AN EXTENDED MEASURE OF GOVERNMENT PRODUCT: PRELIMINARY RESULTS FOR THE UNITED STATES, 1946–76

BY ROBERT EISNER AND DAVID H. NEBHUT*

Expanded measures of government output include imputed values of the services of government capital, uncompensated factor services of military draftees and jurors, and net revaluations, as well as the usually included compensation of employees. The government output is allocated to consumption, capital formation and product intermediate to other sectors, on the basis of its classification in ten broad functions: defense, space research, education, health, sanitation, transportation, parks and recreation, natural resources, welfare, and general administration. Final government product in 1976, including $116 billion in defense and $125 billion in education, amounted to $450.5 billion, which was 26.5 percent of the 1976 GNP. This final government product corresponded to the BEA measure of $191.6 billion.

Total capital formation related to government is defined to include both government product which enters into capital formation in other sectors and government expenditures for its own capital accumulation. After a more rapid rate of growth in previous years, this total government capital formation in the United States in 1976 is found to exceed gross private domestic investment. A significant but only minor portion was found to be constituted by government expenditures for capital goods and change in government inventories. Investment in research and development, health and, particularly, education and training, were dominant components in capital formation related to government.

The role of government has been one of increasing concern in modern mixed economies. Yet two important measures of that role, government product and capital formation accounted for by government, are so narrow as to be misleading if not useless for many purposes.

In the National Income and Product Accounts of the United States (NIPA), general adherence to a criterion of final product, taken to be goods and services purchased but not resold, limits the measure of government product to compensation of employees. No government capital formation is included in the usual measure of investment, designated accordingly as "gross private domestic investment."

In earlier work by one of the current authors, it was noted that the narrow measure of government product constituted in 1959 only 75 percent of net government product measured more comprehensively in accordance with the Total Incomes System of Accounts. By 1969, this ratio had declined to 65 percent. According to the conventional United States Bureau of Economic Analysis measures, product of government in 1959 was only $44 billion, just over 9 percent of gross national product. By 1969 it was $103.7 billion, which amounted to just over 11 percent of gross national product.

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In the preliminary extended TISA measures (Eisner, 1978), net government product grew from $58.8 to $158.6 billion or from 10.7 percent to 12.6 percent of expanded gross national product, between 1959 and 1969, the two years for which estimates were presented. And indeed by both measures the ratio of government product to total output in current dollars grew, at a 2.06 percent per annum rate in the conventional measure and at a 1.64 percent rate in the TISA measures.

In the current paper we shall present estimates of expanded measures of government product in the United States in both current and constant (1972) dollars, for selected years[1] from 1946 through 1976. We shall undertake several major imputations. First, we shall make use of new estimates of government capital to impute values of services of capital. These will be the sum of a measure of interest return and capital consumption allowances at replacement cost. Second, we shall offer estimates of uncompensated factor services, particularly those of military draftees and jurors. These services are defined as the difference between what government actually paid as compensation and our estimates of the true factor opportunity cost. Third, we shall estimate the gains or losses on government capital or "net revaluations", that is, the difference between increases in value of government capital, aside from net investment, and increases, corresponding to changes in the general price level, which would have been necessary to keep its real value intact.

We introduce two adjustments to the labor income component of government product. First, we add the value of employee training to compensation of employees. Second, we net out of compensation of employees the expenses related to work. We treat these as intermediate goods and services, generally produced by other sectors, and hence not value added or product originating in the government sector. In principle, such expenses might involve a broader set of items but in practice we have endeavored to measure only travel expenses of government employees and have subtracted them from compensation of employees in order to arrive at the net value of factor services going into the production of government output. Conventional compensation of employees is thus essentially broken down into two components, one of which is true compensation and the other is a payment to workers which they in turn use to pay for their expenses in coming to work.

In addition to measuring the totals of government output, we endeavor to divide the output into three categories, that which goes to consumption, that which goes to capital formation, and that which constitutes intermediate product for the output of other sectors. We view consumption services as transferred to households, investment as transferred to households or enterprises (business, government or nonprofit) or retained by government, and the intermediate product of government as transferred to households and enterprises.

The categorization involves a three-step procedure. First, published NIPA data (Table 3.14) as to government expenditures by twenty types of function and 43 sub-types are reclassified into ten broad functions: defense (including police and fire protection), space research, education, health, sanitation, transportation, parks and recreation, natural resources, welfare, and general administration.

[1]Estimates for all years and a complete set of tables may be obtained from the authors.

Second, the published data are adjusted by deletion of expenditures which do not correspond to current output and by allocation of labor income, imputed interest, capital consumption allowances, uncompensated factor services, intermediate product inputs, and expenses related to work. Third, for each function, judgmental allocations are decided upon as between consumption, investment and intermediate product and the sector to which the output is destined. Thus, for example, output of parks is considered as consumption, output of education is taken to be investment in intangible capital, output of health services is viewed as half current consumption and half investment in future health and productivity, and output of defense, except for a component of investment in research and development, is viewed as intermediate product.

In many instances, while allocations are systematic they are based upon gross assumptions. Thus, defense services are presumed to be intended to protect the capital of the nation and the value of these services credited to each sector is made proportionate to its share of physical capital. Some of government defense services are hence used to protect government. Government transportation services are allocated to enterprises and to government in proportion to the output of the enterprise and government sectors. Government transportation services to households are then in turn related to services to enterprises on the basis of annual mileage of trucks, busses and passenger cars in each sector. General administration services are allocated in proportion to product originating in each sector.

Some of government services are thus inputs as well as outputs attributable to the various functions of government. Allocation of government services of defense, transportation and general administration among functions of government is made proportional to what we designate as the "untransferred product" of each function. This is simply value added in that function plus the intermediate product purchased (from outside of government) and used in current production. The gross product of the function will then include, in addition to untransferred product, the product transferred to that function from defense, transportation and general administration. The final product of each function, available for transfer to households and enterprises, will equal the gross product minus transfers of product to other functions of government. (These transfers are assumed to be zero except in the case of product originating in defense, transportation or general administration.)

We are thus able to produce in Table 1 estimates of final government product by each of ten major functions, shown for 1946, 1956, 1966, and 1976.

These estimates are also developed in constant dollars, with the results shown in Table 2. The constant dollar estimates reflect largely general indices of government purchase prices. In only a few categories of government product do we have anything near reasonable separate deflators. A significant effort at separate price deflation of defense expenditures has been initiated in the United States but results are thus far available only for the years from 1972 on (Ziemer and Galbraith, 1979).[2]

[2]Various of our explicit and implicit price deflators are shown in Table 9.

TABLE 1

FINAL GOVERNMENT PRODUCT BY FUNCTION

Billions of dollars

Function	1946	1956	1966	1976
Defense	51.0	46.5	79.0	115.9
Space Research	0	0	6.9	4.2
Education	5.3	14.7	39.8	125.2
Health	2.0	5.0	10.9	35.7
Sanitation	1.0	1.1	2.6	8.7
Transportation	6.9	10.5	23.5	68.6
Parks and Recreation	0.2	0.7	1.7	6.0
Natural Resources	1.5	2.9	5.8	16.8
Welfare	0.3	1.4	4.5	28.0
General Administration	2.6	5.7	11.7	41.4
Total	70.7	88.4	186.5	450.4

Underlying the product allocated to each function is our estimate of charges against gross government product for the government sector as a whole. These are to be found on the debits side of Table 3. Labor income includes the value of employee training, military as well as civilian, and compensation of employees less expenses related to work. The only expenses related to work that we have estimated thus far, as indicated above, are transportation expenses.

In imputing interest, we have employed nominal rates—the yield on government bonds—although one may well argue that the opportunity cost of capital is better measured by real rates of interest, that is, the nominal rate of interest minus an expected rate of inflation presumably related to past rates of inflation. Using nominal rates of interest does in a sense inflate our measures of interest income, but a similar problem occurs in measurement of net interest in conventional income and product accounts. In principle, inflation of interest income resulting from expected rates of inflation should be accounted for in deflating to measure product in constant dollars. It is of course doubtful that the current state of price deflators for government product is such that this deflation is accomplished adequately.

Net revaluations involve gains and losses in the value of government wealth which are more than or less than, respectively, changes in the price level. These are considered to be accumulations (or decumulations) of capital by government which do not, however, enter into the final product transferred to households and enterprises.

Income originating in government is taken to be the sum of labor income, interest, and net revaluations. To arrive at total charges against net government product we must then add the value of uncompensated factor services, among which we include the difference between the opportunity cost and the actual compensation of the services of jurors and, most importantly, of military draftees. The estimates for jury services are patterned after the work of Martin (1972) utilized previously in Eisner (1978). The substantial estimates for draftees are taken and developed from the work of Lundberg and Nebhut (1979).

TABLE 2

FINAL GOVERNMENT PRODUCT BY FUNCTION

A. Billions of 1972 dollars

Function	1946	1956	1966	1976	Means 1971–76	Means 1946–76
Defense	170.5	87.0	112.8	87.5	92.7	101.1
Space Research	0	0	9.8	3.1	3.5	2.8
Education	18.6	29.2	58.2	90.7	85.5	47.3
Health	5.7	9.9	15.7	24.4	24.4	14.2
Sanitation	3.3	2.2	3.7	6.4	7.3	3.7
Transportation	16.5	14.2	27.9	51.8	49.9	25.0
Parks and Recreation	0.7	1.3	2.4	4.3	3.7	2.1
Natural Resources	6.6	7.0	8.4	12.1	12.0	8.0
Welfare	1.1	2.7	6.6	20.3	17.1	6.7
General Administration	8.7	11.0	16.8	30.2	26.9	15.8
Total	232.4	164.5	262.6	331.5	323.4	226.7

B. Percentage of total

	1946–50	1951–55	1956–60	1961–65	1966–70	1971–76	1946–76
Defense	66.0	49.7	54.1	48.0	42.0	28.7	44.6
Space Research	0	0	0.2	2.6	2.4	1.1	1.3
Education	11.2	18.1	17.8	20.4	22.7	26.4	20.8
Health	3.9	6.6	5.9	6.1	6.0	7.6	6.2
Sanitation	1.2	1.4	1.3	1.2	1.6	2.3	1.6
Transportation	7.7	9.9	8.2	9.1	11.1	15.4	11.0
Parks and Recreation	0.5	0.8	0.8	0.9	0.9	1.1	0.9
Natural Resources	2.9	4.3	4.0	3.4	3.2	3.7	3.5
Welfare	0.8	1.4	1.5	2.1	3.4	5.3	2.9
General Administration	5.7	7.9	6.2	6.2	6.5	8.3	7.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

C. Average annual rates of growth (percentages)

	1946–50 to 1951–55	1951–55 to 1956–60	1956–60 to 1961–65	1961–65 to 1966–70	1966–70 to 1971–76	1946–60 to 1961–76
Defense	−9.5	8.1	1.5	2.4	−5.0	0.8
Space Research	0	0	76.1	3.4	−11.8	28.0
Education	5.4	5.9	6.9	7.5	4.7	6.4
Health	6.5	3.9	4.5	5.1	6.0	5.0
Sanitation	−0.8	4.6	1.5	11.8	8.3	5.5
Transportation	0.7	2.3	6.2	9.4	8.1	6.1
Parks and Recreation	7.8	7.1	5.9	5.3	5.7	6.1
Natural Resources	3.8	4.4	0.9	3.7	4.8	3.1
Welfare	7.0	8.4	10.3	15.8	10.6	11.4
General Administration	2.0	1.5	4.0	6.2	6.4	4.2
Total	−4.2	6.3	4.0	5.2	1.8	3.5

We finally reach total charges against gross government product by adding capital consumption allowances. These are divided as between capital consumption allowances at original cost and revaluations. The latter correspond to the capital consumption adjustment in the Bureau of Economic Analysis income and product accounts.

Government output is credited to consumption, capital accumulation, intermediate product and change in inventories. Output transferred to households in the form of consumption includes most of the services of the functions of parks and recreation and welfare (excluding a portion of parks and recreation included in investment in education), one-half of health and sanitation, a portion of transportation services (net of transportation expenses related to work) based upon car registrations and mileage, and half of the costs of manned space flights. Governmentally funded private research and development expenditures are viewed as adding to capital accumulation of enterprises. Capital accumulation of households includes all of the services of education and training and half of those of health, viewed as an investment in future health and productivity. Research and development by the Federal government itself, along with expenditures for the conservation of natural resources, are classified as capital accumulation of government.

The total of consumption, capital accumulation by business, households and government, and intermediate product, labelled "gross credits exclusive of change in inventories and net revaluations," corresponds to the total of final government product by function. Intermediate product, which is thus a residual after designation of consumption and capital accumulation, in effect includes the bulk of defense services, half of sanitation services, a portion of transportation, and all of general administration. To arrive at gross government product exclusive of net revaluations we must subtract intermediate purchases from other sectors and expenses related to work and add change in inventories. The further addition of net revaluations gives us a total of gross government product corresponding to the total charges against government product on the debits side of the accounts.

Gross government product, like final product by function, is then roughly converted to billions of 1972 dollars, using various deflators for government purchases of goods and services where specific product deflators are not available. Results are shown in Table 4, which is similar in form to the credits side of the accounts in Table 3.

With the basic data presented for selected years in Tables 1 through 4, we are able to construct a number of comparison and analysis tables. These involve comparisons of BEA government product and our total gross government product (and "current government product," exclusive of net revaluations) in constant dollars and as percentages of GNP (Table 5), means and rates of growth of government output to consumption, capital and intermediate product (Table 6), and measures of capital formation related to government in both current and 1972 dollars (Tables 7 and 8). While we view our actual results as preliminary, subject to substantial improvement in method and underlying data, and we invite particular attention to the detailed description of sources and methods in the appendix, even these preliminary results may be of some substantive interest.

TABLE 3

GROSS GOVERNMENT PRODUCT

Billions of dollars

Debits	1946	1956	1966	1976
1. Labor Income	25.5	42.7	85.1	210.7
1. Compensation of Employees	20.8	36.6	76.5	192.5
2. Employee Training	5.5	8.2	11.7	24.9
3. Less: Expenses Related to Work	0.8	2.1	3.1	6.7
2. Interest	5.3	12.2	29.4	102.3
1. Interest Paid	4.1	5.2	8.5	21.4
2. Net Imputed Interest	1.2	7.0	20.9	80.9
1. Gross Imputed Interest	5.3	12.2	29.4	102.3
1. Land	0.2	1.6	5.7	19.0
2. Structures and Equipment	3.9	8.4	20.5	72.8
3. Inventories	1.2	2.2	3.3	10.5
2. Less: Interest paid	4.1	5.2	8.5	21.4
3. Net Revaluations	−12.7	4.7	2.7	−4.6
1. Land	−1.9	4.1	5.9	18.3
2. Structures and Equipment	−4.1	1.9	−1.8	−22.0
3. Inventories	−6.7	−1.3	−1.3	−0.9
4. Income Originating (1+2+3)	18.1	59.6	117.2	308.4
5. Uncompensated Factor Services	1.3	6.1	10.3	0.6
1. Draftees	1.3	6.0	10.1	0
2. Other	0.0	0.1	0.2	0.6
6. Charges Against Net Government Product	19.4	65.7	127.5	309.1
7. Capital Consumption Allowances	29.7	19.0	24.8	52.9
1. Original Cost	28.0	14.3	19.6	29.4
2. Revaluations	1.7	4.7	5.1	23.5
8. Charges Against Gross Government Product	49.1	84.7	152.3	362.0

Credits	1946	1956	1966	1976
1. Consumption (to Households)	5.0	10.0	27.4	93.3
2. Capital	14.1	33.2	77.0	205.4
1. To Enterprises (R & D)	0.5	3.9	10.9	14.5
2. To Households	11.8	25.4	57.1	168.3
1. Education and Training	10.8	23.0	51.6	150.5
2. Health	1.0	2.5	5.5	17.8
3. To Government	1.8	3.9	9.0	22.6
1. Research and Development	0.3	1.0	3.2	5.8
2. Natural Resources	1.5	2.9	5.8	16.8
3. Intermediate Product	57.1	53.4	93.8	176.6
4. Gross Credits Exclusive of Change in Inventories and Net Revaluations	76.2	96.6	198.2	475.4
5. Change in Inventories	−10.9	2.6	−2.0	5.1
6. Less: Intermediate Purchases from Other Sectors	2.8	17.1	43.5	107.3
7. Less: Expenses Related to Work	0.8	2.1	3.1	6.7
8. Gross Government Product Exclusive of Net Revaluations	61.8	80.0	149.6	366.6
9. Net Revaluations	−12.7	4.7	2.7	−4.6
10. Gross Government Product	49.1	84.7	152.3	362.0

TABLE 4

GROSS GOVERNMENT PRODUCT

Billions of 1972 dollars

Credits	1946	1956	1966	1976
1. Consumption (to Households)	13.5	16.7	36.5	68.0
2. Capital	50.7	69.2	113.1	148.7
1. To Enterprises (R & D)	1.8	7.4	15.8	10.6
2. To Households	41.4	52.8	84.3	121.7
1. Education and Training	38.5	47.9	76.5	109.5
2. Health	2.8	5.0	7.8	12.2
3. To Government	7.6	9.0	13.0	16.4
1. Research and Development	1.0	1.9	4.6	4.3
2. Natural Resources	6.6	7.0	8.4	12.1
3. Intermediate Product	187.3	97.3	131.0	132.7
4. Gross Credits Exclusive of Change in Inventories and Net Revaluations	251.5	183.2	280.6	394.4
5. Change in Inventories	−15.9	3.4	−2.4	3.1
6. Less: Intermediate Purchases from Other Sectors	8.0	25.7	56.0	74.3
7. Less: Expenses Related to Work	1.9	2.9	3.7	5.0
8. Gross Government Product Exclusive of Net Revaluations	225.7	158.1	218.5	273.1
9. Net Revaluations	−30.7	6.9	3.6	−3.3
10. Gross Government Product	195.0	165.0	222.0	269.9

We may note first in the allocation of total government product by function in Tables 1 and 2 that the largest single function throughout the 1946–76 period was defense. It quite dwarfed all others in the immediate post-World War II period and through the cold war of the 1950s and the war in Indochina of the 1960s. In constant dollars, defense output came down sharply from 1946 to 1951 as most of the huge defense capital investment of World War II was written off. It rose through the 1950s, surpassing 100 billion 1972 dollars in 1957, reached a peak of $128.6 billion in 1969, declined to $84.1 billion in 1974, and began to rise once more in 1975.

In recent years, government output in education has, however, risen to the level of defense output and, in constant dollars, exceeded it after 1973. Government output of transportation services, close in amount to output of education in the immediate post-World War II period, comes in as a relatively distant third in more recent years. We estimate the mean of defense output from 1971 through 1976 at $92.7 billion in 1972 dollars, the mean education output at $85.5 billion and the mean of transportation output at $49.9 billion. Health output then comes to $24.4 billion, general administration to $26.9 billion, welfare services to $17.1 billion, the output of natural resources services to $12.0 billion, of sanitation to $7.3 billion, and space research and parks and recreation to $3.5 billion and $3.7 billion, respectively. These figures may be related to a mean total final

government product in the years 1971 through 1976 of 323 billion 1972 dollars. This total, while it includes purchases of intermediate product from the private sector as well as imputations for which there is no analog in private output as measured by the BEA, may be compared with mean gross national product in 1972 dollars which came, for the years 1971 through 1976, to $1,201 billion. Our measure of government services to the public thus came to over 27 percent of gross national product. In current dollars, final government product in 1976, including $116 billion in defense and $125 billion in education, amounted to $450.4 billion. This was 26.5 percent of the 1976 GNP figure of $1700.1 billion.

Indeed, the ratio of total final government product to gross national product was somewhat higher earlier, as may be inferred from the rates of growth of our estimate of product by function shown at the end of Table 2. The mean annual rate of growth of total final government product from the 1966–70 period to the 1971–76 period was only 1.8 percent. It was generally higher from 1951 to 1970, but sharply negative from 1946 to 1951 with the wind-down of World War II defense output.

The debits side of Table 3 makes clear the substantial differences between government product in the traditional BEA accounts and our measure of total gross government product. Looking at our estimates for 1976, for example, we may note that the BEA government product will include only compensation of employees, which amounts to $192.5 billion. While we subtract $6.7 billion for expenses related to work we also add employee training of $24.9 billion to arrive at the labor income component of value added or product of the government sector. Further, we make a substantial imputation of net capital income of $102.3 billion, which is our gross imputed interest figure. Net revaluations were small in this year, −$4.6 billion, as were uncompensated factor services. The imputation for draftees, which had been $16.0 billion in 1970, was now zero. We thus arrive at a figure for net government product of $309.1 billion, more than 50 per cent larger than the BEA measure. If we add our estimate of capital consumption allowances of $52.9 billion, we reach a total gross government product of $362.0 billion, which is 88 percent larger than the BEA government product figure. The imputations for capital income and value added by capital consumption make a major difference.

The allocation of final product indicated in Table 3 reveals $93.3 billion, 19.6 percent of total gross credits exclusive of changes in inventories and net revaluations, going to consumption in 1976. The major components involved transportation services, essentially the use of public highways, and welfare and health services.

The amount of government output going to capital was much larger, $205.4 billion in 1976, the bulk of that, $168.3 billion, to households, largely in education and training provided by public schools. Research and development credited to capital formation in enterprises ran to about $14.5 billion and in government to $5.8 billion. In addition, we credited $16.8 billion to government capital accumulation in the form of improvement of our natural resources. About three-eighths of final product, some $176.6 billion, was in intermediate product, the bulk of that in defense and protection services, with most of the remainder in general administration.

TABLE 5

BEA AND TOTAL GROSS GOVERNMENT PRODUCT COMPARED, 1946–76

Billions of 1972 dollars

Year	BEA Government Product	Total Current Government Product[a]	Net Revaluations	Total Gross Government Product
1946	75.8	225.7	−30.7	195.0
1947	57.9	172.8	20.4	193.3
1948	58.0	154.2	14.9	169.2
1949	62.2	125.8	2.3	128.0
1950	64.6	117.0	−0.5	116.4
1951	78.8	115.7	9.7	125.4
1952	85.3	130.1	−2.9	127.2
1953	85.0	143.7	4.3	148.0
1954	83.9	144.8	1.0	145.8
1955	84.4	151.2	31.7	182.9
1956	86.5	158.1	6.9	165.0
1957	88.9	167.1	5.3	172.3
1958	90.4	167.5	1.9	169.4
1959	91.8	177.1	1.8	178.8
1960	94.9	182.3	8.5	190.8
1961	98.5	187.7	14.6	202.3
1962	102.1	192.7	5.1	197.8
1963	104.8	195.3	4.7	200.0
1964	108.4	202.2	10.5	212.8
1965	112.4	207.1	8.1	215.3
1966	120.4	218.5	3.6	222.1
1967	127.2	232.7	3.0	235.6
1968	131.7	242.6	4.1	246.7
1969	135.0	257.6	15.3	272.8
1970	135.2	265.9	13.1	279.0
1971	136.0	257.1	6.9	264.1
1972	137.4	255.6	30.5	286.2
1973	138.9	268.3	60.6	328.9
1974	141.9	277.4	43.0	320.4
1975	144.4	280.4	1.5	281.8
1976	145.6	273.1	−3.3	269.9
		Means		
1946–60	79.2	155.5	5.0	160.5
1961–76	126.2	238.4	13.8	252.2
1946–76	103.5	198.3	9.5	207.8
		Annual Growth Rates, Percent (Log-Linear Least Squares)		
1946–61	3.2	1.0	0	1.3
1961–76	2.7	2.9	0	3.2
1946–76	3.1	2.6	0	2.8

[a] Total gross government product minus net revaluations.

TABLE 5 (cont.)

Year	BEA Government Product as Percentage of Total Current Government Product	BEA Government Product as Percentage of Total Gross Government Product	BEA Government Product as Percentage of GNP	Total Current Government Product as Percentage of GNP	Total Gross Government Product as Percentage of GNP
1946	33.5	38.9	15.9	47.5	40.9
1947	33.5	30.0	12.4	36.9	41.3
1948	37.6	34.3	11.9	31.6	34.7
1949	49.5	48.6	12.7	25.6	26.1
1950	55.1	55.5	12.1	22.0	21.8
1951	68.3	62.8	13.7	20.0	21.8
1952	65.7	67.1	14.3	21.7	21.3
1953	59.3	57.4	13.7	23.1	23.8
1954	58.0	57.5	13.7	23.6	23.8
1955	55.9	46.1	12.9	23.1	27.9
1956	54.8	52.4	12.9	23.6	24.7
1957	53.2	51.6	13.1	24.5	25.3
1958	54.1	53.5	13.3	24.6	24.9
1959	51.9	51.4	12.7	24.6	24.8
1960	52.1	49.7	12.9	24.7	25.9
1961	52.5	48.7	13.0	24.9	26.8
1962	52.9	51.6	12.8	24.1	24.8
1963	53.6	52.4	12.6	23.5	24.1
1964	53.6	50.9	12.4	23.1	24.3
1965	54.3	52.2	12.1	22.4	23.3
1966	55.1	54.2	12.3	22.3	22.6
1967	54.6	54.0	12.6	23.1	23.4
1968	54.2	53.4	12.5	23.1	23.5
1969	52.3	49.5	12.5	23.9	25.3
1970	50.8	48.5	12.6	24.8	25.9
1971	52.8	51.5	12.3	23.2	23.8
1972	53.8	48.0	11.7	21.8	24.4
1973	51.8	42.2	11.2	21.7	26.6
1974	51.1	44.3	11.7	22.8	26.3
1975	51.4	51.2	12.0	23.4	23.5
1976	53.2	53.9	11.5	21.5	21.3
			Means		
1946–60	52.2	50.5	13.2	26.5	27.3
1961–76	53.0	50.4	12.2	23.1	24.4
1946–76	52.6	50.4	12.7	24.7	25.8
			Annual Growth Rates, Percent (Log-Linear Least Squares)		
1946–61	2.2	1.9	−0.2	−2.4	−2.1
1961–76	−0.2	−0.5	−0.7	−0.5	−0.2
1946–76	0.4	0.3	−0.5	−0.9	−0.7

The trends in government output to consumption, capital and intermediate product, as shown in Table 6, are revealing. Measured in constant (1972) dollars, growth has generally been substantial in government output going to consumption and to capital formation, 6.9 percent and 4.8 percent, respectively, as measured by log-linear regressions over the 1946 to 1976 period, 5.5 percent and 3.7 percent from 1946 to 1976 by beginning-to-end measures. The growth in capital was generally greater in earlier years, however, while consumption growth has been more rapid in later years.

There has been little or no growth in intermediate product. The levelling in intermediate product is of course dominated by the defense component, which was very high in the immediate post-World War II years and again during the war in Indochina, with declines after both wars.

Total capital formation related to government, shown in Tables 7 and 8, includes both government product which goes directly to form capital in the enterprise, household and government sectors, and government expenditures for capital accumulation in the form of capital goods and additional inventories. Consistent wth the total incomes accounts (Eisner, 1978), it also includes net revaluations of existing tangible capital in the government sector.

TABLE 6

GOVERNMENT OUTPUT TO CONSUMPTION, CAPITAL, AND INTERMEDIATE PRODUCT, BILLIONS OF 1972 DOLLARS, 1946–76, MEANS AND RATES OF GROWTH

Year	Consumption	Intermediate product	Capital
	A. Means		
1946–50	12.3	128.3	43.4
1951–55	14.8	82.4	60.3
1956–60	18.7	109.9	76.3
1961–65	27.4	121.1	96.8
1966–70	42.7	145.8	123.0
1971–76	63.5	134.2	144.7
	B. Average Annual Percentage Growth Rates		
1946–50 to 51–56	3.8	−8.5	6.8
1951–55 to 56–60	4.7	5.9	4.8
1956–60 to 61–65	7.9	1.9	4.9
1961–65 to 66–70	9.3	3.8	4.9
1966–76 to 71–76	7.5	−1.5	3.0
1946–60 to 61–76	7.3	1.5	4.7
	C. Log-Linear Least Squares Growth Rates		
1946 to 1961	4.6	−0.6	5.6
1961 to 1976	8.2	0.8	3.8
1956 to 1976	6.9	1.2	4.8
	D. Beginning-to-end Growth Rates		
1946 to 1960	3.2	−3.2	3.7
1961 to 1976	7.6	0.7	3.6
1946 to 1976	5.5	−1.1	3.7

TABLE 7

CAPITAL FORMATION RELATED TO GOVERNMENT

Billions of dollars

	1946	1956	1966	1976
1. Government Expenditures for Capital Goods	2.7	26.2	38.5	59.6
2. Change in Government Inventories	−10.9	2.6	−2.0	5.1
3. Government Product Accumulated	1.8	3.9	9.0	22.6
1. Research and Development	0.3	1.0	3.2	5.8
2. Natural Resources	1.5	2.9	5.8	16.8
4. Total Government Capital Accumulated Exclusive of net Revaluations	−6.4	32.8	45.5	87.4
5. Net Revaluations	−12.7	4.7	2.7	−4.6
6. Total Government Accumulation	−19.0	37.4	48.2	82.8
7. Government Product to Enterprise Capital	0.5	3.9	10.9	14.5
8. Government Product to Household Capital	11.8	25.4	57.1	168.3
1. Education and Training	10.8	23.0	51.6	150.5
2. Health	1.0	2.5	5.5	17.8
9. Total Capital Formation Related to Government	−6.7	66.8	116.1	265.6
10. Capital Formation Related to Government Exclusive of Net Revaluations	6.0	62.1	113.4	270.2
Addendum				
11. Gross Private Domestic Investment, Billions of Dollars	30.7	71.0	124.5	243.0
12. Total Capital Formation Related to Government as Percent of Gross Private Domestic Investment	−21.8	94.1	93.3	109.3
13. Capital Formation Related to Government Exclusive of Net Revaluations as Percent of Gross Private Domestic Investment	19.5	87.5	91.1	111.2

Total capital formation related to government then turns out to be quite substantial, amounting to $265.4 billion in 1976. Omitting net revaluations, which were slightly negative in 1976, capital formation related to government came to $270.2 billion. This may be compared with the more familiar gross private domestic investment figure of $243 billion in 1976. Capital formation related to government turns out to be more than gross private domestic investment!

It has not always been thus. Table 7 indicates that in earlier years government-related capital formation tended to be somewhat less than gross private domestic investment but still generally of a similar order of magnitude. This suggests that those who look to capital formation as a source of economic growth would do well to offer at least equal focus on government-related capital formation as on the traditional measure of gross private domestic investment.

As Tables 7 and 8 make clear, a significant but only minor portion of capital formation related to government is constituted by government expenditures for capital goods and change in government inventories. These together amounted to a little less than a quarter of total capital formation related to government. Direct government investment in research and development and natural resources constituted somewhat less than ten percent of the total. Government funding of enterprise investment in research and development was another five percent. The half of government health product assumed adding to household capital comes to seven percent of total capital formation related to government. The dominant component then is government product in the form of education and training. This accumulation of "household capital" amounted to $168 billion in 1976, over half of total capital formation related to government.

TABLE 8

CAPITAL FORMATION RELATED TO GOVERNMENT

Billions of 1972 Dollars

(1972 = 100)

	1946	1956	1966	1976
1. Government Expenditures for Capital Goods	5.3	40.5	53.5	41.6
2. Change in Government Inventories	−15.9	3.4	−2.4	3.1
3. Government Product Accumulated	7.6	9.0	13.0	16.4
1. Research and Development	1.0	1.9	4.6	4.3
2. Natural Resources	6.6	7.0	8.4	12.1
4. Total Government Capital Accumulated Exclusive of Net Revaluations	−3.1	52.9	64.1	61.1
5. Net Revaluations	−30.7	6.9	3.6	−3.3
6. Total Government Accumulation	−33.8	59.8	67.7	57.8
7. Government Product to Enterprise Capital	1.8	7.4	15.8	10.6
8. Government Product to Household Capital	41.4	52.8	84.3	121.7
1. Education and Training	38.5	47.9	76.5	109.5
2. Health	2.8	5.0	7.8	12.2
9. Total Capital Formation Related to Government	9.3	120.0	167.8	190.1
10. Capital Formation Related to Government Exclusive of Net Revaluations	40.1	113.1	164.2	193.4
Addendum				
11. Gross Private Domestic Investment, Billions of 1972 Dollars	71.0	102.9	161.3	173.4
12. Total Capital Formation Related to Government as Percent of Gross Private Domestic Investment	13.1	116.6	140.0	109.6
13. Capital Formation Related to Government Exclusive of Net Revaluations as Percent of Gross Private Domestic Investment	56.4	110.0	101.8	111.5

It should of course be pointed out that extended measures of capital formation will also show a considerably enlarged role for total private investment. This would include all private output in the way of research and development and education and training, comprising in some instances the opportunity costs of learning. It would also include a full measure of household capital accumulation and net revaluations in all sectors.

But all this is another story. We may here merely repeat the observation that capital formation related to government is substantial and indeed of a similar order of magnitude to gross private domestic investment as the latter is usually measured.

Among major refinements of this body of data yet to be attempted we should list: (1) acquisition of information enabling us to relate each of the cost components of product directly to particular government functions; (2) a reliable series on the value of government land for all of the years from 1946 on; (3) better data on transportation (and other) expenses related to work for all years; (4) less arbitrary methods of allocating output to consumption, investment, and intermediate product; (5) better price deflators for government product,[3] particularly the large defense component, for all years for which we are concerned.

We hope, however, that what we have done offers a promising beginning, for others as well as ourselves. in developing useful and relevant measures of government output.

TABLE 9

PRICE DEFLATORS (EXPLICIT AND IMPLICIT), GROSS GOVERNMENT PRODUCT AND ITS COMPONENTS

(1972 = 100)

	1946	1956	1966	1976
1. Consumption (to Households)	37.2	59.5	75.2	137.1
2. Capital	27.8	48.0	68.1	138.2
1. To Enterprises (R & D)	29.4	52.1	69.2	136.8
2. To Households	28.5	48.2	67.7	138.3
1. Education and Training	28.1	48.0	67.5	137.4
2. Health	34.9	50.2	69.7	146.1
3. To Government	23.5	43.9	69.4	138.2
1. Research and Development	29.9	53.4	70.1	134.4
2. Natural Resources	22.6	41.2	69.0	139.6
3. Intermediate Product	30.5	54.9	71.6	133.1
4. Gross Credits Exclusive of Change in Inventories and Net Revaluations	30.3	52.7	70.6	136.0
5. Change in Inventories	68.2	76.8	82.9	165.6
6. Less: Intermediate Purchases from Other Sectors	34.5	66.6	77.7	144.3
7. Less: Expenses Related to Work	41.8	73.5	84.3	132.5
8. Gross Government Product Exclusive of Net Revaluations	27.4	50.6	68.5	134.2
9. Net Revaluations	41.3	68.3	76.2	139.8
10. Gross Government Product	25.2	51.3	68.6	134.1

[3]Some of our current explicit and implicit price deflators are shown in Table 9.

APPENDIX

SOURCES AND METHODS

Government Income and Product: Debits

1. *Labor income* includes compensation of Federal and state and local government employees (from NIPA, Table 6.5, lines 75 and 80, and SCB, July 1977 and 1978) plus the value of employee training but less a deduction for expenses related to traveling to and from work. Non-military employee training estimates for the years 1946 to 1969 were derived from unpublished data furnished by John Kendrick. We separated out government and government enterprises from his total "Government" in proportion to compensation of employees. Estimates for the years 1970 to 1976 were then extrapolated on the basis of a regression for the years 1951 to 1969 of Kendrick's "Government" training costs on accessions, returning employees, full-time employment, part-time employment, gross domestic product originating in government, and training costs of the previous year. The value of military training was estimated as 0.63075 times military wages (NIPA Table 6.6, line 78, and SCB, July 1977 and 1978).

Utilizing both the 1965 and 1975 time-use studies conducted by the Institute for Social Research at the University of Michigan, times series for 1946–76 were interpolated and extrapolated for time traveling to and from work and for total time traveling. Expenses related to work are taken as total travel expenses multiplied by the ratio of time spent traveling to and from work to total time spent traveling. Total travel expenses are the sum of NIPA Table 2.6, lines 68, 69, 70, 71, 72, 73, 77 and the imputed interest on the net stock of autos and other motor vehicles. The portion of travel expenditures attributed to government employees is assumed equal to the ratio of government full and part-time employees to total full and part-time employees in the domestic economy. (NIPA, Table 6.7, (line 73 − line 78 − line 83)/line 2, and SCB, July 1977 and 1978.)

2. *Interest* is the sum of gross imputed interest on government stocks of land, structures and equipment and inventories. It is calculated for any year, t, by averaging net stocks of government capital of years t and $t-1$ and multiplying this average by the yield on long-term government bonds, taken from the *Economic Report of the President*, 1978, Table B-65. Interest paid is taken from NIPA, Table 3.1, line 13, and SCB, July 1977 and 1978. Net imputed interest is simply gross imputed interest minus interest paid. Net stocks of structures, equipment, and inventories held by government are from BEA data made available by John Musgrave (BEA, 1978a). The net stocks of government land for 1952 to 1968 are obtained from Milgram (1973). For 1945 to 1951 we assume that the ratio of government held land to private land was the same as it was in 1952. Similarly we assume that from 1969 to 1976 the government sector's holding of land was the same percentage of private land as it was in 1969. Then, utilizing private land value estimates provided by the Flow of Funds section of the Federal Reserve Board, we calculate.

$$L_{Gt} = \frac{L_{G52}}{L_{Pr52}} \times L_{Pr,t} \qquad t = 1945 \text{ to } 1951$$

and

$$L_{Gt} = \frac{L_{G68}}{L_{Pr68}} \times L_{Pr,t} \qquad t = 1969 \text{ to } 1976$$

where L_{Gt} = value of government land in year t, $L_{Pr,t}$ = value of private land in the U.S. economy in year t.

3. *Net revaluations of land, structures and equipment, and inventories* are obtained from Eisner (1980a), Tables 5.55 and 5.56.

4. *Income originating in the government sector* is the sum of lines 1, 2 and 3, or labor income + interest + net revaluations.

5. We add to income originating the value of the *uncompensated factor services* of draftees, derived from Lundberg and Nebhut (1979), and of jurors, using a method outlined by Martin (1972).

6. *Charges against net government product* are the sum of lines 4 and 5, income originating plus uncompensated factor services.

7. *Capital consumption allowances on government capital* were obtained from the BEA. The figures for original cost are those without adjustment. The revaluations component equals the capital consumption adjustment, which consists only of revaluations in the case of government capital.

8. *Charges against gross government product* are the sum of lines 6 and 7, charges against net government product plus capital consumption allowances.

Government Income and Product: Credits

1. General

A three-step procedure is followed.

1. Classify government activity in one of ten functions.
2. Estimate the untransferred product (value added plus purchases of intermediate product).
3. Classify each function's product as retained by government or transferred to enterprises or households, and as consumption, investment, or intermediate product.

2. Government Functions

Government Expenditures by type of function (reclassified from NIPA, Table 3.14) are as follows:

1. National Defense and International Relations
   - line 2 National defense
   - line 14 Conduct of foreign affairs and informational activities
   - line 26 Civilian safety (=police+fire+correction=lines 27+28+29)
2. Space Research and Technology
   - line 6 Space research and technology

3. Education
   line 16 Education
   line 35 Veterans readjustment and other
   line 63 Recreation times 0.064875 (the remainder to 7. Local Parks and Recreation)
4. Health and Hospital Services
   line 20 Health and hospitals
   line 37 Veterans' hospitals and medical care
5. Sanitation and Sewerage
   line 50 Sanitation
6. Transportation and Mobility
   line 40 Transportation
   line 45 Other commerce and transportation
   line 32 Other labor
7. Local Parks and Recreation
   line 63 Recreation times 0.935125
8. Natural Resources
   line 59 Conservation of agricultural resources
   line 62 Conservation and development of natural resources
9. Welfare
   line 21 Social security and special welfare services
10. General Administration
   line 7 Central administration and management
   line 38 Veterans administration and other services
   line 39 Regulation of commerce and finance
   line 60 Other agriculture and agricultural resources

Government Enterprise activities are excluded from this classification.

3. The Composition of Product by Functions

In describing the allocation of product to functions we find it useful to develop precise concepts on untransferred product, gross product, and final product, along with the following symbols and definitions.

(1) Let VA_i = value added of function i, the sum of factor payments (excluding the value of employee training), uncompensated factor services and depreciation minus expenses related to work. Thus,

(2) $VA_i = R_i + D_i + CE_i + UFS_i - ERW_i$, where R_i = imputed interest on capital stock of function i, D_i = capital consumption of capital stock of function i, CE_i = compensation of employees of function i, UFS_i = uncompensated factor services of function i, and ERW_i = expenses related to work incurred by employees of function i. Interest is distributed by function on the basis of the distribution of land, structures, equipment and inventories, and capital consumption on the basis of the distribution of structures and equipment.

(3) Let IP_{io} = purchases of intermediate products (non-capital goods and non-factor services from outside government) for use in producing output of function i.

(4) Let I_i = purchase of capital goods for use in function i.

(5) Let PGS_i = total purchases of goods and services for use in producing output of function i.

(6) Then $PGS_i = I_i + IP_{io} + CE_i$ and $IP_{io} = PGS_i - I_i - CE_i$.

(7) Let ΔH_i = additions to inventories associated with function i.

(8) Let $UP_i = VA_i + IP_{io} - \Delta H_i + ERW_i$ = untransferred product of function i, net of additions to inventories, that is, the sum of value added, intermediate product purchased and used in current production, and expenses related to work, but exclusive of intermediate product transferred between functions of government.

(9) Let IP_{ij} = transfer of output of function j to function i, $j \neq i$.

(10) Let GP_i = gross product of function i = untransferred product plus product transferred to function i from other functions of government.

(11) Thus $GP_i = VA_i + IP_{io} - \Delta H_i + ERW_i + \sum_j IP_{ij}$.

(12) Let FP_i = final product of function i = gross product minus transfers of product to other functions.

(13) Thus $FP_i = GP_i - \sum_j IP_{ji}$.

4. Allocation of Capital by Function

To calculate value added by function we must assign capital by function. Since precisely appropriate data are rarely available, a variety of more or less complex methods are used to obtain reasonable approximations. We have benefitted particularly from unpublished estimates by Ott and Austin (1978) of stocks of structures by function. They built these up from unpublished BEA tabulations of investment in structures by function.

Data are available for a number of components of capital employed in the defense function. Defense capital is the sum of structures, equipment, inventories, and land used in defense, where defense comprises both military and nonmilitary protection services. Defense structures, S_D, thus includes among its components military structures, S_m, and nonmilitary protection structures, S_p.

Military structures include

S_n = military nonresidential structures

S_b = industrial buildings,

and

S_r = residential structures.

Nonmilitary protection structures involve police protection, fire protection, and correctional institutions. Thus

$$S_m = S_n + S_b + S_r$$

and

$$S_D = S_m + S_p = \text{total defense structures.}$$

Equipment, E_D, consists of military equipment plus police, fire and correctional institutional equipment.

Inventories, H_D, consist of police, fire, and correctional institution inventories and the military share of other government inventories. Aggregate data on structures, equipment, and inventories are from unpublished BEA tabulations. Data on stocks of structures by function are from Ott and Austin.

Land also includes both military and nonmilitary protection components. Military land values are estimated from total Federal land values on the basis of acreage proportions. Thus,

$$L_m = (A_m/A_F)L_F.$$

where L_m = the value of military land, A_m = military land acreage, from the *Statistical Abstract of the U.S.*, table entitled "Federal Land by Agency and Predominant Usage," A_F = total Federal land acreage from the *Statistical Abstract of the U.S.*, table entitled "Total Land and Federally Owned Land and Buildings," and L_F = the value of all Federal land, from Milgram (1973) for 1952 to 1968, and extrapolated for 1945 to 1951 and 1969 to 1976. Utilizing the Milgram data on Federal land holdings, and private land value estimates, L_{Pr}, provided by the Flow of Funds section of the Federal Reserve Board, we calculate:

$$L_{Ft} = \frac{L_{F52}}{L_{Pr52}} \times L_{Prt}, \qquad t = 1945 \text{ to } 1951;$$

and

$$L_{Ft} = \frac{L_{F68}}{L_{Pr68}} \times L_{Prt}, \qquad t = 1969 \text{ to } 1976.$$

This reduces to

$$L_{Ft} = \frac{L_{F52}}{L_{G52}} \times L_{Gt}, \qquad t = 1945 \text{ to } 1951$$

and

$$L_{Ft} = \frac{L_{F68}}{L_{G68}} \times L_{Gt}, \qquad t = 1969 \text{ to } 1976,$$

where L_{Gt} is as described on p. 48, above.

Somewhat devious methods are necessary to disentangle estimates of the nonmilitary protection portions of defense capital, $K_{pD} = S_p + E_p + H_p + L_p$. We

do so by first estimating the structures component, S_p, and then asuming proportionality for the other components.

We have from Ott and Austin estimates of value of structures for "Other State and Local Buildings," which we may designate S_q. These are an aggregate of the value of: structures in civilian safety, that is, in police protection, fire protection and correctional institutions, S_p; structures in local parks and recreational facilities which we designate as S_{LR}; and general purpose and all other state and local buildings which we will designate as S_{LG}, to be included with general administration structures. We do have figures for state and local capital outlays (not values of stocks) for local parks and recreation, I_{LR}, and for general administration, I_{LG}, from the Census of Governments. We also have figures for total state and local purchases of goods and services for protection, PGS_p, and for general administration, PGS_{LG}, from NIPA. We assume ratios of values of structures to be proportionate both to ratios of capital outlays in parks and recreation and in general administration and to ratios of total purchases of goods and services in protection and in general administration. We can then estimate values of state and local structures in protection, in parks and recreation, and in general administration. Writing,

$$x = PGS_p/PGS_{LG} \quad \text{and} \quad y = I_{LR}/I_{LG},$$

we then have

$$S_p = xS_{LG} \quad \text{and} \quad S_{LR} = ySL_G.$$

Since $S_{LG} + S_p + S_{LR} = S_q$, we have $S_{LG}(1 + x + y) = S_q$. Thus, the value of protection structures may be written:

$$S_p = S_q(x/1 + x + y).$$

For structures to be counted with parks and recreation we have

$$S_{LR} = S_q(y/1 + x + y),$$

and for structures to be allocated to general administration we have

$$S_{LG} = S_q(1/1 + x + y).$$

Then, on our proportionality assumptions, designating S_{nm}, E_{nm}, H_{nm} and L_{nm}, and K_{nm} as the total nonmilitary government stocks of structures, equipment, inventories, land, and all capital, respectively, and letting $p = S_p/S_{nm}$ we have

$$E_p = pE_{nm}, \qquad H_p = pH_{nm}, \qquad L_p = pL_{nm}, \qquad \text{and} \quad K_p = pK_{nm}.$$

To allocate nondefense government capital to the other functions we utilize the functional breakdown of government's nonmilitary stocks of structures in the unpublished tabulation of Ott and Austin. That classification maps into our functions as follows:

Education includes Federal education buildings and state and local education buildings.

Health includes Federal hospital buildings and state and local hospital buildings.

Sanitation includes state and local sewerage and water structures.

Transportation includes Federal and state and local highways and miscellaneous state and local structures.

Natural Resources includes Federal conservation and development and state and local conservation and development.

Parks and Recreation includes the portion of "Other State and Local Buildings," S_{LR}, defined above.

General Administration includes other Federal buildings, miscellaneous Federal structures and the portion of "Other State and Local Buildings," S_{LG} defined above.

We have been unable to assign capital to the functions designated as space and welfare. These have been included with defense and general administration, respectively.

For all functions but national defense, we allocate nonmilitary net stocks of equipment, E_{nm} (BEA, 1978a), inventories, H_{nm} (BEA, 1978a), and land, L_{nm} (= total government land minus military land), on the basis of each function's share of nonmilitary structures, S_i/S_{nm}. Hence equipment, inventories and land in the i-th function are:

$$E_{it} = E_{nm,t}(S_i/S_{nm})_t$$

$$H_{it} = H_{nm,t}(S_i/S_{nm})_t$$

$$L_{it} = L_{nm,t}(S_i/S_{nm})_t, \qquad i \neq D,\ t = 1946 \text{ to } 1976.$$

The total capital stock assigned to each function is K_i where

$$K_{it} = S_{it} + E_{it} + H_{it} + L_{it}, \qquad t = 1946 \text{ to } 1976.$$

5. Gross capital income by function

Gross imputed interest is then allocated to each function in proportion to its share of total capital. Thus

$$R_{it} = R_{Gt}(K_i/K_G)_t \qquad t = 1946 \text{ to } 1976.$$

where R_{Gt} is total government gross imputed interest of year t and K_G is again total government capital.

Capital consumption allowances of government are separated into military and nonmilitary components by the BEA (1978a). We allocate the nonmilitary capital consumption allowances on the basis of the distribution of nonmilitary structures and equipment. Hence, with the subscript *nm* again denoting nonmilitary,

$$D_{it} = D_{nmt}\left(\frac{S_i + E_i}{S_{nm} + E_{nm}}\right)_t, \qquad t = 1946 \text{ to } 1976, \quad i \neq \text{Defense}.$$

Thus, let $CE_{F,t}$ and $CE_{SL,t}$ designate the Federal and state and local compensation of employees, respectively, in the year t, and let $CE_{Fi,t}$ = Federal compensation of employees in the ith function in the year t, and $CE_{SLi,t}$ = state and local compensation of employees in the i-th function in the year t. Then, noting that $i = nd$ for national defense and $i = e$ for education, and similarly using *PGS* to refer to purchases of goods and services, we may use subscripts *nnd* for nonfederal

defense and *nse* for non-state-and-local education, and write

$$CE_{Fnnd} = CE_F - CE_{nd}, \qquad PGE_{Fnnd} = PGE_F - PGE_{nd}$$

$$CE_{SLne} = CE_{SL} - CE_{SLe}, \qquad PGE_{SLne} = PGE_{SL} - PGE_{SLe}.$$

Then

$$C_{Fi,t} = CE_{Fnnd,t}(PGS_{Fi}/PGS_{Fnnd})_t \qquad i \neq nd,\ t = 1952 \text{ to } 1976,$$

and

$$CE_{SLi,t} = CE_{SLne,t}(PGS_{SLi}/PGS_{SLne})_t \qquad i \neq e,\ t = 1952 \text{ to } 1976.$$

For 1946 to 1951 we estimate Federal defense compensation of employees as proportional to Federal defense purchases of goods and services. Thus,

$$CE_{FD,t} = CE_{F,t}\left(\frac{PGS_{FD,t}}{PGS_{F,52}}\right) \qquad t = 1946 \text{ to } 1951.$$

For other functions we assume compensation of employees was the same proportion of non-national-defense compensation that it was in 1952. Thus,

$$CE_{Fi,t} = CE_{Fnnd,t}\left(\frac{CE_{fi,52}}{CE_{Fnnd,52}}\right) \qquad i \neq D, \qquad t = 1946 \text{ to } 1951.$$

The national defense function's capital consumption allowances are comprised of the capital consumption allowances of military capital, D_m, and a portion of D_{nm} related to the nonmilitary protection services' structures and equipment. Hence

$$D_{Dt} = D_{mt} + D_{nmt}\left(\frac{S_p + E_p}{S_{nm} + E_{nm}}\right)_t, \qquad t = 1946 \text{ to } 1976.$$

6. Compensation of Employees by Function

Compensation of employees is available separately in NIPA and July issues of SCB for the Federal government as a whole, for the aggregate of state and local governments, for the defense component of Federal expenditures and for the educational component of state and local expenditures. The precise sources are:

Federal *CE*:	Total, Table 3.7, line 3, 1946 to 1976 Defense, Table 3.6, line 4, 1952 to 1976
State and Local *CE*:	Total, Table 3.7, line 10, 1946 to 1976 Education, Table 3.6, line 16, 1952 to 1976.

Government purchases of goods and services are of course also available in NIPA and SCB:

Federal *PGS*:	Total, Table 3.2, line 21, 1946 to 1976 Defense, Table 3.2, line 22, 1946 to 1976
State and Local *PGS*:	Total, Table 3.4, line 39, 1946 to 1976.

With the exception of Federal defense and state and local education, a breakdown of *CE* is not available for any year. We hence assume that the ratio of

Federal CE_i to Federal PGS_i is identical for all functions, i, other than defense, and similarly that the ratio for state and local CE_i to state and local PGS_i is identical for all functions i, other than education.

For state and local compensation of employees by function prior to 1952, we multiply each year's total state and local compensation by the share attributed to that function in 1952. Hence,

$$CE_{SL,it} = CE_{SL,t}\left(\frac{CE_{SLi}}{CE_{SL}}\right)_{52}, \qquad t = 1946 \text{ to } 1951.$$

For each function, i other than defense, compensation of employees is the sum of Federal and state and local compensation of employees by function:

$$CE_{it} = CE_{F,it} + CE_{SL,it}, \qquad t = 1946 \text{ to } 1976.$$

For defense we incorporate three elements of compensation of employees; Federal compensation of employees strictly for "national defense," CE_{Fnd}; state and local compensation of employees in "protection," CE_{LP}; and Federal compensation of employees in Federal civilian safety programs and international affairs, designated CE_{LS+IA}. This last is estimated as a share of total Federal non-national-defense compensation of employees proportionate to its share of Federal non-national-defense purchases of goods and services. Thus,

$$CE_{CS+IA,t} = CE_{Fnnd,t}(PGS_{LS+IA}/PGS_{Fnnd})_t$$

and

$$CE_{Dt} = CE_{Fnnd,t} + CE_{LP,t} + CE_{CS+IA,t}, \qquad t = 1946 \text{ to } 1976.$$

The expenses related to work, ERW, subtracted from compensation of employees to arrive at labor income, consist of the share of the BEA's personal consumption expenditures for transportation which we condiser workrelated expenses. We allocate these expenses to each function in proportion to its share of compensation of employees. Thus, $ERW_i = ERW_G(CE_i/CE_G)$.

7. Other Elements of Product and Expenditures by Function

Uncompensated factor services, *UFS*, consist of services of draftees, which are assigned to the national defense function, and jurors' services, which are assigned to general administration. Our estimates of uncompensated services of draftees are based on Lundberg and Nebhut (1979). They view the supply of volunteers as a function of the draft rate, the relative wage of the military and civilian employment, the unemployment rate for draft-wage males, and the existence of a war for the years 1964 to 1972. A simulated military wage that would have supplied sufficient enlistments to the actual armed forces without the draft is then calculated. The value of uncompensated service is taken as the difference between the actual compensation of first-term members of the armed forces and the implied compensation necessary if all first-termers were to be volunteers.

For the Vietnam War era Lundberg and Nebhut found no response of volunteers to the relative wage rate. Taken literally this would imply the necessity of an infinite military wage to secure sufficient enlistments in the absence of the

draft. We nevertheless apply the pre-Vietnam relative wage function, so that our figures for the Vietnam-War years may be considered very much a lower bound to estimates of the compensation necessary to secure sufficient volunteers. As the last draftees were inducted in 1972 we assume that there were no non-volunteers in the armed forces after 1975.

We base our estimates of uncompensated juror services on the procedure employed by Martin (1972). We apply annual data on the number of jury trials and median income by occupation to his estimates of the 1962 occupational composition of jurors to secure estimates of the annual opportunity costs of jury service. We then deduct the amounts of fees actually paid for jury service to arrive at the uncompensated services of jurors.

Purchases of goods and services, *PGS*, are taken from NIPA and SCB and allocated among our ten functions on the basis of the basic categorization indicated above (section 2).

Investment in structures is available from the BEA (1978b and c) in the same functional breakdown as the stock of structures discussed above. Investment in equipment is broken down only into military and nonmilitary categories. To retain consistency with NIPA accounts we take total investment in structures and equipment from NIPA Table 3.8, lines 5, 8, 12 and 15, and use the proportions found in BEA (1978b and c) to allocate it by function, using the method for allocation of capital stocks described in section 4 above.

Change in inventories, $\Delta H_t = H_t - H_{t-1}$, is calculated from constant (1972) dollar tabulations of the BEA (1978a). Current dollar change in inventories is then reflated from the constant dollar change by multiplying by the change-in-inventory deflator described in section 10, below (p. 88).

Change in inventories is classified in BEA (1978a) as change in nonmilitary inventories ΔH_{nm} and change in military inventories ΔH_m. Change in nonmilitary inventories is allocated in proportion to investment in nonmilitary structures, *IS*. Thus

$$\Delta H_i = \Delta H_{nm}(IS_i/IS_{nm}), \qquad i \neq D.$$

The change in defense inventories equals change in military inventories plus change in inventories in state and local protection services.

$$\Delta H_D = \Delta H_m + \Delta H_{nm}(IS_p/IS_{nm}).$$

8. The Development of Untransferred Product, Gross Product and Final Product by Function

The untransferred product of function i, UP_i, is the sum of value added, intermediate product purchased from other sectors of the economy and used in current production, and expenses related to work. Hence,

$$UP_i = VA_i + IP_{io} - \Delta H_i + ERW_i.$$

We define gross product of function i, GP_i, as the sum of untransferred product and intermediate product transferred to function i from other functions

of government. This intermediate product transferred within government originates in the functions of defense, D, transportation, T, and general administration, GA. Designating the transfer of the output of function j to function i as IP_{ij} we can write:

$$GP_i = UP_i + \sum_j IP_{ij}, \qquad j = D, T, \text{ and } GA.$$

Final product of function i, FP_i, is defined as gross product of function i minus transfers of product to other functions. Thus for all but the defense, transportation and general administration functions the final product and gross product are equal.

For the defense, transportation, and general administration functions we subtract from gross product the transfers of intermediate product to other functions in order to arrive at final product.

We designate the intermediate product of these functions as

$$IP_i, \qquad i = D, T, \text{ and } GA.$$

The share of IP_i allocated to any function j, is based on the proportion of untransferred product produced by function j. Thus

$$IP_{ji} = \left(\frac{UP_j}{\sum_j UP_j}\right) IP_i, \qquad i = D, T, \text{ and } GA.$$

The determination of IP_i, however, proves complex, and differs somewhat for each of the three functions.

We assume that the defense function protects the economy's capital stock. Therefore the amount of defense product retained by government is independent on the government's share of the total capital stock. We can then write

$$IP_D = bGP_D$$

where $b = K_G/K$, K = the total stock of capital—structures, equipment, land, and inventories—in the economy, and K_G = the stock of government capital.

We assume that the gross product of the transportation function is distributed to households and enterprises or retained by government. The nonretained product is distributed on the basis of vehicle miles travelled by the household and enterprise sectors. To determine the proportion retained by government we assume that the production functions for government and enterprises are similar, such that government uses transportation in the same proportion as does the enterprise sector, adjusted for the scale of production, k. Hence,, defining Y_G as total or extended product originating in government, and Y_E as total or extended product originating in enterprise sectors (as reported in Eisner, 1978), $k = Y_g/Y_E$.

To estimate the vehicle miles travelled by households and enterprises we assume that all buses and trucks belong to enterprises and that passenger cars may be owned by either households or enterprises. A representative of the Highway Safety Research Institute suggested to us that 15 percent of passenger cars are purchased by enterprises. We then calculated the fraction of government final

product of transportation services transferred to enterprises as

$$e = \frac{M_b}{M} + 0.15\left(1 - \frac{M_b}{M}\right)$$

$$= 0.15 + 0.85\left(\frac{M_b}{M}\right),$$

where M_b = bus and truck miles travelled and, M = total vehicle miles travelled, and the data are from the *Statistical Abstract of the U.S.*, table entitled "Volume and Characteristics of Travel."

The fraction of final product transferred to households, h, is thus

$$h = 1 - e.$$

Recalling that the final product of a function is gross product minus intermediate product transferred to other functions of government, we have

$$eFP_T + hFP_T + IP_T = GP_T$$

Then recalling that k is the ratio of product originating in the government sector to product originating in the enterprise sector, our assumption about the government's use of transportation may be expressed

$$IP_T = keFP_t = cGP_T,$$

where c is the proportion of GP_T retained by government. Since

$$FP_T = (1 - c)GP_T,$$

$$ke(1 - c) = c$$

and

$$c = \frac{ke}{1 + ke}.$$

The gross product of the general administration function is distributed to households and enterprises or retained by government on the basis of product originating in each sector. Hence, recalling that Y_G and Y_E are total product originating in government and enterprises respectively, and writing Y_H as total product originating in households (all taken from Eisner, 1978), we can define

$$d = Y_G/(Y_G + Y_E + Y_H)$$

and write

$$IP_{GA} = dGP_{GA}.$$

Gross product of defense, for example, is then untransferred product of defense plus the defense share of intermediate product of transportation and general administration. Using the definitions of UP_i and GP_i, for gross product of defense, transportation, and general administration we may write

$$GP_i = UP_i + a_i\left(\sum_{k:k\neq i} IP_{ik}\right), \qquad i = D, T, GA,$$

where

$$a_i = \frac{UP_i}{\sum_i UP_i}.$$

Recalling that the proportions of gross product retained as intermediate within government are respectively b, c, and d, for defense, transportation, and general administration or

$$IP_D = bGP_D, \qquad IP_T = cGP_T, \quad \text{and} \quad IP_{GA} = dGP_{GA},$$

we have

$$GP_D = UP_D + a_D(cGP_T + dGP_{GA}),$$

$$GP_T = UP_T + a_T(bGP_D + dGP_{GA}),$$

and

$$GP_{GA} = UP_{GA} + a_{GA}(bGP_D + cGP_T).$$

These equations are solved simultaneously for GP_D, GP_T, and GP_{GA}.

The final product of the three functions may then be expressed as

$$FP_D = (1 - b + a_D b)GP_D,$$

$$FP_T = (1 - c + a_T c)GP_T,$$

and

$$FP_{GA} = (1 - d + a_{GA} d)GP_{GA}.$$

9. The Distribution of Final Product

The final product of each function is classified as consumption, capital, or intermediate product. It is either transferred to households and enterprises or retained by government.

The consumption goods transferred to households include half of that portion of the final product of the space function related to manned space flights, half of the final product of the health and sanitation functions, transportation product transferred to households times the ratio of total travel time not spent traveling to work, 0.935125 of the final product of the local parks and recreation function, and the final product of the welfare function.

NASA classified its expenditures as attributable to manned space flights or associated space science and technology. We assume that the final product of space, FP_S, can be similarly classified. Thus the proportion of FP_S attributable to manned space flight FP_M is calculated as

$$FP_M = A(FP_S)$$

where

$$A = \frac{\text{NASA expenditures for manned space flight}}{\text{Total NASA expenditures}}$$

and the data are taken from the *Statistical Abstract of the U.S.*, table entitled "NASA—Outlays for Research and Development."

Capital transferred to enterprises consists of research and development funded by government and performed by business, universities, and colleges, and other nonprofit institutions. The data are taken from the National Science Foundation, *National Patterns in R & D Resources* (NSF, 1977), Table B-1.

Capital transferred to households consists of the value of employee training plus final product of education, half of the final product of health and 0.064875 of the final product of parks and recreation.

Capital produced by government and retained by government has two components. One is federally funded, federally performed research and development which we assume relates to the defense and space functions. These data are also from NSF (1977). The final product of the natural resources function is the other component of retained government capital.

The intermediate product component of government final product which is transferred to households and enterprises includes half of the final product of sanitation, the enterprise share of transportation final product, eFP_T, a portion of the household share of transportation final product, all of the final product of general administration, all of space final product not allocated to consumption or research and development and all of national defense final product not allocated to research and development. Putting this in symbols, letting $I_{R\&D,G}$ = federally funded, federally performed research and development, presumed part of defense and space functions in proportions which we do not determine, and noting again that *FP* denotes final product and *IP* intermediate product, and that the subscript *S*, *D* and *M* refer to space, defense, and manned space flights respectively,

$$FP_S + FP_D = \tfrac{1}{2}FP_M + I_{R\&D,G} + (FP_s \text{ to } IP) + (FP_D \text{ to } IP)$$

Thus,

$$FP_{S+D} \text{ to } IP = FP_D + FP_S - \tfrac{1}{2}FP_M - I_{R\&D,G}.$$

Gross credits exclusive of net revaluations and changes in inventories is the sum of product transferred and product retained by government.

To arrive at gross government product exclusive of net revaluation we add changes in government inventories from unpublished BEA data and subtract purchases of intermediate product from other sources, $\sum_i IP_{i0}$.

To arrive at gross government product we add the net revaluations of government capital.

Net revaluations, *NR*, are the change in the dollar value of existing assets beyond that necessary to keep their real value intact. Thus they are the difference between the value of capital at the end of the year and the sum of the general-inflation-adjusted value of the capital at the end of the previous year and the general-inflation-adjusted value of the net investment of the year. As indicated in Eisner (1980a), from which we have drawn the net revaluations used here,

$$NR_t = K_t - \left(\frac{P_{t,\text{end}}}{P_{t-1,\text{end}}}\right)K_{t-1} - \left(\frac{P_{t,\text{end}}}{P_t}\right)IN_t$$

where, NR_t = Net revaluations of the year t, K_t = Net value of capital at the end of the year t, K_{t-1} = Net value of capital at the end of the year $t-1$, $P_{t,\text{end}}$ = General price deflator at the end of the year t, $P_{t-1,\text{end}}$ = General price deflator at the end of year $t-1$, $\bar{P}_t$ = Average value of general price deflator in the year t, and IN_t = Net investment in the year t.[4]

10. Conversion to Constant (1972) Dollars

The undistributed product by function is converted to 1972 dollars using specific deflators in some cases and general deflators for Federal, state and local, or all government purchases of goods and services in others.

Defense product is deflated by the implicit price deflator for Federal purchases of goods and services from NIPA Table 7.1, line 20, for the years 1946 to 1971. We use the defense product deflator calculated by Ziemer and Galbraith (1979) for the years 1972–76. Space product is deflated for all years with the implicit price deflator for Federal purchases of goods and services (NIPA and SCB, July 1977 and 1978).

The products of the education, welfare and local parks and recreation functions are deflated by the implicit deflator for state and local government purchases of goods and services from NIPA Table 7.1, line 21, and SCB July 1977 and 1978.

The product of the general administration function is deflated by the implicit price deflator for all government purchases of goods and services from NIPA Table 7.1, line 19, and SCB July 1977 and 1978.

For the remaining functions we have specific deflators. The product of the health function is deflated by the implicit price deflator for medical care service from NIPA Table 7.12, line 64, and SCB July 1977 and 1978. The products of the sanitation function and transportation function are deflated respectively by the implicit price deflator for water and sanitary services NIPA Table 7.12, line 46, and SCB July 1977 and 1978, and the implicit price deflator for transportation services, NIPA Table 7.12, line 50, and SCB July 1977 and 1978. The product of the natural resources function is deflated by the implicit price deflator for agricultural services, forestry, and fisheries product from NIPA Table 7.15, line 5, and SCB July 1977 and 1978.

[4]When quarterly investment data are available we may use

$$\frac{P_{t,\text{end}}}{4}\sum_{i=1}^{4}\frac{IN_{t,i}}{P_{t,i}} \quad \text{instead of} \quad \left(\frac{P_{t,\text{end}}}{\bar{P}_t}\right)IN_t,$$

where $IN_{t,i}$ is net investment of the i-th quarter, at annual rates, and $P_{t,i}$ is the general price deflator of the i-th quarter. We have taken as the general price deflator at the end of the year t,

$$P_{t,\text{end}} = (P_{t+1,1} + P_{t,4})/2,$$

where $P_{t+1,1}$ is the first quarter deflator of the year $t+1$ and $P_{t,4}$ is the fourth quarter deflator of the year t. With quarterly price deflators available but investment only annual, we have used annual investment, IN_t, instead of $IN_{t,i}$, so that the final term in (2) was generally taken as

$$\frac{P_{t,\text{end}}}{4}\sum_{i=1}^{4}\frac{IN_t}{P_{t,i}}.$$

For change in inventories we derive an implicit deflator from figures on current and constant dollar end-of-year inventory stocks secured from the BEA. The stock deflator is $P_{Ht} = (H_{t,\text{current\$}})/(H_{t,1972\$})$, for inventories at the end of the year t. We then define our change-in-inventory deflator as

$$P_{\Delta H,t} = 100\,(P_{Ht} + P_{H,t-1}) \div (P_{H72} + P_{H71}),$$

thus getting a measure of prices over the year and normalizing to make the index precisely equal to 100 in the year 1972.

We construct our own implicit price deflator to convert intermediate purchases from other sectors to constant dollars. This is based on ratios of current to constant dollar government expenditures for nondurables, G_{ND}, and services other than those of employees, G_S. Thus our deflator may be written

$$P_{IP} = \frac{(G_{ND} + G_S)_{\text{current\$}}}{(G_{ND} + G_S)_{1972\$}} \times 100.$$

We use our transportation services index to deflate expenses related to work.

Constant dollar net revaluations are from Eisner (1978), who used the implicit price deflator for fixed investment (NIPA and SCB, Table 7.1) to convert current dollar estimates to 1972 dollars.

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