net rental income includes the net rental value of household tangible wealth (line 10) and of public sector wealth (line 12). We have also imputed the labor value of proprietors' work (line 6) on the basis of the average wage-salary of employees in the various industries, in order to isolate the profit portion of proprietors' net income to be included with corporate profits (line 11). This is necessary in order to estimate returns on human and nonhuman capital separately, as shown in Table 2-lb. Net interest was modified by deducting from the official estimates consumer interest on brokerage loans and the excess of interest paid by the federal government over and above the net rental value of that sector's real wealth. (See Appendix A for a more detailed discussion.)

It should be noted that we have not imputed a rental income for the human capital stock, tangible and intangible, since our view is that the labor compensation estimates already represent the return on total

2. See William Nordhaus and James Tobin, "Is Growth Obsolete?," *Economic Growth,* Fiftieth Anniversary Colloquium V, New York, NBER, 1972.

Table 2-1. *National Income and Product Account* (billions of current dollars)

Line No.		1929	1948	1966
	DEBITS			
1.	Labor compensation	67.42	182.81	547.58
2.	Wage and salary disbursements (IIA-13)	50.44	135.34	394.50
3.	Wage accruals less disbursements (IIB-73)	0.00	0.04	0.00
4.	Employer contributions for social insurance (IVA-19)	0.10	3.04	20.29
5.	Other labor income (IIA-14)	0.56	2.71	20.71
6.	Imputed labor compensation of propietors (IIA-15)	9.11	21.51	38.86
7.	Additional labor compensation imputations (IIA-16)	7.21	20.17	73.22
8.	Net rental income of persons and institutions	6.96	9.80	28.13
9.	From auxiliary business activities (IIIA-10)	3.08	5.36	8.72
10.	From owner-used capital (IIA-22)	3.88	4.44	19.41
11.	Profits of business enterprises (IIIA-11)	16.30	51.95	116.52
12.	Net rental income of government (IVA-20)	0.78	1.95	6.17
13.	Net interest	6.61	6.07	45.79
14.	Personal interest income (IIA-28)	7.22	7.88	43.64
15.	Less: Unproductive interest paid by consumers (IIA-11)	0.95	0.03	0.19
16.	Government interest income (IVA-21)	0.52	1.36	4.15
17.	Less: Unproductive interest paid by government (IVA-11)	0.18	3.14	1.81
	NATIONAL INCOME	98.07	252.58	744.19

18.	Less: Human capital consumption (IIA-33)	14.57	34.57	101.15
	NET NATIONAL INCOME	83.50	218.01	643.04
19.	Capital consumption allowances	35.07	91.30	272.57
20.	Personal (IIB-57)	24.33	54.53	169.44
21.	Nonhuman	9.77	19.97	68.29
22.	Human	14.57	34.57	101.15
23.	Business (IIIB-38)	9.02	19.45	71.26
24.	Government (IVB-41)	1.72	17.32	31.87
	GROSS NATIONAL INCOME	118.57	309.31	915.61
25.	Current business transfer payments (IIA-30)	0.59	0.70	2.99
26.	Indirect tax and nontax charges (IVA-16)	7.34	20.51	67.60
27.	Less: Subsidies less current surplus of government enterprises (IVA-12)	-0.14	0.86	2.62
28.	Statistical discrepancy (VI-18)	0.70	-1.99	-1.01
	CHARGES AGAINST GROSS NATIONAL PRODUCT	127.34	327.67	982.57

(continued)

Table 2-1. National Income and Product Account (billions of current dollars) (concluded)

Line No.		1929	1948	1966
	CREDITS			
29.	Personal consumption (IIA-2)	64.84	146.04	381.57
30.	Government consumption (IVA-1)	6.43	35.30	98.48
31.	Gross tangible nonhuman investment (VI-1)	29.47	76.63	244.36
32.	Structures	11.48	27.80	78.27
33.	Private residential	3.95	14.44	25.04
34.	Other	7.53	13.36	53.23
35.	Durable goods	15.46	43.80	144.02
36.	Change in inventories	2.53	5.03	22.07
37.	Gross tangible human investment (VI-2)	9.77	18.28	54.62
38.	Gross intangible investment (VI-3)	15.69	44.98	198.26
39.	Education and training	11.00	30.78	136.60
40.	Health	1.90	5.22	21.47
41.	Mobility	2.53	6.61	17.41
42.	Research and development	0.25	2.37	22.77
43.	Net exports of goods and services	1.15	6.44	5.28
44.	Exports (VA-1)	7.03	16.79	43.36
45.	Less: Imports (VA-2)	5.89	10.35	38.08
	GROSS NATIONAL PRODUCT	127.34	327.67	982.57

NOTE: Detail may not add to totals due to rounding.

Table 2-1a. *Reconciliation of Adjusted GNP and Commerce Department GNP, 1929, 1948, and 1969 (billions of current dollars)*

Line No.		1929	1948	1969
1.	GNP, Commerce concept	103.095	257.562	929.095
	Plus			
	Households and institutions:			
2.	Imputed student compensation (less unemployment adjustment)	5.141	15.660	92.265
3.	Imputed compensation of frictionally unemployed (less subsidies)	2.072	4.506	16.048
4.	Imputed rentals (excl. maintenance and insurance) on HH durables and inventories	10.405	20.499	100.057
5.	Imputed rentals (excl. maintenance) on institutional plant and equipment and land, over OBE depreciation and interest paid	0.337	0.544	5.711
	Business:			
6.	Tangible investment conventionally charged to current account	0.282	0.899	2.340
7.	Intangible investment conventionally charged to current account	2.187	6.953	35.387
	General government:			
8.	Imputed rentals (excl. maintenance) on land, durables, and inventories	3.825	21.048	66.967
9.	Equals: GNP, adjusted	127.344	327.671	1,247.870
10.	Ratio: Adjusted to Commerce GNP	1.235	1.272	1.343

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Chart 2-1. *Relation of Adjusted to Official GNP Estimates, 1966*

Billion dollars   Plus :   Equals :
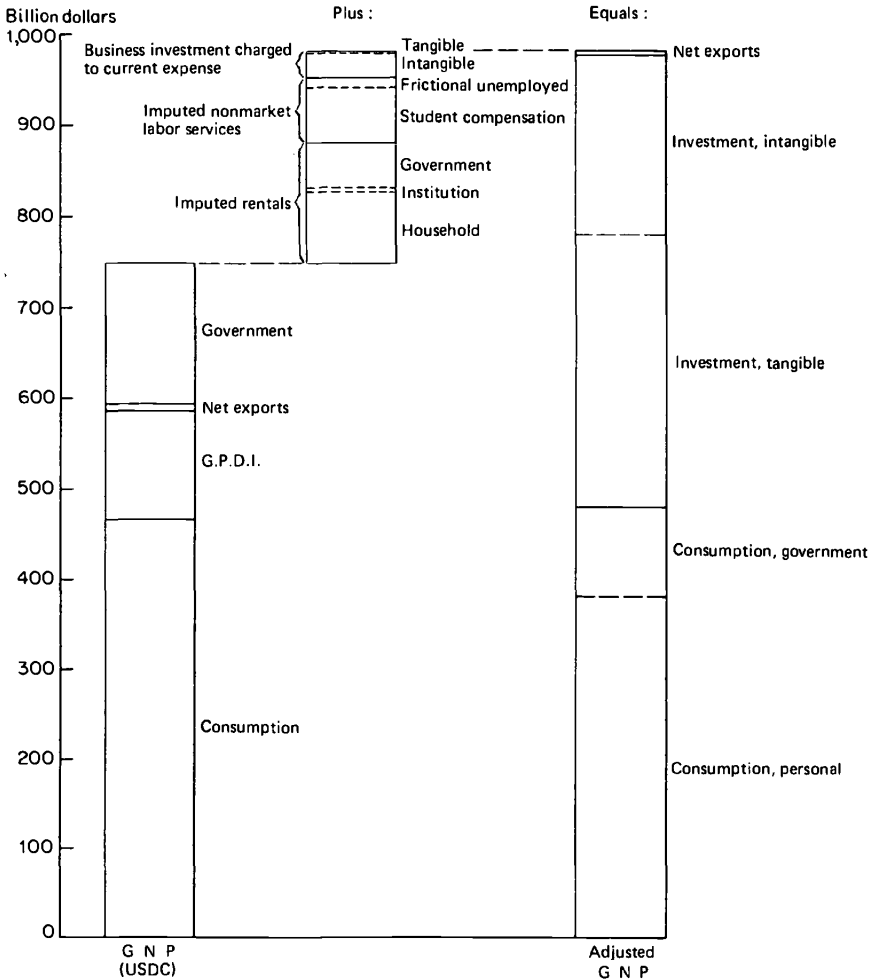
human capital employed. The official national income estimates are asymmetrical, however, in that property income is net of capital consumption allowances, while labor income is gross of human capital consumption. Accordingly, in line 18 we deduct human capital consumption allowances to arrive at "net national income" estimates which are symmetrical in that respect. The allowances represent that portion of gross income which, from a theoretical social accounting viewpoint, must be invested in human capital in order to maintain its productive capacity intact.

Table 2-1b. *Factor Compensation, Gross and Net* (billions of current dollars)

Line No.		1929	1948	1969
	A. U.S. Domestic Economy			
1.	Gross domestic factor compensation	117.764	308.332	1161.365
2.	Capital consumption (nonhuman)	20.503	56.727	223.874
3.	Adjusted domestic income (factor compensation)	97.261	251.605	937.491
4.	Human maintenance	33.974	83.425	216.145
5.	Adjusted gross domestic income less maintenance	63.287	168.180	721.346
6.	Human depreciation	14.566	34.568	126.376
7.	Adjusted net domestic income less maintenance	48.722	133.608	594.952
8.	Employee compensation	51.098	141.131	565.548
9.	Imputed proprietors' labor compensation	9.110	21.509	47.081
10.	Imputed compensation of students and frictionally unemployed	7.213	20.166	108.313
11.	Total gross labor compensation	67.421	182.806	720.942
12.	Total gross labor compensation excluding maintenance	33.447	99.381	504.797
13.	Total net labor compensation	18.881	64.813	378.421
14.	Gross capital compensation	50.344	125.522	440.405
15.	Net capital compensation	29.841	68.795	216.531
	B. Private Domestic Business Economy			
1.	Gross factor income	83.476	213.532	694.338
2.	Human maintenance	29.291	69.275	162.057
3.	Gross income less maintenance	54.185	144.257	532.281
4.	Capital consumption, nonhuman	9.016	19.446	95.557
5.	Human depreciation	12.558	28.705	94.752
6.	Net compensation excluding maintenance	32.611	96.106	341.972
7.	Gross labor compensation	52.251	137.253	469.772
8.	Gross labor compensation excluding maintenance	22.960	67.978	307.715
9.	Net labor compensation excluding maintenance	10.402	39.273	212.963
10.	Gross property compensation	31.225	76.279	224.566
11.	Net property compensation	22.209	56.833	129.009

It could be argued that even our net national income estimates are asymmetrical, since property income is considered net of maintenance expenditures while labor income is not. Most, but not all, economists believe that, since the portion of current consumption representing maintenance affords satisfaction, no deduction should be made if a welfare criterion is observed. We have followed this line in Table 2-1, recognizing a possible inconsistency with our treatment of human capital consumption, although it can be argued that the current utility portion of human investment is negligible in relation to the flow of income, psychic as well as monetary, deriving from human capital creation over future accounting periods. We do estimate maintenance outlays, as shown in Table 2-1b, as a basis for estimating rates of return on human and nonhuman capital in a consistent manner, as discussed in the final section of this volume.

Once deducted, human capital consumption can be neatly combined with nonhuman capital consumption (line 19) and added to net national income to obtain gross national income. Then the usual reconciliation items, chiefly indirect business taxes less subsidies, can be added to arrive at total charges against GNP at market prices.

THE SECTOR ACCOUNTS, CURRENT AND CAPITAL

The basic design of sector accounts is well known. (See Tables 2-2 through 2-5.) On the credit side, "primary" income flows from current production plus transfer payments received (including tax revenues) are entered. To the official U.S. estimates we have added, in the appropriate sector accounts, the rental values of capital goods owned by the household and government sectors, the imputed values of nonmarket time spent by persons on investment-in-self, and the several lesser items discussed earlier. Note that we follow the Commerce Department in crediting total proprietors' profits to the personal sector, since there is no basis for estimating the proportion retained for investment in unincorporated firms. Also, human capital consumption is deducted from personal income to arrive at "net personal income," so that personal saving will be net of human as well as of nonhuman depreciation allowances.

In the business sector account (which the Commerce Department does not explicitly develop), we credit profits (before taxes) after the various valuation adjustments. Our foreign sector account is the same as that of the Commerce Department.

On the debit side of the current accounts, both personal and government consumption estimates are adjusted as described earlier; to

these are added transfer payments (including tax and nontax payments in the case of the personal sector) and "unproductive interest" payments. In using the term "government consumption" we follow U.N. usage, and include noninvestment purchases presumably designed to produce services for collective consumption. In the business sector, the debits are for dividends, entrepreneurial withdrawals, and corporate tax liabilities. In all sectors, net saving is the balancing item obtained as the residual after subtracting the various debits just described from the net sector incomes.

In the sector capital accounts, net saving becomes the initial credit item as a source of funds. Since the capital accounts are gross, in order to explain the sources of funds to finance gross investment, capital consumption allowances—tangible and intangible—are credited to the sector accounts from the gross production account.

The final category of credits, intersectoral net capital transfers, requires some explanation. Whereas initial new investment is entered according to the sector that finances it, we wish to show capital accumulation and stocks by the sector that controls and reaps the primary benefit from the capital. Thus, we posit that the personal sector controls all human capital, so the intangible human investments financed by business and governments are transferred to the personal sector. Transfers are not necessary for rearing costs, which are both incurred by and accrue to the benefit of households. We also posit that applied R&D accrues to the benefit of the business sector, so nonbusiness R&D is transferred to business. Net capital transfers from abroad represent the change in net human stock, calculated by age groups and adjusted for accumulated depreciation, resulting from net immigration (immigration less emigration). To simplify the estimation procedure, we assume that immigrants represent the same amounts of capital, in dollars, as persons of the same age groups already in the United States.

In this treatment, we have adopted the approach of the revised SNA, although the capital transfers provided for there are intended to be primarily financial. As a result of the productive capital transfers, sector stock estimates relate to the capital controlled, and it is on this basis that depreciation is estimated.

On the debit side of the domestic sector capital accounts, there are three chief groupings of entries. First comes the productive tangible and intangible investment financed, by type. Next, the capital accumulation from net capital transfers is detailed by type rather than by sector of origin (as on the credit side). The third category, "net financial investment," is the balancing item in the capital accounts as the difference between total credits and the sum of the other debits. If the capital account were elaborated to show financial transactions, it would repre-

Table 2-2. *Personal Sector Accounts* (billions of current dollars)

Line No.		1929	1948	1966
	A. CURRENT ACCOUNT (Cash Basis)			
	DEBITS			
1.	Personal tax and nontax payments (IVA-14)	2.31	20.64	73.41
2.	Personal consumption (I-29)	64.84	146.04	381.57
3.	Imputed rentals for services of capital	18.47	35.30	138.41
4.	Owner-occupied residences	6.41	10.80	46.28
5.	Institutional plant	0.41	0.75	5.50
6.	Consumer durable goods and inventories	11.38	23.54	85.65
7.	Institutional equipment	0.26	0.20	0.99
8.	Less: Imputed rentals allocated to intangible and human investment	2.84	5.43	22.75
	(Consumption provided by business to employees)			
	(Current consumption transfers from business to general public)			
9.	Other consumption expenditures	49.22	116.18	265.91
10.	Personal transfer payments to rest of world (net) (VA-3)	0.34	0.70	0.56
11.	Unproductive interest paid by consumers (I-15)	0.95	0.03	0.19
12.	Net personal savings (IIB-56)	11.12	30.07	111.22
	DISPOSAL OF NET PERSONAL INCOME	79.56	197.48	566.95
	CREDITS			
13.	Wages and salary disbursements (I-2)	50.44	135.34	394.50
14.	Other labor income (I-5)	0.56	2.71	20.71

15.	Imputed labor compensation of proprietors (I-6)	9.11	21.51	38.86
16.	Additional labor compensation imputations (I-7)	7.21	20.17	73.22
17.	Students	5.14	15.66	60.89
18.	Frictionally unemployed	2.07	4.51	12.34
	(Household members)			
	(Volunteers)			
	(Employees for business provided consumption)			
19.	Withdrawals of proprietors' profits (IIIA-2)	5.47	18.54	21.92
20.	Net rental income	6.96	9.80	28.13
21.	From auxiliary business activities (IIIA-1)	3.08	5.36	8.72
22.	From owner-used capital (I-10)	3.88	4.44	19.41
23.	Residences	2.13	0.98	8.33
24.	Institutional plant	0.11	0.27	2.82
25.	Consumer durable goods and inventories	1.61	3.18	8.06
26.	Institutional equipment	0.02	0.02	0.20
27.	Dividends (IIIA-4)	5.80	7.04	20.80
28.	Personal interest income (I-14)	7.22	7.88	43.64
29.	Current transfers to persons	1.50	11.24	44.06
30.	From business (I-25)	0.59	0.70	2.99
	(Cash)			
	(Consumption provided to general public)			
31.	From government (IVA-9)	0.91	10.54	41.08
32.	Less: Personal contributions for social insurance (IVA-18)	0.14	2.18	17.74
	PERSONAL INCOME	94.13	232.05	668.10

(continued)

Table 2-2. *Personal Sector Accounts* (billions of current dollars) (completed)

Line No.		1929	1948	1966
33.	Less: Human capital consumption (I-18)	14.57	34.57	101.15
	NET PERSONAL INCOME	79.56	197.48	566.95
	B. CAPITAL ACCOUNT (Accrual Basis)			
	DEBITS			
34.	Gross personal investment (VI-7)	33.26	81.20	260.38
35.	Tangible nonhuman investment	12.95	34.14	99.41
36.	Land (net purchase)	0.01	-0.17	-1.63
37.	Residential structures	2.21	11.74	18.67
38.	Institutional plant	0.43	0.71	3.82
39.	Consumer durable goods	9.21	22.68	70.75
40.	Institutional equipment	0.27	0.20	0.80
41.	Change in household inventories	0.82	-1.02	7.00
42.	Tangible human investment	9.77	18.28	54.62
43.	Intangible investment	10.54	28.78	106.35
44.	Education and training	6.85	19.37	75.29
45.	Health	1.47	3.82	15.37
46.	Mobility	2.20	5.55	14.83
47.	Research and development	0.02	0.04	0.86
48.	Accumulation through capital transfers (VI-11)	5.85	15.10	75.22
49.	Tangible nonhuman capital	0.00	0.00	0.00
50.	Tangible human capital	0.47	0.51	1.68
51.	Education and training	4.59	12.10	64.84
52.	Health	0.46	1.44	6.38

53.	Mobility	0.33	1.06	2.58
54.	Research and development	-0.00	-0.01	-0.25
55.	Net financial investment (VI-15)	2.19	3.44	20.28
	GROSS ACCUMULATION	41.30	99.74	355.88

CREDITS

56.	Net personal saving (IIA-12)	11.12	30.07	111.22
57.	Personal capital consumption allowances (I-20)	24.33	54.53	169.44
58.	Tangible nonhuman capital	9.77	19.97	68.29
59.	Residential structures	1.51	4.10	11.74
60.	Institutional plant	0.17	0.33	1.69
61.	Consumer durable goods	7.87	15.39	54.20
62.	Institutional equipment	0.21	0.15	0.65
63.	Tangible human capital	5.10	9.84	17.42
64.	Intangible capital	9.46	24.73	83.73
65.	Education and training	5.28	15.55	54.67
66.	Health	1.21	3.16	13.26
67.	Mobility	2.98	6.02	15.80
68.	Net capital transfers	5.85	15.10	75.22
69.	Capital transfers from business (IIIB-48)	2.02	5.92	19.94
70.	Capital transfers from government (IVB-46)	2.90	7.94	50.05
71.	Capital transfers from rest of world (VB-8)	0.93	1.25	5.48
72.	Less: Capital transfers to business (IIIB-45)	0.00	0.01	0.25
73.	Wage accruals less disbursements (1-3)	0.00	0.04	0.00
	FINANCE OF GROSS ACCUMULATION	41.30	99.74	355.88

Table 2-3. *Business Sector Accounts* (billions of current dollars)

Line No.		1929	1948	1966
	A. CURRENT ACCOUNT			
	DEBITS			
1.	Withdrawals of net rental income from auxiliary business activities (IIA-21)	3.08	5.36	8.72
2.	Withdrawals of proprietors' profits (IIA-19)	5.47	18.54	21.92
3.	Corporate profits tax liability (IVA-15)	1.37	12.52	34.28
4.	Dividends (IIA-27)	5.80	7.04	20.80
5.	Net business saving (IIIB-37)	3.66	13.86	39.52
6.	Unincorporated business nonwithdrawn profits before adjustment	NA	NA	NA
7.	Corporate undistributed profits before adjustment	2.82	15.63	29.15
8.	Amortization adjustment	0.22	0.78	12.55
9.	Inventory valuation adjustment	0.61	-2.56	-2.17
	DISPOSAL OF NET BUSINESS INCOME	19.38	57.30	125.25
	CREDITS			
10.	Net rental from auxiliary business activities (I-9)	3.08	5.36	8.72
11.	Profits of business enterprises (I-11)	16.30	51.95	116.52
12.	Unincorporated business profits before adjustment	5.47	18.54	21.92
13.	Corporate profits before adjustment	9.99	35.19	84.22

14. Amortization adjustment	0.22	0.78	12.55
15. Tangible capital	−1.83	−5.05	−0.67
16. Intangible capital	2.05	5.84	13.22
17. Inventory valuation adjustment	0.61	−2.56	−2.17
NET BUSINESS INCOME (BEFORE INCOME TAX)	19.38	57.30	125.25

B. CAPITAL ACCOUNT

DEBITS

18. Gross business investment (VI-8)	15.78	41.22	127.03
19. Tangible investment	13.60	34.27	99.98
20. Land (net purchase)	0.00	0.00	0.00
21. Residential structures	1.74	2.70	6.37
22. Nonresidential structures	4.53	8.11	24.67
23. Producers' durable equipment	5.61	18.75	54.14
24. Change in inventories	1.71	4.71	14.80
25. Intangible investment	2.19	6.95	27.04
26. Education and training	1.64	4.84	17.50
27. Health	0.07	0.22	0.58
28. Mobility	0.31	0.86	1.86
29. Research and development	0.16	1.03	7.10
30. Accumulation through capital transfers (VI-12)	−1.95	−4.60	−4.88
31. Tangible human capital	0.00	0.00	0.00
32. Education and training	−1.64	−4.84	−17.50
33. Health	−0.07	−0.22	−0.58

(continued)

Table 2-3. *Business Sector Accounts* (billions of current dollars) (completed)

Line No.		1929	1948	1966
34.	Mobility	−0.31	−0.86	−1.86
35.	Research and development	0.07	1.32	15.07
36.	Net financial investment (VI-16)	−3.11	−7.92	−16.24
	GROSS ACCUMULATION	10.72	28.70	105.91
	CREDITS			
37.	Net business saving (IIIA-5)	3.66	13.86	39.52
38.	Business capital consumption allowances (I-23)	9.02	19.45	71.26
39.	Tangible capital	8.88	18.33	57.44
40.	Residential structures	1.11	1.59	3.89
41.	Nonresidential structures	3.05	5.21	14.76
42.	Producers' durable equipment	4.72	11.53	38.79
43.	Intangible capital, research and development	0.14	1.12	13.82
44.	Net capital transfers	−1.95	−4.60	−4.88
45.	Capital transfers from persons and institutions (IIB-72)	0.00	0.01	0.25
46.	Capital transfers from government (IVB-47)	0.07	1.31	14.81
47.	Capital transfers from rest of world (VB-9)	0.00	0.00	0.00
48.	Less: Capital transfers to persons (IIB-69)	−2.02	−5.92	−19.94
	FINANCE OF GROSS ACCUMULATION	10.72	28.70	105.91

Table 2-4. *Government Sector Accounts* (billions of current dollars)

Line No.		1929	1948	1966
	A. CURRENT ACCOUNT			
	DEBITS			
1.	General government consumption (I-30)	6.43	35.30	98.48
2.	Imputed rentals for services of capital	4.93	26.28	60.73
3.	Public land	0.76	0.73	2.83
4.	Structures	3.42	9.23	31.09
5.	Equipment and inventories	0.75	16.32	26.81
6.	Less: Imputed rentals allocated to intangible investment	0.55	1.71	12.00
7.	Other consumption expenditures	2.05	10.73	49.75
8.	Government transfer payments	0.94	14.37	43.35
9.	To persons (IIA-31)	0.91	10.54	41.08
10.	To rest of world (net) (VA-4)	0.03	3.83	2.28
11.	Unproductive interest paid by government (I-17)	0.18	3.14	1.81
12.	Subsidies less current surplus of government enterprises (I-27)	−0.14	0.86	2.62
13.	Surplus or deficit (−) on current account (IVB-40)	5.15	8.53	77.39
	DISPOSAL OF GOVERNMENT INCOME	12.56	62.20	223.65
	CREDITS			
14.	Personal tax and nontax receipts (IIA-1)	2.31	20.64	73.41
15.	Corporate profits tax accruals (IIIA-3)	1.37	12.52	34.28

(continued)

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Table 2-4. *Government Sector Accounts* (billions of current dollars) (completed)

Line No.		1929	1948	1966
16.	Indirect tax and nontax charges (I-26)	7.34	20.51	67.60
17.	Contributions for social insurance	0.24	5.22	38.04
18.	Personal (IIA-32)	0.14	2.18	17.74
19.	Employer (I-4)	0.10	3.04	20.29
20.	Net rental income of government (I-12)	0.78	1.95	6.17
21.	Government interest income (I-16)	0.52	1.36	4.15
	GOVERNMENT INCOME	12.56	62.20	223.65

B. CAPITAL ACCOUNT

DEBITS

Line No.		1929	1948	1966
22.	Gross government investment (VI-9)	5.89	17.47	109.83
23.	Tangible investment	2.92	8.23	44.97
24.	Land (net purchase)	−0.01	0.17	1.63
25.	Structures	2.57	4.55	24.74
26.	Equipment	0.36	2.17	18.33
27.	Change in inventories	0.00	1.34	0.27
28.	Intangible investment	2.96	9.24	64.86
29.	Education and training	2.51	6.56	43.81
30.	Health	0.36	1.18	5.52

31.	Mobility		0.02	0.20	0.71
32.	Research and development		0.07	1.31	14.81
33.	Accumulation through capital transfers (VI-13)		-2.96	-9.24	-64.86
34.	Tangible nonhuman capital		0.00	0.00	0.00
35.	Education and training		-2.51	-6.56	-43.81
36.	Health		-0.36	-1.18	-5.52
37.	Mobility		-0.02	-0.20	-0.71
38.	Research and development		-0.07	-1.31	-14.81
39.	Net financial investment (VI-17)		0.98	8.38	-0.57
	GROSS ACCUMULATION		3.91	16.61	44.40
	CREDITS				
40.	Surplus or deficit (−) on current account (IVA-13)		5.15	8.53	77.39
41.	Government capital consumption allowances (I-24)		1.72	17.32	31.87
42.	Structures		1.20	4.77	13.76
43.	Equipment		0.52	12.55	18.11
44.	Net capital transfers		-2.96	-9.24	-64.86
45.	Capital transfers from rest of world (VB-10)		0.00	0.00	0.00
46.	Less: Capital transfers to persons (IIB-70)		2.90	7.94	50.05
47.	Less: Capital transfers to business (IIIB-46)		0.07	1.31	14.81
	FINANCE OF GROSS ACCUMULATION		3.91	16.61	44.40

Table 2-5. *Foreign Sector Accounts* (billions of current dollars)

Line No.		1929	1948	1966
	A. CURRENT ACCOUNT			
	DEBITS			
1.	Exports of goods and services (1-44)	7.03	16.79	43.36
	RECEIPTS FROM FOREIGNERS	7.03	16.79	43.36
	CREDITS			
2.	Imports of goods and services (1-45)	5.89	10.35	38.08
3.	Personal transfer payments to rest of world (net) (IIA-10)	0.34	0.70	0.56
4.	U.S. Government transfer payments to rest of world (net) (IVA-10)	0.03	3.83	2.28
5.	Surplus of nation on current foreign account (VB-6)	0.77	1.92	2.45
	CURRENT DISBURSEMENTS AND SURPLUS ON FOREIGN ACCOUNT	7.03	16.79	43.36
	B. CAPITAL ACCOUNT			
	DEBITS			
6.	Surplus of nation on current foreign account (VA-5)	0.77	1.92	2.45
7.	Net capital transfers from rest of world	0.93	1.25	5.48
8.	To persons (IIB-71)	0.93	1.25	5.48
9.	To business (IIIB-47)	0.00	0.00	0.00
10.	To government (IVB-45)	0.00	0.00	0.00
	SOURCE OF ACCUMULATION	1.70	3.17	7.92
	CREDITS			
11.	Accumulation through net capital transfers from rest of world (VI-4)	0.93	1.25	5.48
12.	Net foreign investment (VI-5)	0.77	1.92	2.45
	ACCUMULATION ON FOREIGN ACCOUNT	1.70	3.17	7.92

Table 2-6. Consolidated Capital Formation Account (billions of current dollars)

Line No.		1929	1948	1966
	DEBITS			
1.	Gross tangible nonhuman investment (I-31)	29.47	76.63	244.36
2.	Gross tangible human investment (I-37)	9.77	18.28	54.62
3.	Gross intangible investment (I-38)	15.69	44.98	198.26
4.	Accumulation through net capital transfers from rest of world (VB-11)	0.93	1.25	5.48
5.	Net foreign investment (VB-12)	0.77	1.92	2.45
	GROSS ACCUMULATION	56.63	143.05	505.16
	CREDITS			
6.	Gross domestic investment	54.93	139.89	497.24
7.	By persons and institutions (IIB-34)	33.26	81.20	260.38
8.	By business (IIIB-18)	15.78	41.22	127.03
9.	By government (IVB-22)	5.89	17.47	109.83
10.	Accumulation through capital transfers	0.93	1.25	5.48
11.	By persons (IIB-48)	5.85	15.10	75.22
12.	By business (IIIB-30)	-1.95	-4.60	-4.88
13.	By government (IVB-33)	-2.96	-9.24	-64.86
14.	Net financial investment	0.07	3.90	3.46
15.	By persons and institutions (IIB-55)	2.19	3.44	20.28
16.	By business (IIIB-36)	-3.11	-7.92	-16.24
17.	By government (IVB-39)	0.98	8.38	-0.57
18.	Statistical discrepancy (I-28)	0.70	-1.99	-1.01
	SOURCE OF GROSS ACCUMULATION	56.63	143.05	505.16

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Table 2-7. *Disposable Receipts and Expenditures, by Sector (billions of current dollars)*

Line No.		1929	1948	1966
1.	Net personal income (IIA-Credits total)	79.56	197.48	566.95
2.	Plus: Personal capital consumption (IIB-57)	24.33	54.53	169.44
3.	Wage accruals over disbursements (IIB-73)	0.00	0.04	0.00
4.	Equals: Gross personal income accruals	103.89	252.05	736.39
5.	Less: Personal tax and nontax payments (IIA-1)	2.31	20.64	73.41
6.	Personal transfer payments to rest of world (net) (IIA-10)	0.34	0.70	0.56
7.	Unproductive interest paid by consumers (IIA-11)	0.95	0.03	0.19
8.	Equals: Disposable personal income*	100.29	230.68	662.23
9.	Disposal: Tangible nonhuman investment (IIB-35)	12.95	34.14	99.41
10.	Tangible human investment (IIB-42)	9.77	18.28	54.62
11.	Intangible investment (IIB-43)	10.54	28.78	106.35
12.	Personal consumption (IIA-2)	64.84	146.04	381.57
13.	Net financial investment (IIB-55)	2.19	3.44	20.28
14.	Net business income before income tax (IIIA-Credits total)	19.38	57.30	125.25
15.	Plus: Business capital consumption (IIIB-38)	9.02	19.45	71.26
16.	Excess wage accruals over disbursements (I-3)	0.00	0.04	0.00
17.	Equals: Gross business income	28.40	76.79	196.51
18.	Less: Withdrawals of auxiliary business income (IIIA-1)	3.08	5.36	8.72
19.	Withdrawals of proprietors' profits (IIIA-2)	5.47	18.54	21.92
20.	Corporate profits tax liability (IIIA-3)	1.37	12.52	34.28
21.	Dividends (IIIA-4)	5.80	7.04	20.80
22.	Wage liability over disbursements (I-3)	0.00	0.04	0.00

No.		1	2	3
23.	Equals: Gross retained earnings accruals[a]	12.68	33.29	110.79
24.	Disposal: Tangible investment (IIIB-19)	13.60	34.27	99.98
25.	Intangible investment (IIIB-25)	2.19	6.95	27.04
26.	Net financial investment (IIIB-36)	-3.11	-7.92	-16.24
27.	Government income (IVA-Credits total)	12.56	62.20	223.65
28.	Plus: Government capital consumption (IVB-41)	1.72	17.32	31.87
29.	Equals: Gross government receipts or accruals	14.28	79.52	255.52
30.	Less: Government transfer payments (IVA-8)	0.94	14.37	43.35
31.	Unproductive interest paid by government (IVA-11)	0.18	3.14	1.81
32.	Subsidies less current surplus of government enterprises (IVA-12)	-0.14	0.86	2.62
33.	Equals: Disposable government income[a]	13.30	61.15	207.74
34.	Disposal: Tangible interest (IVA-23)	2.92	8.23	44.97
35.	Intangible investment (IVB-28)	2.96	9.24	64.86
36.	General government consumption(IVA-1)	6.43	35.30	98.48
37.	Net financial investment (IVB-39)	0.98	8.38	-0.57
38.	Net foreign transfers (VA-3 + 4)	0.38	4.53	2.83
39.	Less: Net exports (I-43)	1.15	6.44	5.28
40.	Equals: Net foreign claims	-0.77	-1.91	-2.45
41.	Total current income (lines 8 + 23 + 33 + 38)	126.65	329.65	983.59
42.	Plus: Statistical discrepancy (I-28)	0.70	-1.99	-1.01
43.	Equals: Adjusted GNP	127.34	327.67	982.57

[a]Gross of capital consumption and capital transfers, but net of current transfers to other sectors.

sent the difference between net acquisition of assets (lending) and net incurrence of liabilities (borrowing), each of which could be detailed by type of financial instrument. But our interest here is not in the flow of funds.

In the foreign sector capital account (Table 2-5), note that we add the net capital transfers from the rest of the world (line 7), by recipient sector, to the surplus of the nation on current account (line 6).

The consolidated capital formation account (Table 2-6) contains the contra-entries to the various investments and capital transfers of the sectors, and summarizes national investment, by sector and major type. Note that the capital transfers among the domestic sectors plus net capital transfers from abroad sum to zero. So do net financial investment of the domestic sectors plus net foreign investment, after allowance for the statistical discrepancy. Or, to state it alternatively, the sum of net financial investment for the domestic sectors (line 14) equals net foreign investment (line 5) less the statistical discrepancy (line 18).

Another useful summary is provided in Table 2-7, showing disposable income and its disposition, by sector. The disposable income for each sector is derived as its gross income less transfers to other sectors, and it sums to GNP less statistical discrepancy. Disposable income is allocated by each sector to consumption, productive tangible and intangible investments, and net financial investment. Although saving equals investment for the nation, they are unequal for each sector to the extent of net financial investment. The sector disposable income series, and the channels of disposition, are necessary for an analysis of consumption, saving, and investment functions.

BALANCE SHEETS AND WEALTH STATEMENTS

The combined national balance sheets show the condition of the economy at the end of a period as a result of saving and borrowing, investing and lending, and (if stated in current prices) revaluations of assets since the beginning of the period. In the balance sheet, productive wealth, hitherto confined to tangibles, is added to the financial assets to obtain total assets, which are conventionally shown on the left-hand side. On the opposite side are liabilities (including stock and other equity if these are also carried on the asset side, as is usual in national and sector balance sheets).

Table 2-8 below presents a combined national balance sheet for the United States for the end of the year 1968. The financial assets and liabilities are taken from Goldsmith, who based them largely on Fed-

Table 2-8. *Combined Balance Sheet of the United States, 1968, Including Human Capital (billions of current dollars)*

Financial assets	4,349	Liabilities—total	2,791
Monetary reserves	22	Monetary reserves	5
Currency and demand deposits	209	Currency and demand deposits	211
Short-term claims	1,136	Short-term debt	1,061
Long-term claims	1,343	Long-term debt	1,337
Corporate shares	1,107	Other	177
Equity in unincorporated business	392		
Miscellaneous assets	140		
Productive assets—total	6,296	Equity—Noncorporate business and corporate shares	1,489
Nonhuman capital	2,952		
Tangible	2,783		
Land	623		
Structures	1,250	Net worth	6,365
Equipment	570		
Inventories	340		
Intangible	169		
Human capital	3,344		
Tangible	1,063		
Intangible	2,281		
TOTAL ASSETS	10,645	TOTAL LIABILITIES AND NET WORTH	10,645
Addendum: Net foreign assets	69		

Table 2-9. *Net National Wealth of the United States, by Sector and Type, 1929* (billions of current dollars)

	Nation	Persons	Business	Governments
Nonhuman	392.0	122.0	222.2	47.9
Tangible	390.3	121.7	221.2	47.4
Land	111.5	14.3	80.1	17.1
Structures	157.2	52.4	77.6	27.3
Equipment	60.0	33.5	23.6	3.0
(Military)	(4.3)			(4.3)
Inventories	61.5	21.5	39.8	0.1
Intangible	1.7	0.3	0.9	0.5
Human	390.7	327.3	15.6	47.8
Tangible	204.0	204.0	—	—
Intangible	186.7	123.3	15.6	47.8
Education	164.1	105.2	14.7	44.2
Health	18.1	14.2	0.4	3.5
Mobility	4.6	3.9	0.5	0.1
Total—domestic	782.8	449.3	237.7	95.7
Net foreign assets	16.5			
Total—national	799.2			

eral Reserve Board estimates.[3] The productive assets estimates (net of depreciation reserves), human as well as nonhuman, are those presented in this study. The estimates are intended to represent market price or proxies, notably depreciated replacement cost in the case of the depreciable assets. The latter concept is not only far easier to implement statistically than the economic concept of present value, but also makes possible the calculation of historical rates of return without the circularity inherent in relating compensation to a discounted future income stream, actual or expected.

The nonhuman reproducibles were obtained by use of the perpetual inventory method, generally with a double-declining balance method of depreciation. Estimates for the private business economy are largely extensions of earlier Goldsmith estimates. The human capital estimates were prepared in large part by cumulating human investments over the lifetimes of successive cohorts of individuals and summing each year for all cohorts.

It can be seen from the balance sheet that net worth is equal to the

3. Raymond W. Goldsmith, ed., *Institutional Investors and Corporate Stock: A Background Study*, Studies in Capital Formation and Financing 13, New York, NBER, 1973.

Table 2-10. *Net National Wealth of the United States, by Sector and Type, 1948* (billions of current dollars)

	Nation	Persons	Business	Governments
Nonhuman	892.5	298.7	378.1	215.8
Tangible	879.2	297.7	372.8	208.8
Land	197.9	44.7	123.6	29.6
Structures	365.2	134.7	110.8	119.7
Equipment	175.6	65.5	53.6	56.5
(Military)	(65.6)			(65.6)
Inventories	140.6	52.7	84.9	3.0
Intangible	13.3	1.0	5.3	7.0
Human	908.8	715.9	37.3	155.6
Tangible	396.9	396.9	—	—
Intangible	511.9	319.0	37.3	155.6
Education	457.8	278.1	35.2	144.5
Health	43.5	32.0	1.0	10.5
Mobility	10.6	8.9	1.2	0.5
Total—domestic	1,801.4	1,014.6	415.4	371.4
Net foreign assets	37.6			
Total—national	1,838.9			

Table 2-11. *Net National Wealth of the United States, by Sector and Type, 1969* (billions of current dollars)

	Nation	Persons	Business	Governments
Nonhuman	3,220.5	1,103.0	1,306.5	811.1
Tangible	3,035.6	1,091.5	1,252.1	692.0
Land	686.8	174.3	393.7	118.8
Structúres	1,376.1	515.9	423.0	436.3
Equipment	617.4	284.0	230.7	102.7
(Military)	(146.8)			(146.8)
Inventories	355.3	117.3	203.8	34.2
Intangible	184.9	11.5	54.4	119.1
Human	3,699.9	2,695.9	169.5	834.5
Tangible	1,146.9	1,146.9	—	—
Intangible	2,553.0	1,549.0	169.5	834.5
Education	2,267.3	1,334.1	162.4	770.9
Health	241.7	175.0	5.0	61.7
Mobility	43.9	40.0	2.0	1.9
Total—domestic	6,920.4	3,798.9	1,476.0	1,645.6
Net foreign assets	69.2			
Total—national	6,989.6			

value of the productive assets plus net foreign claims. This is, in effect, the result of *consolidating* sector balance sheets, with domestic assets and liabilities canceling out. Since our interest here is in *wealth*, the Appendix B tables show domestic productive wealth, by sector and type, with net foreign claims added for those who prefer to work with the national wealth aggregate. Changes in the statements of wealth are directly related to net investments in our capital accounts, plus revaluations.

Tables 2-9 through 2-11 show that inclusion of human capital more than doubles the national wealth of the United States as conventionally measured. The proportion of human to total wealth did not increase significantly between 1929 and 1969, however. In fact, nonhuman capital increased significantly in relation to tangible human wealth. But the intangible human wealth increased much faster. In Chapter 5 we suggest that the growth of intangible capital generally in relation to tangible factors is a primary explanation of the increase in total tangible factor productivity.

Summary of Methodology and Sources

The behavior of time series and their interpretation depend not only on the underlying concepts, but also on the methodology used in their estimation and the reliability of the basic data sources. This summary of sources and methods is provided for the general reader who is not interested in perusing the detailed description contained in the appendixes (particularly since much of it is on microfiche) but wants to grasp the general approach. The data sources are referred to here only in general terms; for specific references the appendixes must be consulted.

Our summary starts with the current dollar gross investment series, tangible and intangible. Next we look at the price indexes used for (1) deflating the various categories of investment to obtain the real investment estimates on the basis of which the associated real stocks are estimated, and (2) reflating real reproducible stocks to current prices. Finally, the methodology for estimating the real stocks, by category, is set forth.

CAPITAL FORMATION

TANGIBLE NONHUMAN INVESTMENT. This category covers expenditures for new construction, equipment, and inventory accumu-

lation. In the U.S. national income accounts, only gross private domestic investment by businesses and institutions is identified as such. We include the comparable outlays for households and governments.

Personal sector residential construction consists of BEA's farm residential construction and our estimates of that portion of expenditures on nonfarm residential construction destined for owner-occupancy. Institutional plant and equipment outlays as well as expenditures on consumer durable goods come from BEA. Inventory stocks and the net change are estimated roughly on the basis of methods developed by Lenore Epstein.

Business sector figures on residential and nonresidential construction, outlays on producers' durable equipment, and the change in business inventories are based on BEA, but outlays pertaining to other sectors are deducted. The old BEA estimates of producers' durable equipment conventionally charged to current expense are resurrected and extended.

For *government sector* outlays on new construction, BEA estimates are used for federal, state, and local governments, including military as well as civilian construction. Estimates of government outlays on civilian and military equipment and inventories are based primarily on the work of Raymond Goldsmith.

Since we assume the national land stock constant over time, overall investment is zero. This assumption is somewhat arbitrary, but changes do take place in farmland, mineral land, and siteland, and a residual category of vacant and nonclassified land was introduced to offset these changes. Estimates of intersectoral land transfers are based on information from BEA. Net foreign investment estimates are taken directly from BEA.

TANGIBLE HUMAN INVESTMENT. This category embraces the portion of personal consumption expenditures allocated to rearing children to working age, that is, age fourteen, corresponding to the official U.S. labor force definition at the time the estimates were made (subsequently changed to age sixteen). All rearing costs are considered financed by the personal sector.

Estimates of average annual costs per child are by age groupings, based on surveys of family consumption patterns. Basically, BEA personal consumption expenditures by category are used, but some items are left out, either because they are not attributable to rearing children or because they are included elsewhere, such as expenditures on education. Population is divided into age groups, and the corresponding proportions of personal consumption expenditures are assigned to each group.

For the estimates of personal consumption expenditures prior to

1929 we relied upon Dewhurst, Kuznets, and Gallman. Rearing costs for the period 1830 to 1929 were estimated on the assumption that the 1929 ratios of per capita rearing costs for each age group to per capita consumption expenditures were true for the 1830–1928 period.

The opportunity costs of parents' time devoted to rearing were not included, since in this study we have not undertaken imputations for unpaid work, with the exception of schoolwork.

INTANGIBLE NONHUMAN INVESTMENT (R&D). Research and development outlays result in the production of new knowledge and its commercial application in the development of new or improved consumer and producers' goods and methods of production. While basic research, about 10 per cent of total R&D, is not directed toward practical application, it progressively enlarges the pool of scientific knowledge continually drawn upon (and contributed to) by those engaged in applied research, invention, and engineering development. It seems fair to count basic research as well as development activities as investment, with the cost of the "useless" research being borne by that which eventually has an economic payoff.

Measured R&D includes only the formal activities of the various sectors; some informal activity, such as that of the "lone wolf" inventor, is not included. As informal inventive activity has become relatively less important with the spread of the industrial laboratory, the estimates tend to have some upward bias as a measure of total R&D. This is accentuated by a tendency for more complete reporting of such costs with R&D gaining in prestige. In real terms, however, this possible upward bias is offset by the upward bias of the price deflators, which are based on input prices due to the difficulty of defining and measuring R&D outputs.

National Science Foundation estimates of R&D outlays are used for the period from 1953 onward, broken down into basic research and applied research and development. (It was not possible to subdivide the latter category.) The National Science Foundation estimates are available by sector of finance according to the sectoring used in this study, except that the relatively scanty funds provided by state and local governments are merged by NSF with those of private nonprofit institutions and had to be disentangled from fragmentary data. The R&D estimates were also distributed by broad product fields as a basis for developing the stock estimates.

The NSF estimates were carried back from 1953 to 1921 in a Conference Board study for selected years by Nestor Terleckyj.

INTANGIBLE HUMAN INVESTMENT. The *education and training* series cover expenditures on formal, informal, and special education, as well as costs of employee training.

Formal education costs for the personal sector consist of BEA's personal consumption expenditures on private education and research, plus our estimates of the net rental for this sector's educational plant and equipment. Students' expenditures on supplies and rentals of books and equipment are estimated as a percentage of imputed student compensation (opportunity costs). The latter forms an important part of educational costs in the personal sector, and is estimated by level of education, adjusted downward for unemployment (BLS rates). Government sector-financed formal education expenditures are basically BEA figures on federal, state, and local purchases for education and for veterans' education and training. Gross public educational structure and equipment rentals are added, with public educational capital derived from public construction figures and educational capital outlays estimated by HEW.

Informal educational outlays by the government sector are estimated from BEA data as the total purchases for state and local libraries and recreation, the Library of Congress, and the Smithsonian Institution. Personal sector informal education consists of parts of consumer costs for radio, TV, records, books, periodicals, libraries, museums, et cetera. For most of these items the proportions ascribed to informal education are derived from estimates developed by Fritz Machlup. For book rentals similar assumptions are made, while for libraries and museums net rentals as well as direct costs are based on BEA figures. Business and institutional expenditures on public education are estimated as percentages of media advertising expenditures, based on Machlup's proportional allocations to intellectual and practical topics of media time and space.

Special (religious) education expenditures are derived from BEA totals in the religious activity expenditures personal sector. The allocation to religious education uses a ratio based on numbers of students in Sunday schools times expenditures per pupil, with a portion of imputed interest on plant and equipment of religious organizations added. Military education and training is estimated from government expenditure series.

Employee training is estimated separately for each sector. Several cost components are included. The cost of initial nonproductive time is estimated by converting nonproductive hours of employees and supervisors to standard hours. The occupational standard hours are weighted by occupational distributions of employment, and training time is derived as a proportion of annual hours worked, applied to annual compensation of new hires. Training hours are based on *Personnel Journal* data, and occupational distributions of workers and average annual hours worked, on BLS data. Government new hire rates are

from the U.S. Civil Service Commission, private sector rates, from BLS, and employee compensation, from BEA. Besides initial training time lost there is additional time lost, estimated as a percentage of the former. Nonwage production costs are also taken into account. Formal training costs for the business sector are the numbers of trainees by type of training, based on a U.S. Department of Labor survey, times cost per employee, based on a sample survey. The direct costs of formal training of federal government employees are estimated from Civil Service Commission data, and state and local costs, as a percentage of federal costs.

One-half of the expenditures on *medical, health,* and *safety* objectives is considered as investment, the other half as maintenance that does not increase future productive capacity. The personal sector's expenditures on health and medical care are based mainly on BEA estimates of this category of personal consumption expenditures, with imputed rental values of ophthalmic products and orthopedic appliances added. An imputed net interest on nonprofit hospital structures and equipment is derived by applying interest rates to stock estimates. Business sector outlays for in-plant medical care are derived from HEW estimates, and safety costs are based on Brookings Institution estimates of expenditures for safety programs. Government sector expenditures on health, sanitation, and medical care consist of the BEA estimates of total federal, state, and local outlays on goods and services for health and hospitals, sanitation, and veterans' hospital and medical care. Hospital construction and equipment outlays are deducted, but gross rentals on public hospital structures and equipment are added. The latter consist of depreciation and net interest (a percentage of total net interest on structures).

Mobility costs include job search and hiring, frictional unemployment, and migration costs. Job search costs are incurred by persons and are included in BEA's personal consumption expenditures (we used part of the group of expenditures which includes employment agency fees). The business sector also has costs linked to job changes. A cost estimate per new hire was multiplied by the number of new hires derived from BLS data. Hiring costs are estimated along the same lines for the government sector, using government new hire rates. To this sector's outlays for mobility are added the administrative costs of the U.S. Employment Service, based on Department of Labor and U.S. Government Budget data. These costs are allocated half to hiring and half to unemployment costs. Of the assumed employment costs, however, only part is retained in the frictional unemployment group, since frictional unemployment is assumed to be 3 per cent of the labor force. For the personal sector, frictional unemployment costs are the product

of the number of frictionally unemployed and average annual wages and salaries. Although the opportunity cost of the unemployed may be less than the average pay of those employed, no adjustment is attempted. In recent years a deduction has been made for severance pay. The latter is included in business sector frictional unemployment costs along with separation costs incurred by firms because of layoffs.

Another important component of mobility costs is the outlay linked to work-oriented travel and moving of household items. We worked with a cost-per-mile estimate for each of these categories, applied to an estimated average mileage of work-oriented travel and moving for interstate and intrastate migration. Numbers of migrants are based on Census Bureau data, adjusted for work-oriented migration. For moving costs, numbers of families moving are derived. One-half of the estimated moving and travel costs is charged to the personal sector, the other half, to the business and government sectors in proportion to the number of persons employed by each. Besides internal migration, an estimate is made of the federal government's investment in international migration, i.e., the administrative costs of the Immigration and Naturalization Service.

PRICE DEFLATORS

NONHUMAN TANGIBLES.   For most categories of personal sector investment we use BEA deflators, supplemented by detailed consumer price indexes for selected components. For the business sector, all deflators are from BEA, and for the government sector, from BEA plus several other sources. Land deflators are based on prices of various land categories as compiled by Manvel and Goldsmith for the nonfarm sector, and the U.S. Department of Agriculture for farm lands.

HUMAN TANGIBLES.   Rearing cost estimates were made directly in constant dollars: most of the categories were either available in constant dollars from BEA. or deflators could be constructed from the underlying BLS consumer price indexes. However, to reflate constant dollar stock figures an implicit deflator for total rearing costs was calculated.

HUMAN INTANGIBLES.   Personal sector formal education costs in constant dollars are estimated directly, by the same method as that used for the current dollar estimates. Associated costs are deflated by a composite index including transportation and supply costs. For constant dollar foregone earnings of students, average compensation is held at the 1958 level. Organized education and training outlays for the government sector are deflated by BEA's implicit price deflator for state and local purchases of goods and services. The same deflator is used for

this sector's *informal* education expenditures. Direct outlays on librar-
ies and museums are deflated by a BEA deflator for religious and
welfare outlays. The deflator for institutional and business public edu-
cation costs is based on the cost of the various media per person
reached. *Religious* education expenditures are deflated by the BEA
deflator for religious and welfare activity. *Military* education costs are
deflated by the BEA deflator for federal government purchases of goods
and services.

Finally, for *training* costs all compensation is converted into 1958
dollars by an index of average compensation adjusted for quality
change. Nonwage training costs are deflated, for the personal and
business sectors, by BEA's private fixed nonresidential investment
price deflator, and for the government sector, by the price deflator for
government purchases of goods and services. The latter is also used to
deflate the government sector's formal training costs. For business
sector training costs we used a composite index including the compen-
sation deflator and the nonresidential private fixed investment deflator.

Turning to *medical care* costs, deflators for both personal and
business sectors come from the American Medical Association. Govern-
ment sector expenditures on health, sanitation, and medical care are
deflated by BEA's price index for government purchases of goods and
services. Hospital depreciation and net interest in real terms are
derived by applying base period ratios to constant dollar stock esti-
mates.

In the area of *mobility* costs, job search costs in the personal sector
are estimated via the implicit BEA price deflator corresponding to the
personal consumption expenditures category used to get the costs. For
business sector hiring costs a composite index is applied based on
BEA's average industry labor compensation adjusted for quality
changes. The same index is used for frictional unemployment costs
other than governmental. For government sector hiring costs, frictional
unemployment costs and immigration costs are deflated by the price
index of government purchases of goods and services. For moving costs
the BLS transportation services price index is used, and for travel costs
a composite price index for costs of owner-operated and other transpor-
tation charges is developed.

CAPITAL STOCKS

TANGIBLE NONHUMAN STOCKS. The estimates of tangible non-
human capital were prepared via the perpetual inventory method. Both
current and constant dollar stock figures for the business sector are

those published by the BEA, adjusted to our sector definitions. Of the variants estimated by BEA for private structures and equipment, we chose those based on Treasury Bulletin F service lives less 15 per cent, and the Winfrey S-3 retirement curve. This curve is based on studies of the age distribution of retirements for various types of producers' durable goods in the 1930s. It seemed more accurate to apply a mortality curve than to assume retirement of assets at the end of their average life. The Bulletin F minus 15 per cent lives were adopted because structures and equipment since World War II have had a somewhat shorter life than before. Real nonfarm structures were adjusted for the well-known upward bias of construction cost deflators by using BEA's "constant cost 2" variant, which results in a higher growth of fixed capital.

Net stocks in all sectors are calculated by using double-declining balance depreciation, which is believed to give a more accurate representation of the decline in values of fixed assets as they age than the straight-line method.[4] A switch was made to straight-line depreciation in all stock calculations when it exceeded that obtained by the declining balance method.

The depreciable stock estimates for the personal and government sectors were calculated from investment estimates. Gross investments were retired at the end of their average lives and depreciated within these periods, by type. The price indexes used for deflating gross investment were generally adopted also for reflating real stocks.

Farm and nonfarm gross stocks of residential structures were accumulated in constant dollars, using 70-year average lives and 25-year flat-top retirement patterns centered on average life. Net stocks for this category, as well as for institutional plant and equipment and consumer durable goods, were derived by using double-declining balance depreciation. For household inventories we relied on methodology developed by Epstein.

Government sector real capital stocks, federal as well as state and local, are based on Goldsmith's estimates.

The value of total U.S. land in constant dollars has been kept unchanged apart from additions to territory. For most land categories we relied on Goldsmith. Siteland for all sectors is estimated as a constant proportion of the corresponding real stocks of structures.

Net foreign assets for recent years are from BEA, but are carried backward following estimates by Goldsmith. Monetary metals are included with net foreign assets. The gold component is compiled from

4. See, for example, George Terborgh, *Realistic Depreciation Policy*, Chicago, Machinery and Allied Products Institute, 1954.

Federal Reserve Board figures, the silver component, from Treasury data.

TANGIBLE HUMAN STOCKS.   To estimate the stock of tangible human capital we cumulated the average constant dollar rearing costs per child up to age fourteen and multiplied the cumulative cost by the number of persons in each cohort up to age ninety-five plus. Retirements are thus automatically accounted for. Summing the total real costs for all cohorts each year yielded the annual real gross tangible human capital estimates.

Depreciation is calculated by the declining-balance formula, for the sake of consistency of the net investment and stock estimates with the nonhuman categories. Real gross and net human stocks can be revalued to current prices by the implicit deflator for rearing costs. Stock calculations required getting investment estimates as far back as the 1830s.

INTANGIBLE NONHUMAN STOCKS.   Capital stock calculations for basic research are kept fairly simple: annual constant dollar expenditures are cumulated without regard to length of time needed for completion (since each step taken adds to new knowledge) and without regard to obsolescence or retirement (in view of the cumulative nature of the advance of knowledge). To the extent that these assumptions are exaggerations the portion of applied research that might be treated as basic research is considered as a tradeoff.

Stocks of applied research and development are estimated by the perpetual inventory method. To this end, R&D is divided into process and product innovations. The latter, in turn, are disaggregated into nondurable and durable, producers' and consumer, defense and nondefense goods.

Since information on process-product innovation breakdowns, time lags between R&D and commercial application, and lifespan of innovations was unavailable to us, a small survey was made of companies conducting research. Some of these were engaged in business-oriented research and others in government contract work, so that the results could be applied to all R&D expenditures.

As to product versus process innovations, the results of our survey were averaged by major product field and weighted by R&D product field expenditures. Durable goods had a high product-process innovation ratio; for nondurable goods the ratio was lower. For government sector defense goods the business durable goods ratios were used; other government R&D expenditures, as well as personal sector R&D, were allocated half to process and half to product innovations.

The next problem was that of retiring R&D from stock. It was subdivided into projects in process and completed projects, the latter

being retired. Here again the survey gave some information as to the percentage of expenditures attributable to projects of different duration and the distribution of the expenditures within projects. These data were applied for all years to durable and nondurable goods R&D expenditures. The survey also gave some indication of the time lag between the end of R&D and the application of the innovation, which enabled us to estimate the amount of R&D ready to enter stock each year. Constant percentages were used to derive these magnitudes throughout the whole period, except for durable goods, where percentages varied between prewar and postwar years. Average lifespans of product and process innovations were derived from the same survey.

Separate stock estimates were made for producers' and consumer durable goods innovations based on BEA input-output data, using estimated lifespans for various categories of durable goods. Flat-top retirement patterns were constructed, centered at the average life expectancy.

To obtain net stocks and depreciation for applied research and development the double-declining balance switched depreciation method was used: at the point where straight-line depreciation of the net stock balance gives a larger annual depreciation we switch to staight-line for the remaining net stock balances.

INTANGIBLE HUMAN STOCKS. For education, general training, and health expenditures, the stock accumulation and depreciation methods used are analogous. We first estimated the average annual real expenditures per head by single age groups up to age ninety-five, then accumulated per capita lifetime expenditures for each cohort for each year covered in the stock calculation, then multiplied this by the number of persons in each age group each year and summed across age groups. This means we had to push the investment estimates back ninety-five years prior to 1929, the first year for which stock estimates exist. Our procedure automatically provides for the retirement of investment in persons who die during the year: expenditures are only accumulated into gross stock for survivors. Basic population figures by single years of age are from the Bureau of the Census.

For formal education, whether financed by the personal or government sector, constant dollar direct costs are broken down into elementary, secondary, higher, and other education, and allocated to age groups within these educational levels. This allocation is based on proportions by age in the enrollment series for each level. Informal education follows the same general procedure. For the portion financed by the personal and business sectors, it is assumed that all ages benefit equally. Government sector costs are allocated equally to persons of age five and over, and special education investment is traced only to

ages five to seventeen. Military training costs are split between specific training and general training, the former cumulated over the period of active plus reserve duty, the latter spread over the total male population, with different ages receiving different weights. Employee training is broken down into the same subcategories, with specific training costs included in stock for the average duration of job tenure, and general training costs allocated to age groups according to the estimated age distribution of employment (developed from labor force participation rates, with a deduction for unemployment).

While all of the medical and health investment financed by the personal and government sectors is allocated by age groups, business sector investment is only partly treated that way. Fifty per cent of the investment outlays of this sector are considered "general" investment and are accumulated as stock, as in the case of other human categories. The other half is assumed to be "specific" investment, yielding benefits only as long as an employee stays with the original firm. This investment is considered part of stock for the average duration of job tenure only.

Medical, health, and safety outlays had to be allocated among age groups as a basis for cumulative real per capita outlays from which gross stocks were calculated. Personal and government expenditures are on a per capita basis and are distributed over various age groups according to data from *Vital and Health Statistics*. Business sector general health and safety expenditures are divided by the population (ages fourteen to seventy).

As to mobility stocks, lives are different for each cost category. Since these costs are estimated only for a fraction of persons in a group, life is estimated as the reciprocal of the percentage of people in the group. Thus, if in a given year mobility costs are incurred for 20 per cent of the employed, the life of these costs is assumed to be five years. Changes in the yearly percentages are taken into account. Hiring cost lives are the reciprocal of new hires rates; frictional unemployment cost lives are based on layoff rates; and moving and travel costs use the ratios of work-oriented migrants to the labor force.

Net capital stocks embodied in humans are derived by depreciating investment units from maturation ages (or the ages at which outlays are made if later) through age seventy-five. This is done for each investment unit and each age. Per capita accumulations are the next step, multiplied by corresponding population figures. The net stocks for those persons who die before age seventy-five are dropped out at the time of death.

Double-declining balance switched (to straight line) depreciation is used, constructed so as to approximate depreciation factors published

by the Internal Revenue Service. Depreciation of rearing and medical costs is started at age eighteen, education and training, at age twenty-eight. This later age for education and training is derived from lifetime earnings curves: our depreciation reflects the decline in the lifetime earning capacity of the human capital. Discounted future earnings curves were obtained from a U.S. Census Bureau study which assumed an annual 3 per cent productivity increase and discount rates of 8 to 10 per cent per year.[5] It indicated appreciation in value of individuals through the late twenties, and a pattern of decline thereafter that seemed to be approximated by our declining-balance switched (to straight line) depreciation methods.

The real gross and net capital stock estimates, by type, are reflated to current prices with the same price indexes that are used to deflate current dollar investments, by type. The annual depreciation charges, in constant and current prices, are subtracted from the corresponding gross investment series to obtain net investment estimates.

STOCK VARIANTS.   It is assumed that all of the nonhuman capital is productively employed. But clearly much human capital is embodied in persons not employed. To estimate employed human capital stocks we applied ratios of employment to population by age group to the total stock estimates, by type and by age groups. Sector proportions of persons engaged were then applied to the productive stocks to obtain sector breakdowns. This treatment does not make allowance for the human capital devoted to unpaid economic activity (other than school-work), and the real product estimates are likewise unadjusted for the nonmarket outputs of unpaid labor.[6]

For organized education the basic method for calculating employed stock is the same, except that cost differentials are used. The differentials adjust for differences, by age group, in the stock of organized education embodied in employed persons relative to the total population.

All employee training, military education and training, and business medical stocks are considered employed during estimated average job tenures; that is, for the time span that specific investment is retained in stock. After average job tenure, only general investment is carried in stock. Stocks resulting from mobility costs, job search and hiring costs, and moving and travel costs are considered totally employed.

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5. Herman P. Miller and Richard A. Hornseth, Technical Paper 16, Bureau of the Census, 1967.

6. The author is currently engaged in a study involving the expansion of imputations for nonmarket economic activity in the national income accounts, but the results were not ready for inclusion in this volume.

Besides employed stocks we also estimate stocks *utilized* by the private domestic business economy by applying a utilization rate to human stock employed by the private domestic economy. Utilization factors are calculated as the ratio of average weekly hours worked to hours awake, assumed to be 112 per week (7 times 16 per day). The real nonhuman capital stocks are adjusted only for cyclical variations in rates of capacity utilization, relative to selected high-level years taken as 100. Information is not available to determine whether there has been a significant trend in composite utilization rates of nonhuman capital.