Japan's Saving Rate: An Update

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1. Introduction

In this paper I report my most recent calculation of Japan's saving rate. It has been almost ten years since I realized that Japan's saving rate as compiled in the Japanese National Income Accounts was substantially overstated (see Hayashi (1986)). Since then I have had several occasions to update my calculation of adjusted Japanese saving rate. The last update is in Hayashi (1991). The calculation I report in this paper will incorporate not only the National Income Accounts data that became available since the last update but also recent criticisms made by Iwamoto (1994).

2. Why Japan's Saving Rate is Overstated

For the sake of completeness, I will quickly summarize reasons why Japan's saving is overstated when compared to the U.S. saving rate; a more detailed account is in Hayashi (1986).

There are two major differences between the U.S. and Japan in the way saving in the national accounts is calculated. One is the way depreciation is measured, and the other concerns treatment of government saving. In the U.S. national accounts complied by the Bureau of Economic Analysis (BEA) of the Commerce Department, depreciation is valued at *replacement costs*. That is not the case in Japanese national accounts, where depreciation is at *historical costs* or *book value*. Since replacement cost depreciation is larger than historical cost depreciation in an inflationary environment, Japanese depreciation is understated and saving (net of depreciation) is overstated.

The second difference is that the BEA does not recognize government capital. Accordingly, for the U.S., government saving and hence national saving do not include

government capital formation, and GNP does not include service flows from government capital.

3. Calculating Japan's Saving Rate under the BEA Definition

I now describe in detail the updated procedure for calculating Japanese saving rates from the Japanese National Income Accounts (NIA) that adhere to the BEA convention of valuing depreciation at replacement costs and excluding government assets. It consists of calculating replacement cost depreciation, net saving, and net national product. All variables involved in our calculation are listed in Table 1, along with the source table in the NIA if the variable is directly available from the NIA and the equation number if the variable is generated in our calculation procedure.

3.1. Replacement Cost Depreciation by Sector

As noted in Iwamoto (1994), gross fixed investment in the flow section of the NIA, which we denote as GK, includes investment in nondepreciable assets (*e.g.*, investment in land improvement) as well as investment in depreciable assets. In the nation's balance sheet in the stock section of the NIA, net fixed investment is divided between net investment in depreciable assets and net investment in nondepreciable assets which we denote as GKND. GKND is also gross investment because depreciation is zero for nondepreciable assets. However, the NIA does not provide a breakdown of GKND between sectors, and it is not possible to divide total investment in depreciable assets between sectors without imputations.

The stock of depreciable assets (the capital stock) in the stock section of the NIA evolves according to

$$(1) \qquad KD_i(t+1) = KD_i(t) + GK_i(t) - DEPH_i(t) + REC_i(t),$$

where KD_i is the capital stock of sector i (i = H (households), C (corporations), and G (government)), GK_i is gross fixed investment, $DEPH_i$ is historical cost depreciation, and REC_i is the value of the reconciliation account for sector i. Each of these terms is directly available from the NIA. EPA(1978, p. 233) states that the reconciliation $REC_i(t)$ consists of the following four items:

$$(2) \qquad REC_i(t) = REV_i(t) - GKND_i(t) + [DEPH_i(t) - DEPR_i(t)] + U_i(t),$$

where REV_i is revaluation, $GKND_i$ is the sector's investment on nondepreciable assets, $DEPR_i$ is replacement cost depreciation, and U_i accounts for the incorporation of Okinawa's capital stock in 1972:

$$(3) \qquad U_i(t) = \begin{cases} \text{capital stock of Okinawa at the beginning of 1973} & \text{if } t = 1972 \\ 0 \quad \text{otherwise} \end{cases}.$$

The NIA does not provide the breakdown of REC_i into these four terms. However, EPA(1973, p. 233) states that revaluation is calculated as

$$(4) \qquad REV_i(t) = \frac{P_i(t+1) - P_i(t)}{P_i(t)} KD_i(t) + \frac{P_i(t+1) - PA_i(t)}{PA_i(t)} [GKD_i(t) - DEPR_i(t)],$$

where $P_i(t)$ is the asset price at the beginning of t and $PA_i(t)$ is the average asset price during year t. It is not clear from EPA (1973) how the average price is calculated; we assume that

$$(5) \qquad PA_i(t) = (P_i(t+1) + P_i(t))/2.$$

Substituting (2) into (1), we obtain

$$(1') \qquad KD_i(t+1) = KD_i(t) + [GK_i(t) - GKND_i(t)] - DEPR_i(t) + REV_i(t) + U_i(t).$$

It is now clear why investment in nondepreciable assets, $GKND_i$, is a debit item in the reconciliation account: gross investment in depreciable assets is given by GK_i (gross fixed investment) - $GKND_i$ (gross (= net) investment in nondepreciable assets).

The question is how to calculate $DEPR_i$ for each sector i using these relations from data on KD_i, GK_i, $DEPH_i$, REC_i, P_i, and GKND (= $GKND_H + GKND_C + GKND_G$). Hayashi (1986)'s procedure is to first use (4) with $DEPR_i$ replaced by $DEPH_i$ to calculate REV_i and then use (2) to solve for $DEPR_i$.[1] It ignores the term $U_i(t)$ (which equals zero except for t = 1972) and, as pointed out by Iwamoto (1994), the term $GKND_i$. Iwamoto (1994) also observes that $DEPR_i$ can be calculated without the replacement of $DEPR_i$ by $DEPH_i$ in (4) by

$$(6) \qquad DEPR_i(t) = GKD_i(t) - PA_i(t) \cdot \left[\frac{KD_i(t+1) - U_i(t)}{P_i(t+1)} - \frac{KD_i(t)}{P_i(t)} \right].$$

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[1] Hayashi's (1986) equation A1 contains a typographical error. Its last term should be $[(P_i(t+1)-PA_i(t))/PA_i(t)]N_i(t)$ where N is net investment. His calculation used the corrected formula.

This can be obtained by substituting (4) into (1') and solving for $DEPR_i$. Iwamoto (1994) estimates the sector-specific value $GKND_i$ from the economy-wide GKND (GKND) by[2]

$$(7) \qquad GKND_i(t) = \left[\frac{GK_i(t)}{GK_H(t) + GK_C(t) + GK_G(t)} \right] \cdot GKND(t),$$

Okinawa's capital stock, $U_i(t)$, is still ignored in his calculation.

My calculation of $DEPR_i$ follows (6) and (7), assuming that Okinawa's capital stock at the beginning of 1973 is 1% of the national capital stock for the sector.

3.2. Net Saving and Investment by Sector

The capital transactions (use-of-saving) account of the flow section of the NIA for each sector i (= H, C, G) is

$$(8) \qquad GK_i + DINV_i + DLAND_i + DFA_i = SVGH_i + DEPH_i + CTR_i,$$

where GK_i is gross investment, $DINV_i$ is net inventory investment, $DLAND_i$ is net land purchase, DFA_i is net increase in financial assets (referred to in the NIA as the "saving-investment gap"), $SVGH_i$ is net saving (in the NIA definition), $DEPH_i$ is historical cost depreciation, and CTR_i is what the NIA calls capital transfers receipts. Capital transfers are positive for the corporate sector because of various capital grants from the government. They are negative for the household sector due to gift and inheritance taxes. $SVGH_i$ cannot be taken as net saving for two reasons, because it is based on the historical cost depreciation and because it does not incorporate net transfer receipts. For the household and corporate sectors, the BEA definition of net saving for sector i, SVG_BEA_i, should be

$$(9) \qquad SVG\_BEA_i = \text{gross saving after taking account of capital transfers - replacement cost depreciation}$$

$$= SVGH_i + DEPH_i + CTR_i - DEPR_i$$

$$= GK_i - DEPR_i + DINV_i + DLAND_i + DFA_i \quad (\text{for } i = H, C).$$

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[2] Iwamoto (1994) erroneously identifies GKND by land improvement investment available from Table 1-[3]-15 of the flow section of the NIA. GKND is net(= gross) investment on nondepreciable assets available from the stock section.

The last line makes clear that, unlike Iwamoto (1994), I treat investment in nondepreciable assets as part of saving.

For the government sector, since BEA does not recognize government capital, net saving should simply be equal to net purchase of financial assets (*i.e.*, the general government budget surplus)[3]

(10) $$SVG\_BEA_G = DFA_G.$$

Accordingly, for the household and corporate sectors, net investment after replacement cost depreciation, NI_BEA_i, should be defined as

(11) $$NI\_BEA_i = GK_i - DEPR_i + DINV_i + DLAND_i \quad (i = H, C).$$

For the government sector, it is zero. Therefore, for each sector, including the government sector, we have

(12) $$SVG\_BEA_i - NI\_BEA_i = DFA_i \quad (i = H, C, G).$$

The sum of DFA_i over sectors should equal the balance on the current account up to statistical discrepancy.

3.3. Net National Product

Since government assets are not recognized in the BEA definition, gross profits for the government sector should be deducted from the NIA definition of GNP to obtain the GNP under the BEA definition. As pointed out by Iwamoto (1994), net profits for the government in the NIA appear to be set to zero, so that gross profits equal historical cost depreciation in the NIA. Thus, the BEA definition of GNP equals the NIA definition of GNP less DEPH for the government sector. Therefore, the BEA definition of NNP is

(13) $$NNP\_BEA = GNP - DEPH_G - (DEPR_H + DEPR_C).$$

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[3] In his previous calculations (e.g., Hayashi (1986)), Hayashi used as DFA_G net increase in financial assets (excluding revaluation) available from the financial sub-account of the capital transactions account for the government sector. This should be equal to the saving-investment gap in the main capital transactions account, if there are no measurement errors. The difference between the two used to be small but in recent years it has become quite substantial. For 1992, for example, the saving-investment gap is 8.5 trillion yen whereas the net increase in financial assets is -3.8. The difference between the two is about 2.6% of GNP.

3.4. Calculation for 1955-1969

To implement the calculation described above for the earlier period of 1955-1969, we need to estimate asset deflators P_i which are available only since 1970. We use the value of the deflator for gross investment for the fourth quarter of the previous year available from the flow section of the NIA. More specifically,

(14) $P_i(t)$ = deflator in the fourth quarter of year t-1 for gross private investment (i = H, C),

$P_G(t)$ = deflator in the fourth quarter of year t-1 for gross public investment expenditure for general government.

The deflator is calculated as the ratio of nominal to real values. Nominal and real values of gross private and government expenditures for 1955-1969 are available from Table 1-[3]-1 of EPA (1991).

4. Results

Results of my calculation for the period 1956-1992 are contained in Tables 2 and 3 (we cannot calculate depreciation and hence saving and NNP for 1955 because we do not have $P_i(t)$ for t = 1955). Table 2 displays depreciation at historical costs and replacement costs by sector. I report depreciation on government capital even though it does not go into the calculation of net saving and NNP. The large discrepancy between historical and replacement cost depreciation for government implies that net government capital formation in the NIA is severely overstated. Net saving reported in Table 3 reflects the depreciation adjustment and the adjustment for capital transfers described above. Since the sum of capital transfers over sectors is very small, amounting to net transfer receipts to foreigners, the capital transfer adjustment has very little effect on national saving, although it somewhat affects the allocation of national saving between sectors. Table 3 also displays net investment and net national product. The implied national saving rate is graphed in Figure 1, along with the unadjusted saving rates. The thin solid line is the national saving rate in the NIA. It includes government capital formation in national saving and depreciation is at historical costs. The thick dotted line excludes government capital formation but depreciation is still at historical costs.

The thick solid line is based on the fully adjusted saving shown in Table 3. Figure 2 shows the breakdown of adjusted the national saving rate between the three sectors. Finally, Figure 3 graphs net national saving, net investment, and the current account. The current account here is the difference between net national saving and net investment and equals the sum of DFA_i over sectors.

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Table 1: Relevant NIA Tables

variable	source NIA Table or equation	available since
GNP	1-[2]-I-1	1955
NNP_BEA	equation (13)	–
GK	1-[2]-I-1	1955
GKND	2-III-1	1955
$GKND_i$	equation (7)	–
GK_i	1-[2]-III	1955
$DINV_i$	1-[2]-III	1955
$DLAND_i$	1-[2]-III	1955
DFA_i	1-[2]-III	1955
$SVGH_i$	1-[2]-III	1955
$DEPH_i$	1-[2]-III	1955
$DEPR_i$	equation (6)	–
CTR_i	1-[2]-III	1955
SVG_BEA_i	equation (12)	–
NI_BEA_i	equation (11)	–
KD_i	2-II	1955
REC_i	2-II	1955
REV_i	2-II	1955
U_i	equation (3)	–
P_i	2-IV-1	1970
PA_i	equation (5)	–

Table 2: Depreciation at Historical and Replacement Costs

in trillion yen

year	Household		Corporate		Government	
	historical costs	replacement costs	historical costs	replacement costs	historical costs	replacement costs
1956	0.36	0.84	0.68	1.40	0.05	0.35
1957	0.37	0.79	0.77	1.57	0.05	0.45
1958	0.39	0.55	0.83	1.30	0.06	0.22
1959	0.42	0.57	0.97	1.46	0.07	0.17
1960	0.48	0.68	1.20	1.96	0.07	0.28
1961	0.54	0.65	1.59	2.25	0.08	0.34
1962	0.62	0.81	1.87	2.32	0.10	0.35
1963	0.72	0.69	2.23	2.72	0.11	0.35
1964	0.85	0.99	2.86	3.14	0.12	0.44
1965	0.99	1.06	3.23	3.48	0.14	0.55
1966	1.14	1.84	3.70	4.95	0.18	0.43
1967	1.40	1.63	4.27	4.58	0.22	0.19
1968	1.67	2.43	5.02	6.07	0.25	0.50
1969	1.99	3.40	6.01	5.91	0.28	1.29
1970	2.36	2.59	7.05	6.56	0.33	1.05
1971	2.71	3.01	7.83	7.17	0.37	1.15
1972	3.19	3.62	9.22	7.82	0.42	1.19
1973	3.87	4.79	10.96	10.04	0.47	1.74
1974	4.79	6.94	12.42	14.66	0.55	2.46
1975	5.77	7.34	12.59	15.94	0.67	2.63
1976	6.80	8.98	13.12	17.10	0.79	3.11
1977	7.79	10.37	14.33	18.37	0.90	3.36
1978	8.77	11.41	15.18	19.69	1.05	3.98
1979	9.68	12.99	16.77	21.17	1.20	4.56
1980	10.63	15.12	18.68	24.03	1.39	5.73
1981	11.49	15.70	20.97	25.58	1.60	5.87
1982	12.18	16.50	22.28	27.15	1.75	6.54
1983	12.79	17.00	23.75	28.80	1.89	6.75
1984	13.46	17.73	25.30	30.47	2.01	7.22
1985	14.07	18.50	27.47	31.89	2.08	7.42
1986	14.58	18.40	29.44	33.81	2.14	7.63
1987	15.23	19.08	31.39	35.21	2.24	7.94
1988	16.15	19.68	33.83	38.32	2.32	8.23
1989	17.37	21.27	38.12	41.09	2.46	8.78
1990	18.60	22.65	41.70	46.13	2.50	9.38
1991	19.90	24.56	45.90	51.12	2.50	10.28
1992	20.90	25.60	49.10	56.24	2.60	10.69

Table 3: Net Saving and NNP, BEA Definition
in trillion yen

year	Household	Corporate	Gov't	Nat'l Saving	Net Invest	NNP_BEA
1956	0.42	-0.55	0.07	-0.06	-0.07	7.16
1957	0.56	-0.36	0.15	0.35	0.57	8.46
1958	0.89	-0.13	0.01	0.77	0.77	9.63
1959	1.16	-0.01	0.11	1.26	1.23	11.10
1960	1.38	0.29	0.28	1.95	1.97	13.28
1961	1.95	0.62	0.47	3.04	3.40	16.32
1962	2.10	0.67	0.31	3.07	3.27	18.68
1963	2.55	0.76	0.26	3.56	3.83	21.54
1964	2.90	1.11	0.24	4.24	4.62	25.19
1965	3.42	0.93	0.15	4.51	4.35	28.09
1966	3.08	0.84	-0.12	3.80	3.60	31.10
1967	3.79	3.27	0.34	7.40	7.45	38.20
1968	4.93	3.16	0.44	8.53	8.39	44.07
1969	5.21	5.62	0.74	11.56	11.06	52.47
1970	7.81	7.65	1.21	16.67	15.75	63.71
1971	8.82	6.04	0.93	15.78	14.01	70.04
1972	10.34	7.76	-0.12	17.98	15.53	80.54
1973	14.20	7.29	0.60	22.08	20.80	97.21
1974	19.51	-0.89	0.49	19.11	20.47	111.84
1975	23.22	-3.50	-4.10	15.62	16.41	124.22
1976	26.44	-1.88	-6.14	18.42	17.24	139.56
1977	26.76	-0.74	-7.08	18.94	16.80	155.88
1978	28.17	3.58	-11.23	20.53	17.75	172.32
1979	25.29	4.85	-10.51	19.63	21.82	186.46
1980	25.91	3.09	-10.60	18.40	21.20	199.56
1981	29.09	2.38	-9.88	21.60	20.82	214.54
1982	27.28	3.08	-9.72	20.63	18.96	225.26
1983	27.44	2.87	-10.26	20.05	15.18	234.39
1984	28.30	4.40	-6.24	26.47	18.23	250.83
1985	29.24	6.66	-2.60	33.30	21.94	269.09
1986	32.16	6.90	-3.23	35.84	21.92	281.48
1987	29.46	7.37	1.61	38.44	24.80	293.94
1988	30.17	9.16	5.58	44.91	33.02	313.41
1989	33.14	6.58	9.99	49.71	39.70	334.23
1990	34.05	4.96	12.40	51.41	44.22	356.22
1991	38.84	0.98	13.20	53.02	42.72	376.32
1992	36.90	-2.54	8.40	42.76	30.46	383.66

Figure 1: National Saving Rate

Percent of Net National Product

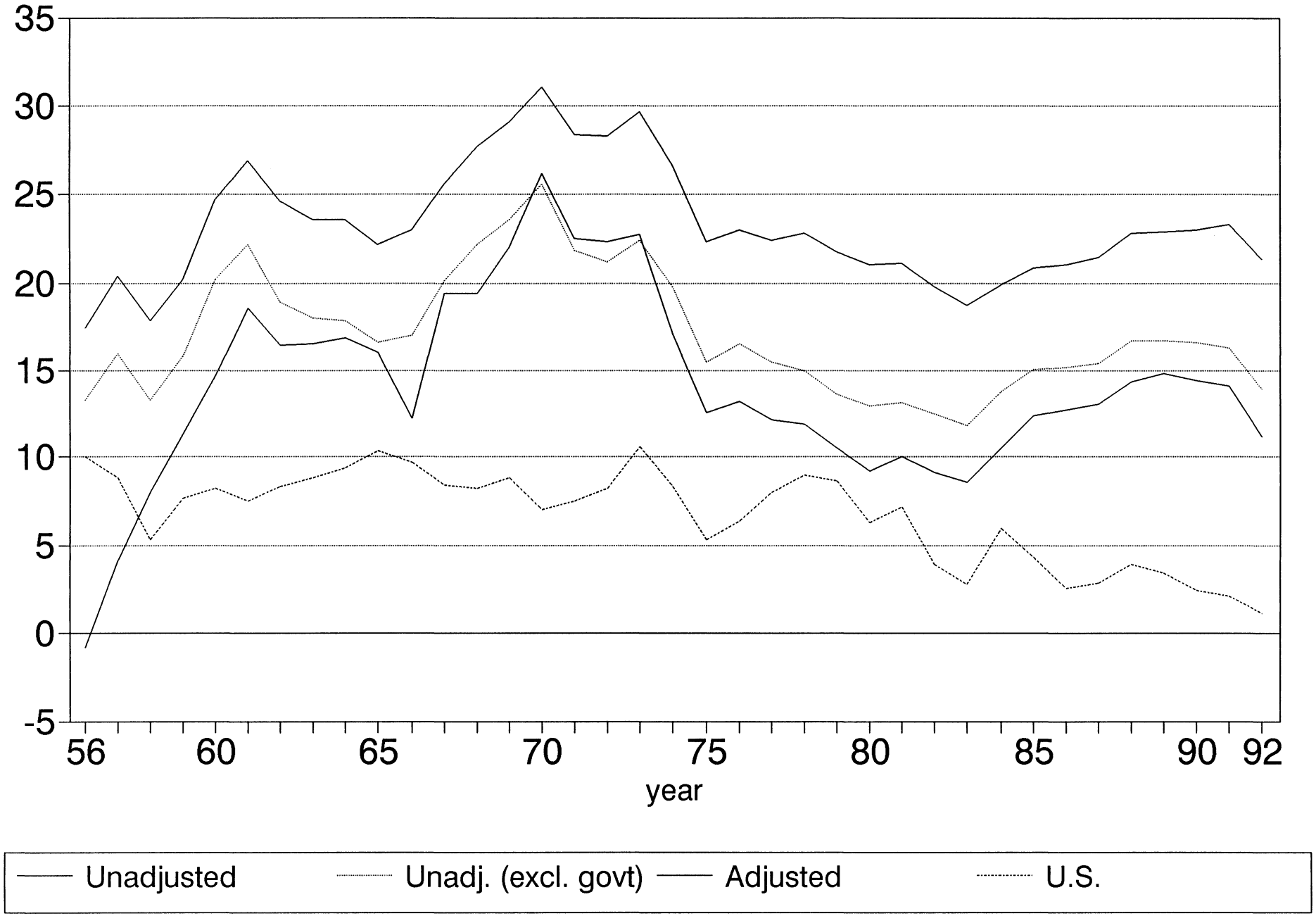

Figure 2: Breakdown of National Saving

Percent of Net National Product

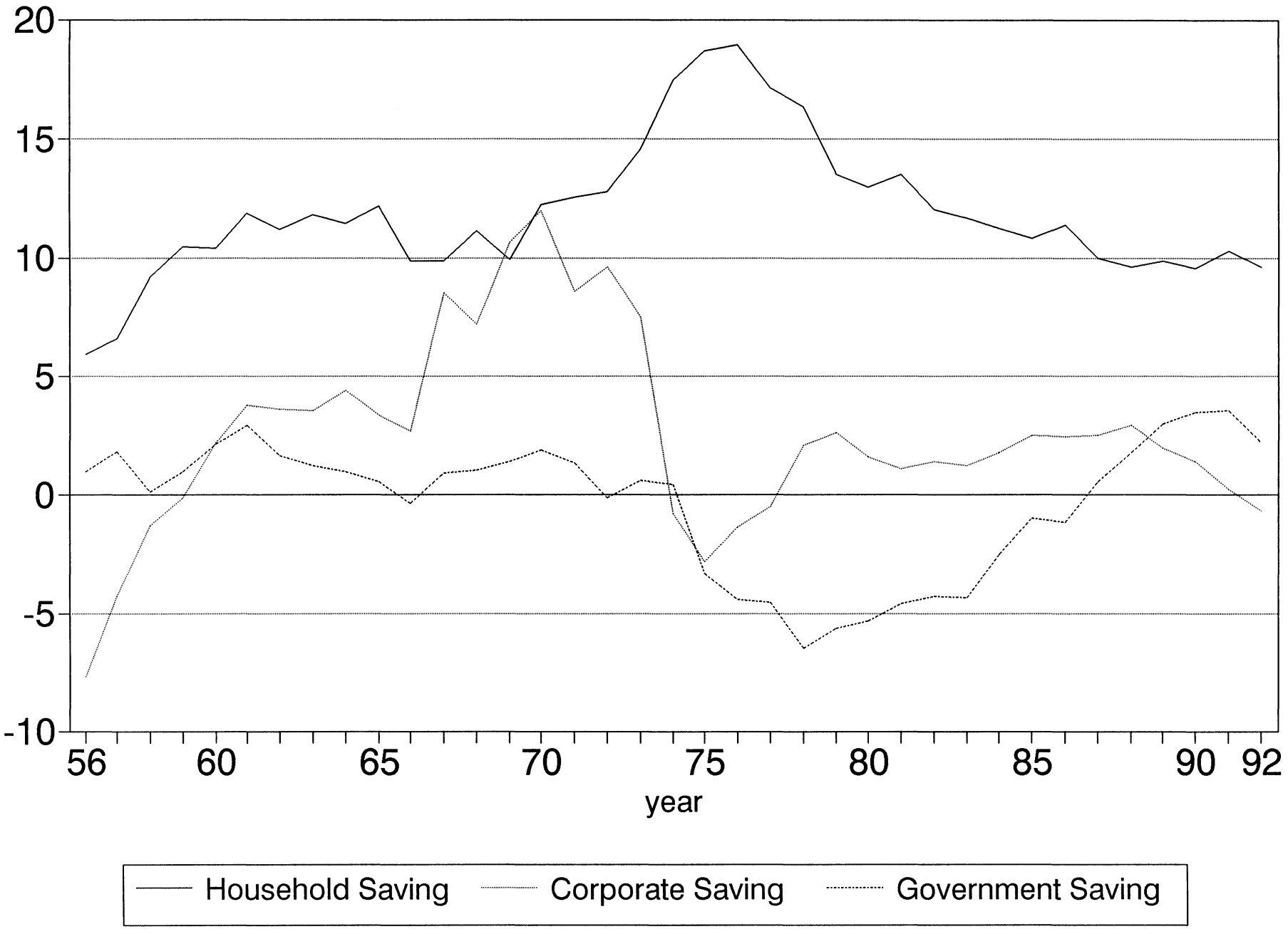

Figure 3: Saving and Investment

Percent of Net National Product