The Changes of Japanese Business Cycles*

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I. Introduction

The Japanese economy made a remarkable change from high growth to low growth after the mid-1970s. One of the noticeable features in this period may be that the Japanese business cycles became considerably smaller in fluctuation when observing GNP statistics and other economic indicators. This phenomenon has been studied, for example, by Meltzer (1985), who viewed its main causes as the shift to the floating exchange rate system and successful monetary policy, in particular, money supply control.

However, in view of the fact that the patterns of cycles have not necessarily changed in other major industrial countries where increasing importance was also attached to money supply, there seems to be a good possibility that domestic factors affected stabilization of business cycles in recent Japan. Moreover, although more active international capital movements and business cycles in the U.S. may have begun to affect Japan increasingly in recent years, through imports and exports, the fluctuations on the whole have become far more stable when examined in terms of real GNP.

With these points in mind, this paper aims to examine empirically on the basis of GNP statistics, the factors that might have stabilized business cycles in Japan, with emphasis on fact-finding. In contrast to numerous previous analyses of business cycles, in which data were examined without detrending, we mainly take notice in

* The authors are grateful to Professor Masahiro Kuroda of Keio University, Hiroshi Yoshikawa of Osaka University, Kenjiro Hirayama of Kansai University, and Professor Eduard J. Bomhoff of Erasmus University, Rotterdam, the Netherlands (former Visiting Scholar at the Institute for Monetary and Economic Studies, the Bank of Japan), for valuable comments.

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this paper of cyclical component which is estimated stochastically with trend and irregular components simultaneously using the state space model developed by Kitagawa and Gersch, in which an original series (usually percent change versus the corresponding period of the previous year) decomposed into the trend (T), cyclical (that is, auto-regressive AR) and irregular (I) components.[1] As regards cyclical movements, our standpoints in this paper assume that cycles are not necessarily constant in frequency and amplitude, and they in fact vary according to the prevailing economic conditions.

When explaining business conditions in Japan, the Diffusion Index of the Economic Planning Agency is normally used. In view, however, of the recent criticism that this index does not always reflect actual economic activity or cyclical condition in frequency, for instance, the analysis in this paper is based mainly on real GNP growth, measured as percent change over the previous year, assuming that fluctuations in real GNP growth reflect business cycles. This measure may have some disadvantages, for example, the turning points of percent change data and those of business condition have some lag periods (see Tahara (1983), for example). The reasons we adopted percent change mainly in this paper are: (1) this paper is not intended to explain turning points, (2) the changes of cyclical movements are usually reflected clearly to percent change data, and (3) this measure is the easiest to understand when examining economic growth and business trends.

When discussing business cycles, it is in principle important to analyze in relation to short-term cycles (Kitchin cycles, average 3–4 years), medium-term cycles (Juglar cycles, average 7–10 years), building cycles (Kuznets cycles, average around 20 years), and long-term cycles (Kondratieff waves). However, we did not deal with them here, as it is not always clear what indicators are appropriate to specify these cycles and the periods or terms of cycles are hard to define objectively. Also it is true

1. For details, see Kitagawa and Gersch (1985) and Naniwa (1985, 1986).

2. For example, Tahara (1983) covered business cycles in Japan, including those in recent years. The reason why this paper almost entirely excludes descriptions of earlier theories is that the authors believe it difficult to explain changes in recent years merely by applying past analyses. The following passage written by Kimura (1986), a scholar of European history, illustrates the view held by the authors. "UNESCO once organized a contest of research papers on elephants on a world-wide basis. A paper from Britain was on the utility of elephants, arguing that they can be used for transporting goods and people on the plains and that the tusks can be used for ornamental purposes. A paper from Germany discussed the methodologies for elephant studies. A French paper was on the love life of elephants. In contrast, a Japanese paper was on what research had been made in the world on elephants. It is an American that composed this well-arranged joke, which mentions national traits quite suitably. Even if one reads all the papers that has ever been published until the previous day, the next day he has to read newly published papers written by numerous researchers..... He can never write his original paper because he must always read new papers to the best of his ability."

that such analyses as cycles are restricted by the lack of sampled data. Data we used here cover the period since 1955 where major indicators are available for our analysis and, in particular, emphasis is placed on explaining changes in the pattern of cyclical fluctuations in the last ten years or so.[2]

In section II, we examine the features of business cycles in Japanese GNP by observing estimated trends and cyclical components. It then presents that, in contrast to other major industrial countries, both trends and cyclical components in Japan underwent a significant change in the mid-1970s. Sections III and IV discuss that there has been no significant change in growth trends and cycles in the U.S. demand components, whereas significant changes on the way to stability have occurred in both growth trends and cyclical changes of government expenditure and personal consumption in Japan. Also, the continual larger fluctuations in the cyclical pattern of Japanese exports reflecting the U.S. variability in economic activities are shown. Section V examines the changes in interrelations among demand components and in those between demand components and policy variables. In addition, it considers the impact of exogenous variables including policy variables on real GNP in view of shocks.

Conclusions from this paper may be summarized as follows;

(1) Japan's real GNP growth has changed in three ways since the mid-1970s: there has been a marked downward shift in the trend; the amplitude of cycles has contracted; and the cycle itself has lengthened. These changes seem not to be observed in other major industrial countries.

(2) Cyclical fluctuations in government expenditure including transfer payments stabilized during the latter half of the 1970s largely due to an increase in transfer payments such as social security which are relatively stable. Cyclical fluctuations of personal consumption and housing investment have also contracted in recent years reflecting the increase in transfer payments.

(3) Fluctuations of exports, however, showed no major change in cyclical pattern, even after the shift to the floating exchange rates regime; they have continued to fluctuate markedly under the influence of U.S. business cycles. Cyclical fluctuations of inventory investment remained to show larger variability, but its influence on GNP is relatively small because the contribution ratio to GNP is decreasing.

(4) Cyclical fluctuations in plant and equipment investment became smaller since the latter half of the 1970s, particularly in tertiary industry. This is due to (i) investment itself has been stable in service and machinery industries, increasing its proportion in total investment, and (ii) investment activities among other industries have become uncorrelated by groups of industries and by corporations, thus contributing to the stability of investment as a whole.

(5) The relationships among domestic private demand, exports and government expenditure, examined with VAR model, suggest that, after 1976, (i) the

autonomous behavior of domestic private demand declined and the cross-correlations with exports and government expenditure increased; and (ii) the autonomous changes of exports increased. Moreover, when financial variables such as interest rates are considered, the cross-correlations between financial variables and domestic private demand have either maintained or increased in strength since 1976. In this sense, the effectiveness of monetary policy has been maintained. As the background of these movements, we can see the dynamic operation of monetary policy, such as monetary targetting policy, by watching the movements of domestic private demand.

(6) To summarize, although there remain destabilizing factors such as the impact of increased variability of exports, the stabilizing effects of less variability in government expenditure and money supply and that of less volatile plant and equipment investment resulting from the growth of service industries have dampened the cyclical fluctuations in real GNP and domestic private demand since 1976.

II. Changes in GNP

1. Trends and Cycles

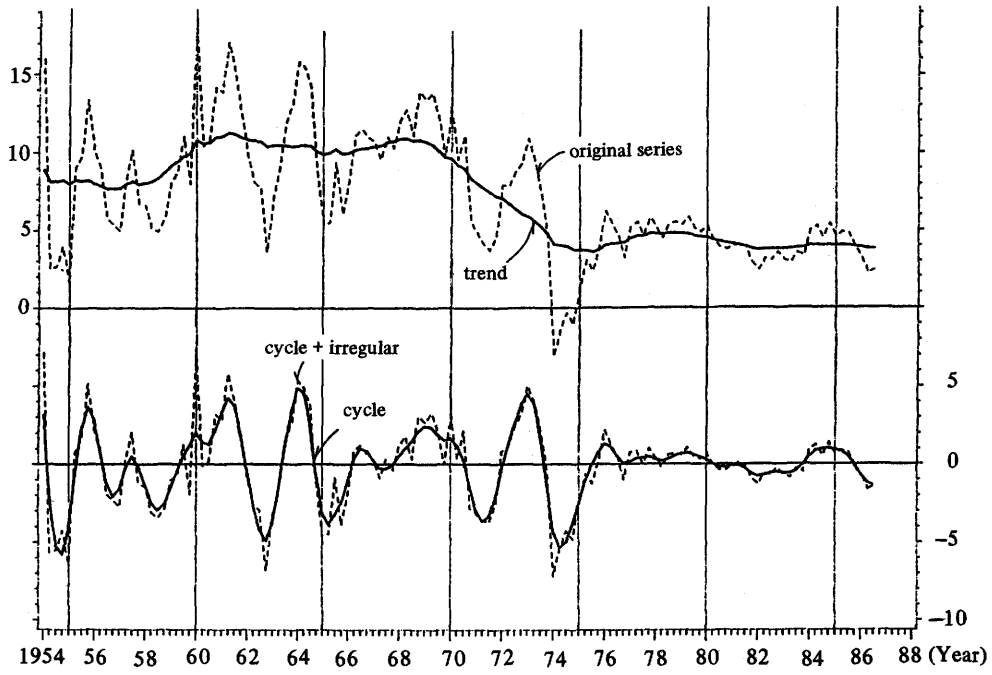
At first, Japan's real GNP growth (percent change over the previous year) is analyzed by decomposing it into the trend (T), cyclical movement (AR) and irregular (I) components using the Kitagawa-Gersch method (1984, 1985) (hereafter K-G) (Figure 1-1).[3] This method is designed to estimate the trend stochastically and to detect changes over time in the statistical properties of movements around the estimated trend. In this case, if the statistical properties of the time series show a significant change at a certain period, we take it to suggest a structural change in the economy (see Naniwa 1986).

Figure 1-1 gives the following characteristics. First, the trend of Japanese GNP growth shifted downward markedly since the latter half of 70s compared with that of 50–60s, from about +10% to about +4%. Estimated trend shows that the downward shift developed gradually from the beginning of the 70s instead of occurring suddenly after the first oil crisis. A similar analysis of the prewar period (1897–1936 on a yearly

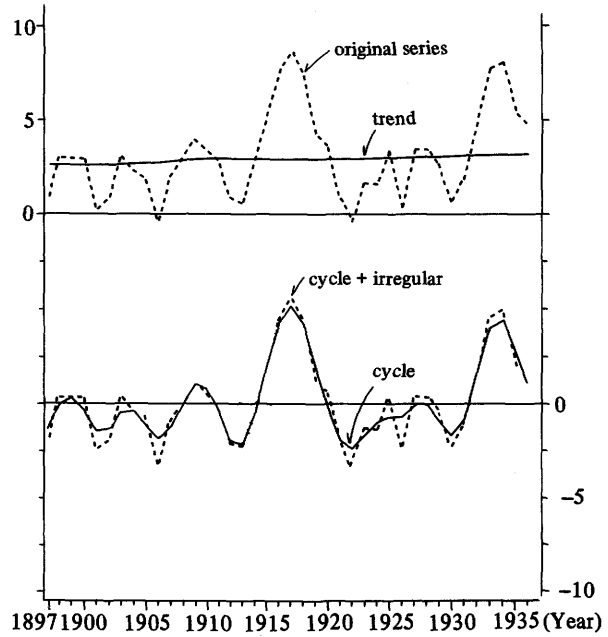
3. Some problems in analyzing time series data by decomposition into the trend and cyclical components have been pointed out. In our analysis, however, the differences between Japan, U.S. and Europe can be seen clearly in the figures, and it can be assumed that the conclusions are not attributable to the specific method employed. It should be added that the rate of change for the period before 1965 is based on earlier methods of compiling national accounts statistics.

Figure 1. Changes of GNP

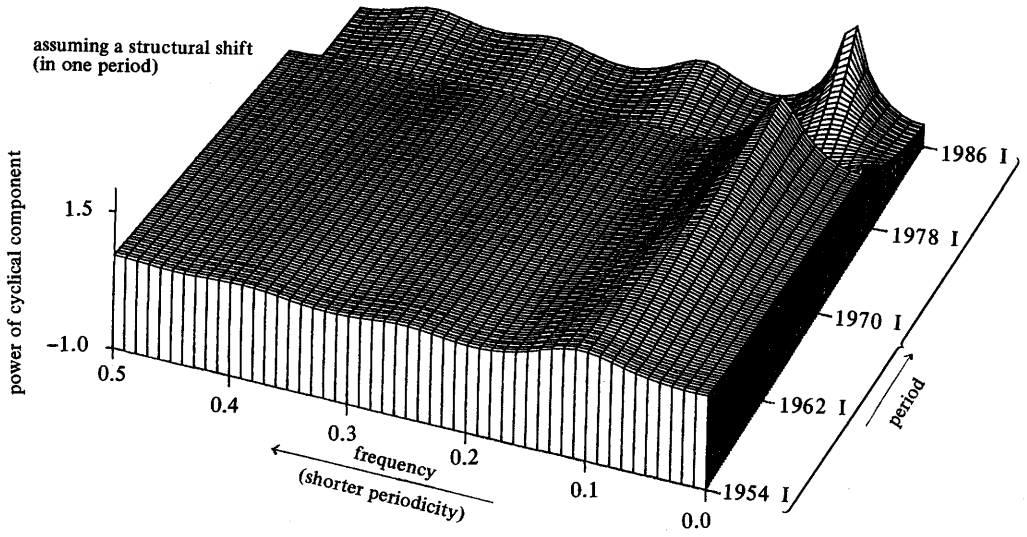
(1) Real GNP (percent change over the previous year)



(2) Real GNP in the Prewar Period (annual data, percent change)



(3) Changing Cyclical Component of Real GNP



(4) AIC Estimated from Time Varying Autoregressive Coefficient Model of GNP (sample period 1954 I ~ 86 II)

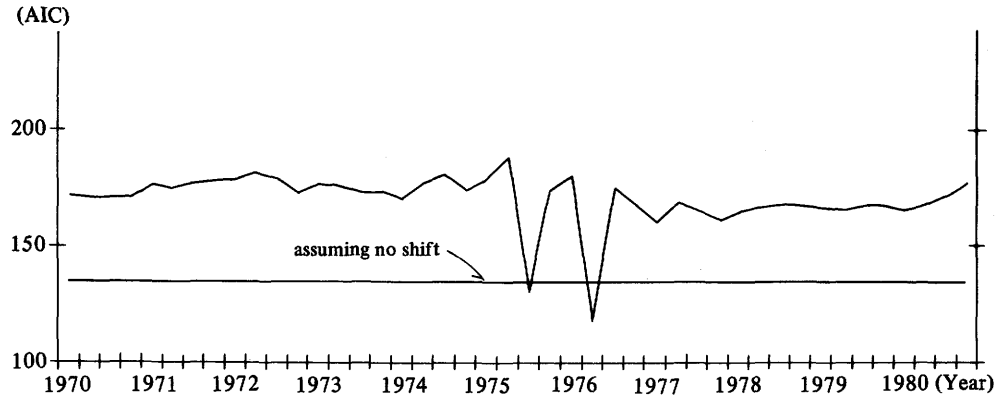
Case 1 assuming no structural shift 303.9

Case 2 assuming a structural shift (in one period)

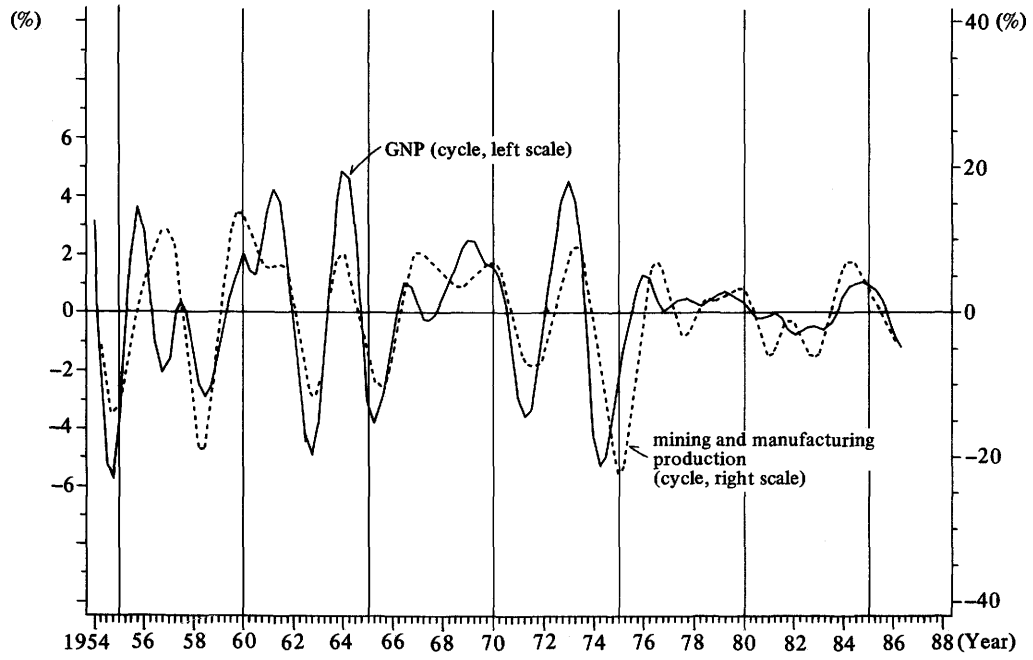
1970	I	304.9	1974	I	302.5	1978	I	291.2
	II	307.4		II	320.4		II	291.5
	III	306.4		III	302.0		III	291.6
	IV	310.6		IV	298.0		IV	298.1
1971	I	310.6	1975	I	295.8	1979	I	298.9
	II	312.5		II	291.8		II	301.5
	III	311.0		III	288.3		III	302.1
	IV	306.3		IV	294.4		IV	298.5
1972	I	304.5	1976	I	293.1	1980	I	297.5
	II	309.6		II	285.9		II	302.4
	III	310.7		III	280.0		III	301.9
	IV	308.4		IV	277.8*		IV	302.3
1973	I	307.2	1977	I	288.8			
	II	306.4		II	287.7	* minimum AIC		
	III	302.6		III	287.6			
	IV	297.9		IV	287.5			

Figure 2. Mining and Manufacturing Production

(1) AIC of Mining and Manufacturing Production



(2) Relationship of GNP and Mining and Manufacturing Production



basis)[4] suggests that there was a gentle upward drift of the trend about +4% growth rate after 1926 (See Figure 1–2).

Second, there was a change in cyclical fluctuations, that is, in the pattern of business cycles. From the 1950s to the first half of the 1970s GNP fluctuated with a larger amplitude and a periodical movement of about three years. After the mid-1970s, in contrast, the amplitude contracted and the periodicity lengthened (Figure 1–3). Since the latter half of 1985, the amplitude seems to have been somewhat larger, but still small compared with previous downswings. Incidentally, variance coefficient contracted to 5.4 after the mid-1970s from 15.5 in the former period.

Based on the K-G method and using the AIC (Akaike Information Criterion) as a criterion, the pattern of cyclical fluctuations underwent a substantial change around 1976 (Figure 1-4). The AIC also shows that a major structural change in mining and manufacturing production cycles took place around 1975–76, resulting in a somewhat smaller amplitude and a longer periodicity (Figure 2). The relation between this series and cycles in GNP appears relatively close and correlation is higher. A closer look reveals, however, that GNP fluctuations tended to precede those in mining and manufacturing production until the first half of the 70s, but have lagged since 1980, with the correlation rising in recent years (Table 1). These features imply the reflection of the increased weights of exports in industrial production activities and the increased impact of exports on domestic private demand which contributes to larger part of GNP. In this sense, mining and manufacturing production is still of

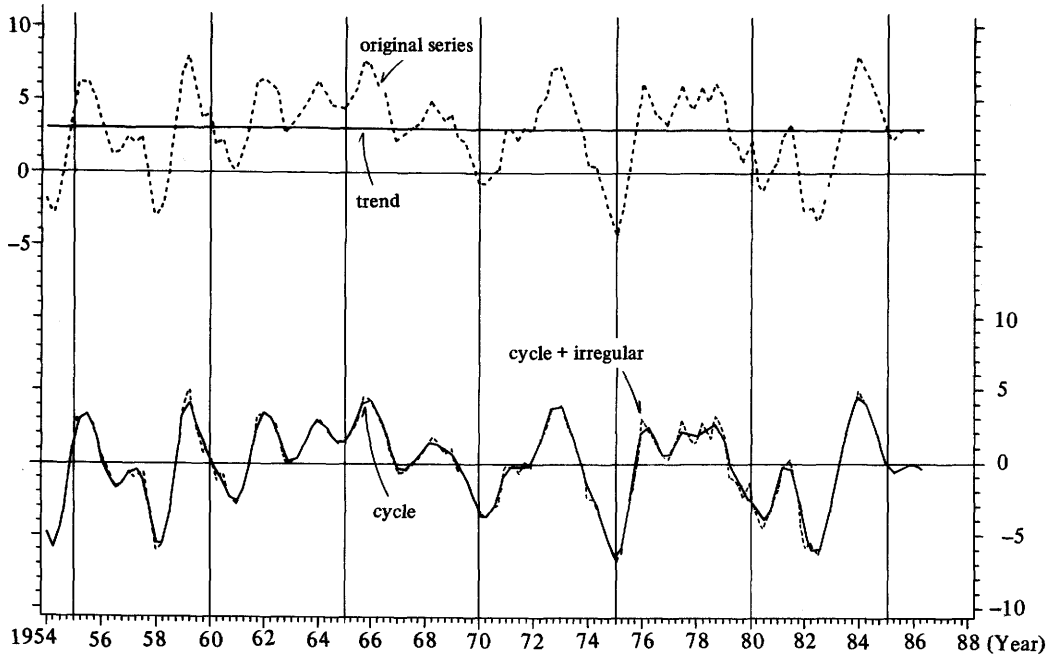
Table 1. Correlation Coefficients at Different Lag Periods between GNP and Mining and Manufacturing Production

lag on mining and manufacturing production	1954 II ~ 75 IV	1976 I ~ 86 II	1980 I ~ 86 II
−3	−0.06	0.57	0.65
−2	0.28	0.67	0.78
−1	0.48	0.69	0.82
0	0.67	0.69	0.77
+1	0.70	0.67	0.61
+2	0.59	0.52	0.35
+3	0.39	0.28	0.07

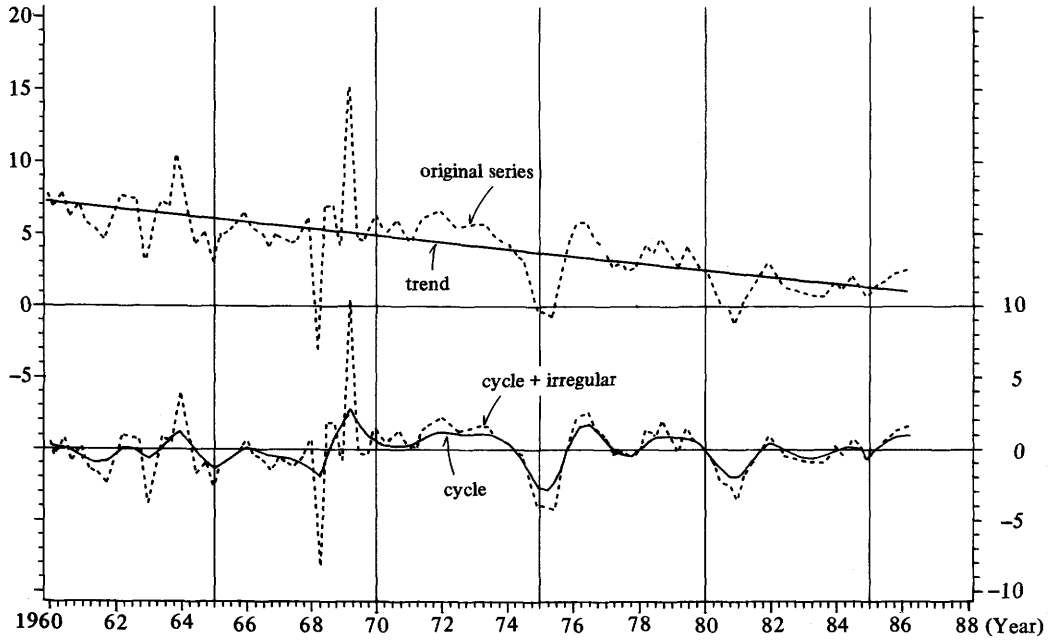
4. The figures are based on Kazushi Ohkawa, et al., *Long-term Economic Statistics: 1. National Income*, Toyo Keizai Shinposha, 1974. Note that the compilation method differs from that for current statistics. Figure 1–2 is based on a 3-year moving averages.

Figure 3. GNP in Major Industrial Countries
(percent change over the previous year)

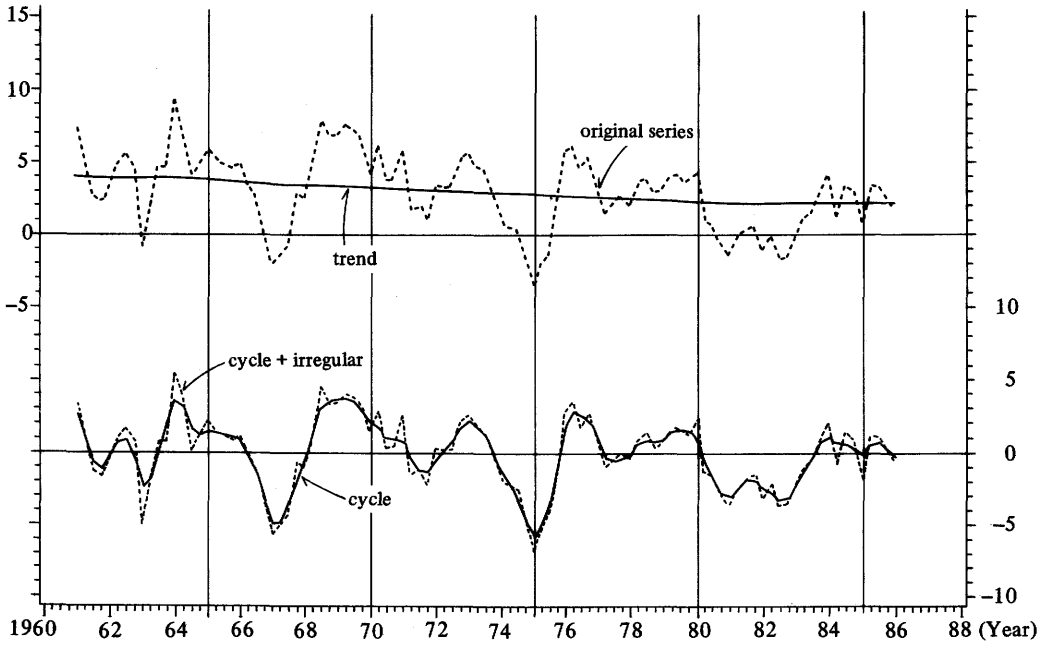
(1) U.S.



(2) France



(3) West Germany



(4) U . K .

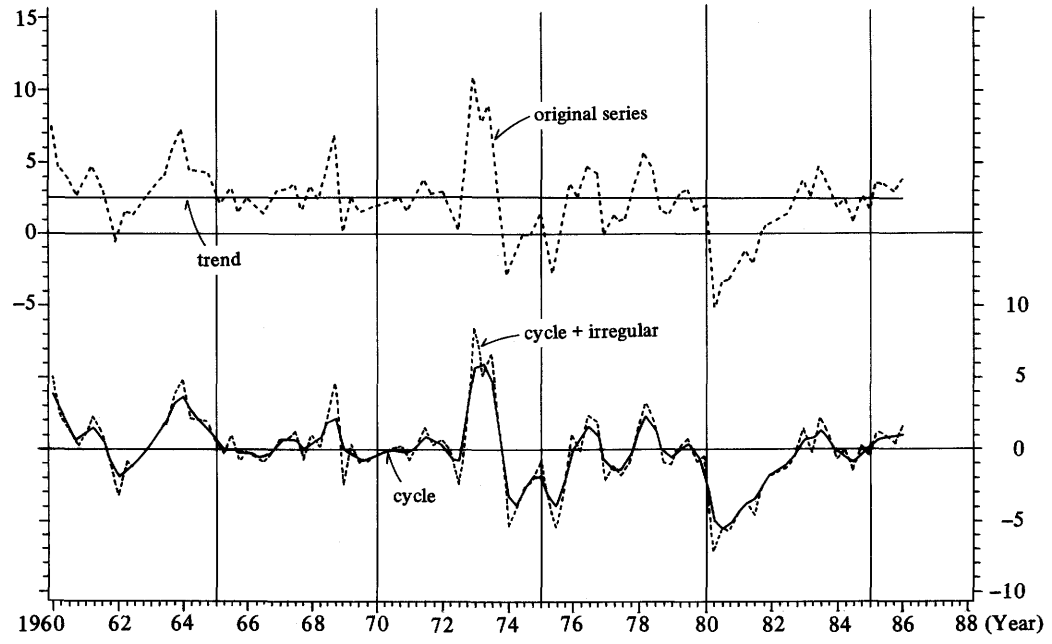


Table 2. AIC Estimated from Time Varying Autoregressive Coefficient Models for Major Industrial Countries (assuming structural shift in one period)

		U.S. (265.2)	West Germany (213.1)	U.K. (338.3)	France (236.1)
1970	I	296.5	214.8	352.6	245.6
	II	297.6	213.2	344.6	248.7
	III	297.0	212.9	344.0	248.4
	IV	298.8	210.8	343.7	245.8
1971	I	297.8	207.7	336.3	246.8
	II	300.9	214.4	333.4	246.8
	III	301.3	216.1	334.0	246.8
	IV	301.5	213.4	329.8	246.7
1972	I	299.8	212.7	330.5	247.9
	II	296.7	216.8	326.4	248.6
	III	299.6	217.7	327.4	247.5
	IV	295.5	221.1	321.0	248.6
1973	I	298.0	221.8	322.4	247.7
	II	303.2	221.7	323.5	246.4
	III	304.1	219.7	323.6	245.3
	IV	301.4	217.4	368.8	242.5
1974	I	300.9	220.4	369.3	240.8
	II	294.5	221.8	362.4	240.8
	III	293.9	222.5	361.0	239.7
	IV	295.0	222.9	355.9	241.3
1975	I	294.2	225.8	352.5	246.7
	II	294.8	227.9	347.8	249.5
	III	292.3	225.4	348.4	246.4
	IV	306.4	215.5	343.1	239.4
1976	I	257.3	215.3	341.4	250.6
	II	252.7	226.7	338.0	254.0
	III	295.7	223.5	337.1	254.0
	IV	303.7	216.1	338.8	247.6
1977	I	304.5	211.7	336.7	247.5
	II	296.3	211.9	336.7	246.1
	III	294.6	213.6	335.0	245.7
	IV	289.2	214.5	333.5	246.9
1978	I	288.0	214.8	332.4	245.8
	II	286.9	218.4	333.8	249.0
	III	290.8	220.1	332.7	249.9
	IV	286.5	221.8	330.7	246.3
1979	I	287.3	221.7	329.5	244.3
	II	287.6	222.2	332.3	241.1
	III	288.6	221.7	327.9	244.2
	IV	286.4	220.8	327.6	247.0
1980	I	283.3	219.1	326.9	245.8
	II	287.3	218.1	327.8	242.5
	III	285.7	219.1	332.1	245.9
	IV	279.6	219.1	332.2	250.9

Note: 1. Sample periods: 1954 I ~ 86 II for the U.S., 1961 I ~ 86 I for West Germany, 1956 I ~ 86 I for the U.K. and 1960 I ~ 86 II for France.
2. Value in parenthesis is the AIC when no structural shift was assumed.

great importance as a business cycle indicator.

For other industrial countries, the estimated trends produce quite different results (Figure 3). The trend of GNP showed little or almost no change for the U.S., West Germany and the U.K. France showed a downward trend; but it does not change in a relatively short period as seen in Japan. When looking for statistical features of structural change in cyclical patterns, we find that France appears to be unchanged and that changes occurred for the U.S. (around 1976), West Germany (1970–71 and 1977) and the U.K.(1972–73) (Table 2). However, AIC in these cases are relatively close to those in which no change is assumed and the difference is not so marked as in Japan. Figure 3 depicts that no clear changes in amplitude or periodicity can be detected in each country. So we can say that, even if there were structural changes, they were minor and developed gradually.

2. Interrelation between Japan and Other Major Industrial Countries

Let us now turn to the interrelation of business cycles among major industrial countries, that is, relationship in GNP fluctuations of Japan, the U.S. and major European countries (West Germany, the U.K., France and Italy). To examine, we use a vector autoregressive (VAR) model in which the current values of variables expressed in terms of current and past innovations of the variable itself and of past innovations of other variables. The estimation periods are divided before and after 1976, because this year showed a major change in the cyclical pattern of Japanese GNP.

The results (Table 3) suggest that GNP in each countries generally moved independently in the 1960s and up to the mid-1970s. Since the latter half of the 1970s, however, the independence of GNP increased for the U.S., but became considerably less autonomous for Japan and Europe. In particular, Japan suffers extremely from the impact of business cycles in the U.S.

Naturally, the results show only superficial relationships among variables, and it is also true that the results depend heavily on the method of variance decomposition which provides sometimes different outcomes when the order of variables is changed. [5] However, the results can be justified to present as evidence of the

5. The lags were selected based on the AIC. One problem seen in Table 3 is the high correlation between the U.S. and Europe in the latter half of the period (see Table 3 Reference). However, the results of other cases, in which the order of variables differed, do not suggest a need to modify the above conclusion. The authors are grateful to Professor Hirayama of Kansai University for his valuable comment on this point. See Aoki (1986) for a discussion of problems in variance decomposition of VAR models.

Table 3. Variance Decomposition by VAR Model

(contribution in percentage at the 30th period)

Order of Variables \ Explanatory Variable		1960 III ~ 75 IV (Model Order: 2)			1976 I ~ 85 IV (Model Order: 4)		
		(1) Japan	(2) U.S.	(3) Europe	(1) Japan	(2) U.S.	(3) Europe
(1) (2) (3)	Japan	93	2	5	53	43	4
	U.S.	13	78	9	8	88	4
	Europe	26	15	59	19	44	37
(2) (1) (3)	Japan	90	5	5	47	49	4
	U.S.	7	84	9	5	91	4
	Europe	20	20	59	14	50	37
(3) (2) (1)	Japan	74	5	21	46	49	6
	U.S.	11	84	5	5	91	4
	Europe	10	20	70	11	50	40

Reference: Correlation of Residuals

	1960 III ~ 75 IV			1976 I ~ 85 IV		
	Japan	U.S.	Europe	Japan	U.S.	Europe
Japan	1.00	0.16	0.29	1.00	0.34	0.30
U.S.	0.16	1.00	0.01	0.34	1.00	0.66
Europe	0.29	0.01	1.00	0.30	0.66	1.00

increasing influence of the U.S. through the exchange rate (and especially exports), when considering more active international capital movements.

The above results imply that, among the major industrial countries, only Japan exhibited a larger change in the trend and cyclical fluctuations of GNP growth, and this change occurred around 1976. We may say that it is to attribute it partly to exogenous shocks and institutional changes, such as the oil shock and the shift to the floating exchange rate regime, which had taken place just before the period of change. But this cannot be a full explanation. Neither the U.S., which is less dependent on foreign trade than Japan, nor Europe, which is more so, experienced such a downward trend shift or a contracted amplitude of cyclical fluctuations. Thus,

it can be assumed that there were conditions peculiar to Japan.[6] In order to explore this, let us examine the movements of the demand components of GNP in real terms.

III. Exogenous Demand Components

1. Government Expenditure

Government expenditure as a component of GNP is normally defined as final government consumption plus government investment. However, when considering the influence of government as an exogenous factor on economic activity, it is necessary to use an expanded definition, which includes transfer expenditure (social security benefits, government interest payments, etc.). Actually, the movements of these two series of government expenditure vary considerably (Figure 4–1).

Normally used government expenditure (the ratio to GNP), which is defined as final government consumption plus government investment, has fallen substantially since 1980 due to fiscal consolidation and no major change in structure can be detected in its cyclical fluctuations (Figure 4–2). In contrast, the movement of the expanded defined government expenditure, which includes transfer expenditure, the ratio began to rise remarkably after 1970, reaching 35–36% around 1983 (Figure

6. Several potential reasons for the downward trend shift have been pointed out: for example, the slow pace of the outflow of agrarian population, the rising prices of primary products (deteriorating terms of trade (see Figure 6)), etc. However, analysis of changes in the pattern of cyclical fluctuations so far has been inadequate; hence this paper focused on the cyclical changes.

Number of Persons per Farmer's Household

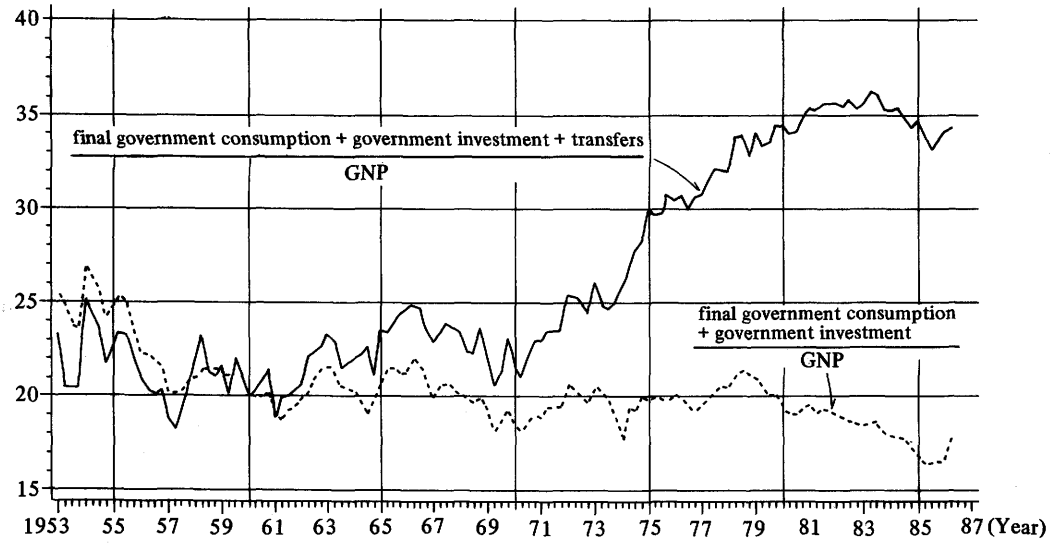
Average	Persons per Farmer's Household	(Reference) Persons per Worker's Household
1926 ~ 40	6.46 persons	4.14 persons
1953 ~ 55	6.33	4.77
1956 ~ 60	5.91	4.43
1961 ~ 65	5.46	4.17
1966 ~ 70	5.07	3.97
1971 ~ 75	4.65	3.85
1976 ~ 80	4.45	3.81
1981 ~ 85	4.36	3.79

Note: Until 1962, figures from the *Receipts and Disbursements of Farmers* are fiscal year basis. Figures from the *Family Income and Expenditure Survey* are totals of cities of more than 50,000 population.

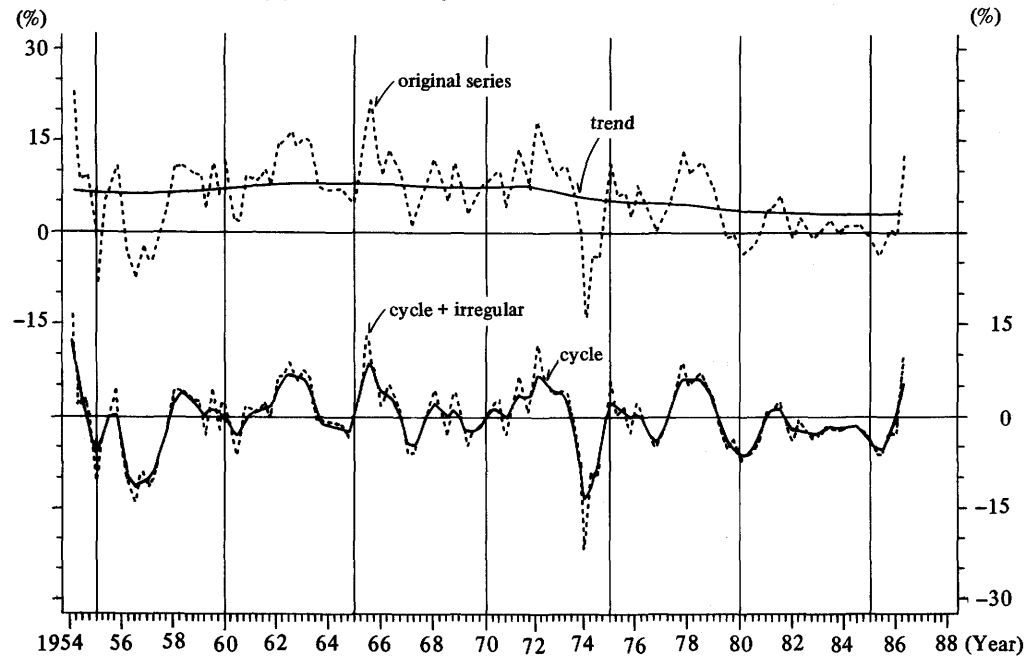
Source: Ministry of Agriculture, Forestry and Fisheries, *Receipts and Disbursements of Farmers;* Management and Coordination Agency, *Family Income and Expenditure Survey.*

Figure 4. Government Expenditure

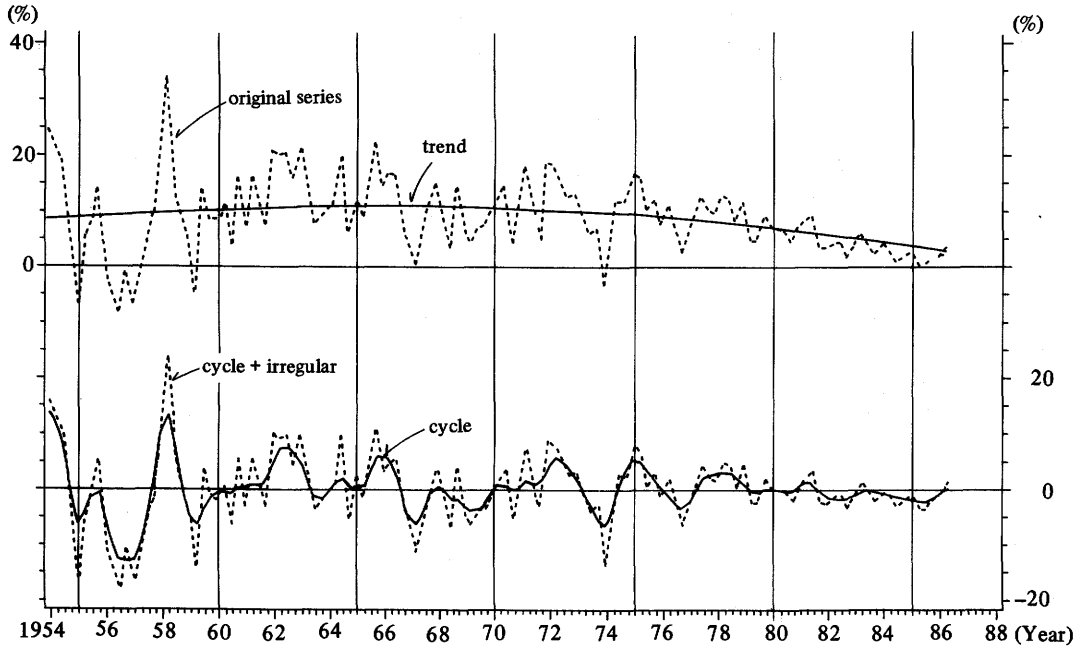
(1) Ratio of Government Expenditure to GNP



(2) Trend and Cycle (excluding transfers)



(3) Trend and cycle (including transfers)



(4) AIC Estimated from Time Varying Autoregressive Coefficient Model of Government Expenditure (including transfers) (sample period 1954 I ~ 1986 II)

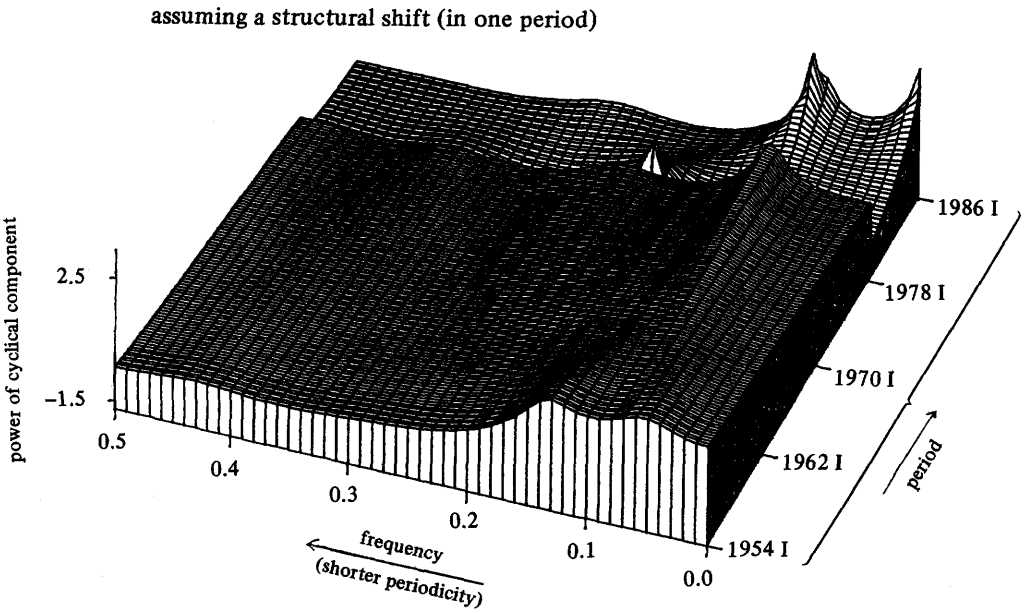
Case 1 assuming no structural shift 372.8

Case 2 assuming a structural shift (in one period)

1970	I	328.5	1974	I	326.5	1978	I	327.5
	II	327.7		II	326.8		II	327.3
	III	327.0		III	326.6		III	324.6
	IV	326.7		IV	326.5		IV	324.0*
1971	I	327.3	1975	I	326.8	1979	I	326.6
	II	326.7		II	328.0		II	328.0
	III	326.7		III	328.0		III	327.7
	IV	325.8		IV	325.9		IV	325.4
1972	I	325.3	1976	I	325.0	1980	I	325.8
	II	325.9		II	326.0		II	325.4
	III	326.2		III	326.3		III	324.6
	IV	326.7		IV	327.7		IV	331.2
1973	I	326.2	1977	I	327.6			
	II	326.2		II	326.4			
	III	326.3		III	326.0			
	IV	326.4		IV	324.3			

* minimum AIC

Figure 5. Government Expenditure (including transfers)



4–1). The growth trend has declined in recent years, reflecting fiscal consolidation, but the ratio to GNP has still remained at about one third and the share of transfer expenditure has above 15 percent.

The correlation between government expenditure including transfers and domestic demand has been negative and it suggests that, as a whole, the cyclical fluctuations in government expenditure have helped to level business cycles.[7] When examining the structural changes in cyclical pattern, by comparing the behavior of the series with and without transfers, the series with transfers showed a major change

7. Correlation coefficients at different lag periods between domestic demand and government expenditure:

(period 1954 I ~ 85 IV)

Lag on Government Expenditure	-4	-3	-2	-1	0	1	2
Government Expenditure (excluding transfers)	0.05	-0.13	-0.28	-0.39	-0.43	-0.42	-0.33
Government Expenditure (including transfers)	-0.18	-0.36	-0.47	-0.49	-0.39	-0.25	-0.05

in the latter half of the 70s: fluctuations became smaller and length of cycles became longer (see Figures 4–3, 4–4 and 5).

From the viewpoint of cyclical fluctuations, it suggests that the rapid improvement of social security and the expansion of government bond costs in the latter half of the 70s have produced a sort of stabilizing effect which leveled income fluctuations in the household sector, and stabilized both spending in the private sector and eventually economic activity as a whole.[8]

2. Exports

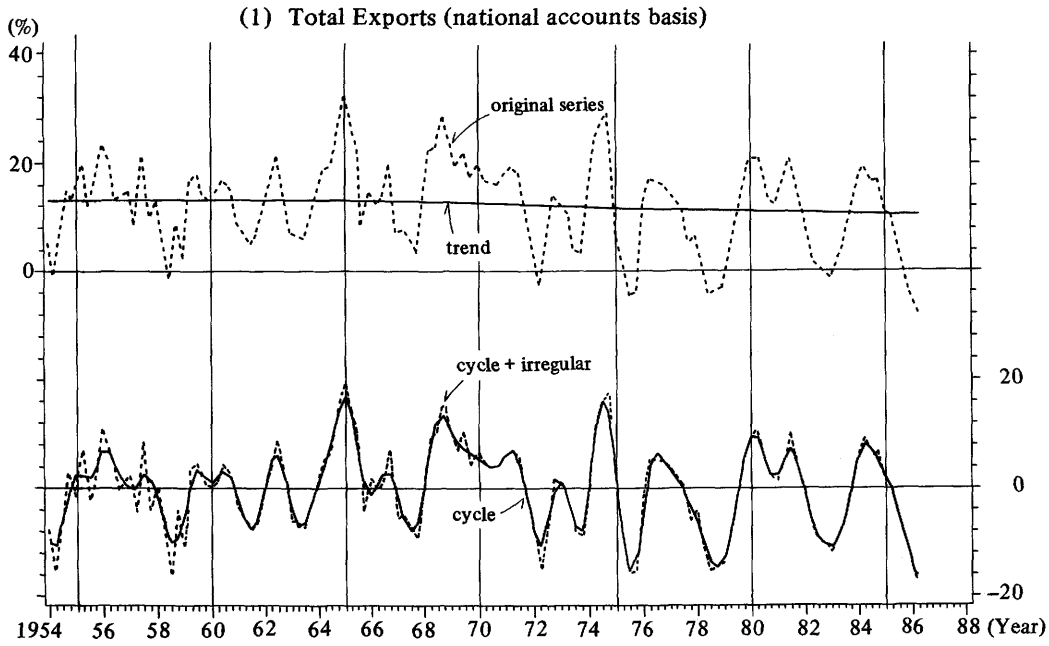
In contrast to the marked downward shift of the GNP trend, the growth trend of exports on a national accounts basis has remained over 10% in recent years though a little slackened after 12–13% level in the 1960s (Figure 6–1). Export cycles appear to have increased in amplitude and shortened in length since the latter half of the 1960s, but time varying autoregressive model imply no significant structural change in pattern even after the shift to the floating exchange rate system (see Figure 6–2 and 7). Exports on a customs clearance basis to the U.S. (Figure 6–3), the largest market for Japanese exports (with a share of 37% in 1985), show similar movement to those in exports as a whole on a national accounts basis: there was a gentle downward trend, from around +20% in the 1960s to around +15% in recent years, and cycles appear to have increased in amplitude and a significant structural change cannot be observed (Figure 6–2). The apparent increase in cyclical fluctuation seemed to occur around 1976: the period is a little later than that for exports on a national accounts basis.

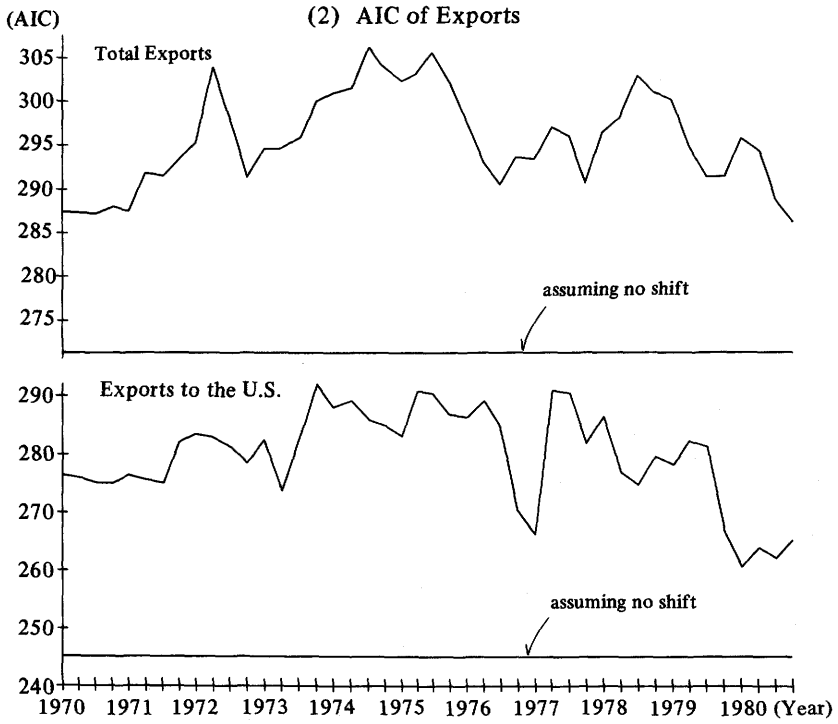
The time lag correlation coefficients of cyclical movements relating Japan's exports to the U.S. GNP (Table 4) shows that the U.S. business cycles affected Japan's exports to the U.S. (current and previous terms) more strongly after 1976, particularly after 1980 (Figure 6–4). Also, the impact of business fluctuations in the U.S. on Japan's total exports on a national accounts basis appears to have increased

8. Variance coefficient of government expenditure including transfers is remarkably low compared with that excluding transfers (figures are based on percent changes over the previous year).

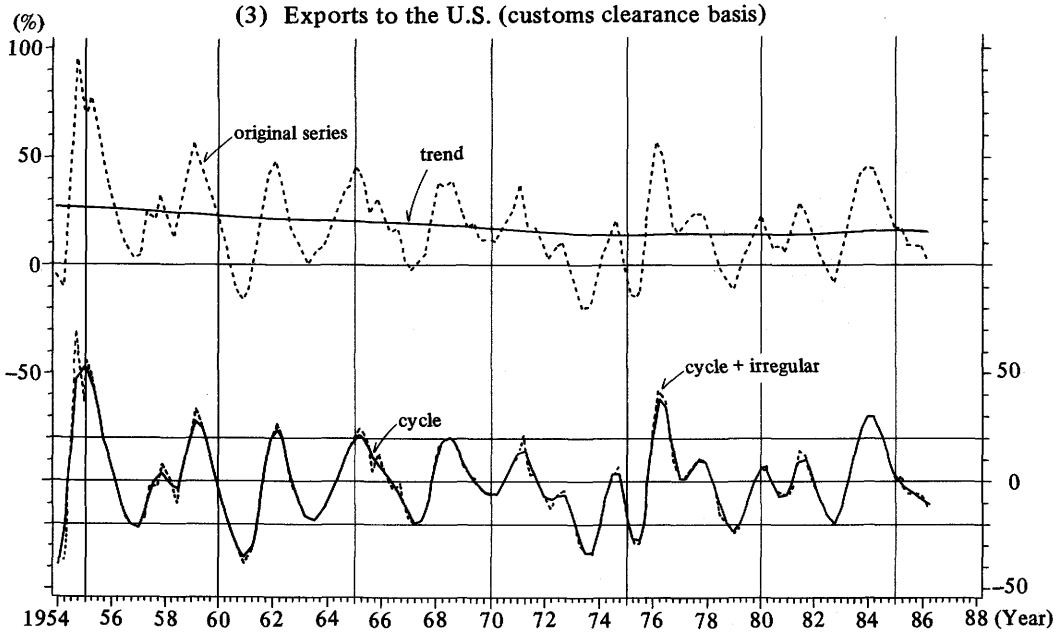
	1954 I ~ 75 IV	1976 I ~ 80 II	1980 I ~ 86 II
Government Expenditure (excluding transfers)	0.85	1.58	3.52
Government Expenditure (including transfers)	0.73	0.60	0.59

Figure 6. Exports (percent change over the previous year)





(3) Exports to the U.S. (customs clearance basis)



(4) Cyclical Fluctuations of Exports to the U.S. and the U.S. GNP

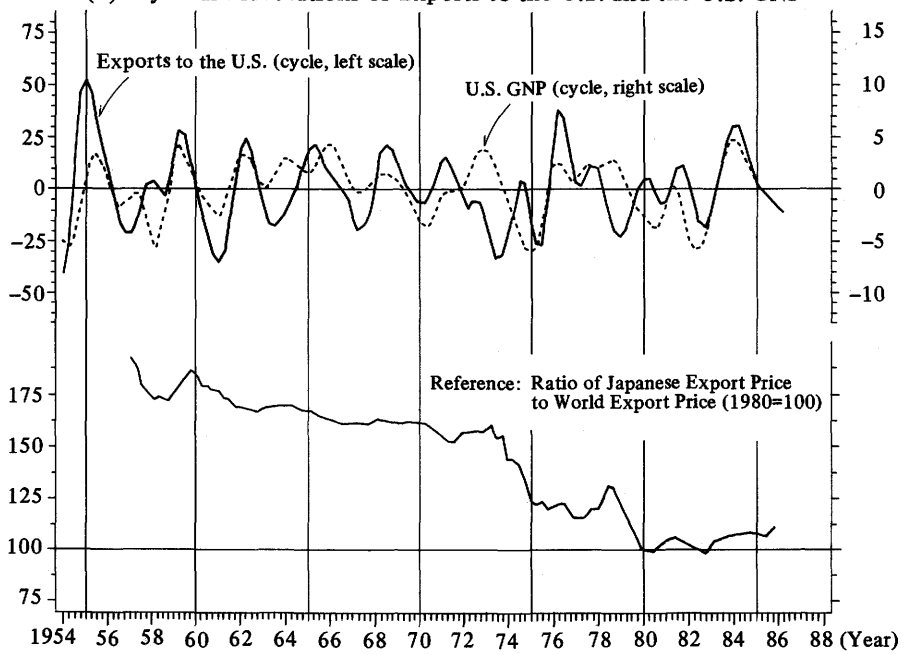


Figure 7. Exports

assuming no structural shift

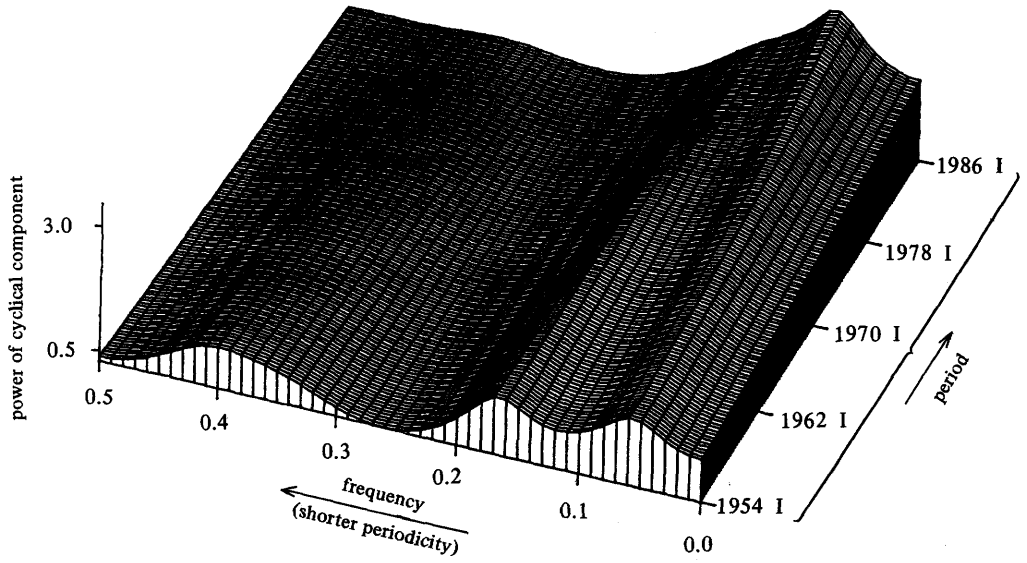


Table 4. Correlation Coefficients at Different Lag Periods between Exports and the U.S. Real GNP

Lag on U.S. GNP		1954 I ~ 75 IV	1976 I ~ 86 II	1980 I ~ 86 II
Total Exports[1]	-3	0.30	0.09	0.32
	-2	0.35	0.16	0.47
	-1	0.30	0.15	0.43
	0	0.13	0.04	0.25
Exports to the U.S.[2]	-3	-0.27	0.11	0.35
	-2	-0.02	0.38	0.69
	-1	0.23	0.51	0.84
	0	0.38	0.51	0.77

Note: 1. On a national accounts basis.
2. On a customs basis.

in the 1980s, with some time lag.[9] It can be said that this result supports the analysis in previous section made with the VAR model.

The increased correlation of Japan's exports with the business cycles in the U.S. may be interpreted as: (1) There was a weakening of export behavior related to domestic factors which seems to have been strong before the mid-1970s and a strengthening of the impact of business conditions in the U.S., (2) The exchange rate mechanism, backed by more active international capital flows, became stronger (for instance, an expansion in the U.S. economic activities leading to depreciation of the yen, with consequent increases in exports and price effects).

Despite the increased impact of the U.S. business cycles on Japan's exports and the increased importance of exports in GNP, cyclical patterns in Japan's real GNP have shown less variability since the latter half of the 1970s. One possible reason may be the increased stability of government expenditure as examined in this section. But there is also a possibility that other stabilizing factors are latent in endogenous demand, such as personal consumption and corporate investment. In the next section, we consider their movement.

IV. Endogenous Demand Components

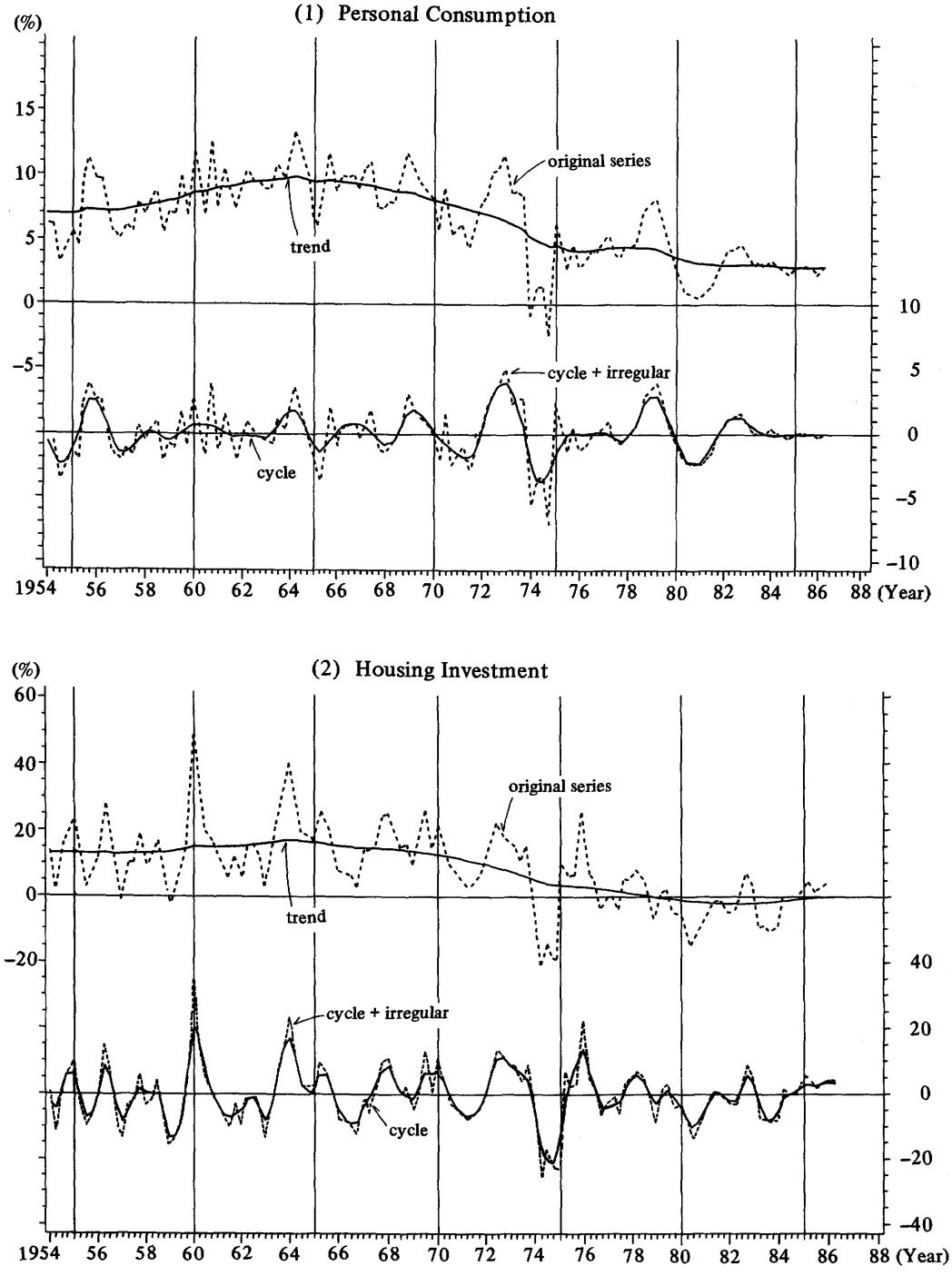
1. Personal Consumption and Housing Investment

Both personal consumption and housing investment (Figures 8–1, 8–2), which seem to be influenced by exogenous demand such as government expenditure, declined in growth trends in the latter half of the 1970s, as seen in real GNP. The trend of housing investment in particular dropped to near zero percent. It is probably because the total number of houses exceeded that of households after 1970 and because the cost of acquiring houses rose with increased land prices. Cyclical patterns of personal consumption and housing investment also showed changes (Figure 8-3). Housing investment began to change in 1973 and in 1977, with some contraction of the fluctuation. A similar test on personal consumption reveals a gradual change that took place over a long period of time and there was a relatively major structural change around 1976, with stabilized fluctuations (Figure 9).[10]

9. See Horiye (1986) for the changes in the relationship between capacity utilization in U.S. manufacturing industry and Japan's export ratio.

10. In the case of personal consumption, it is also necessary to consider the impact of the diffusion of durables. For instance, if imputed services for durables, which are not included in consumption rather than purchases, then fluctuations would probably become even more stable. See Horiye (1985) for an analysis of imputed services for durables.

Figure 8. Personal Consumption and Housing Investment (percent change over the previous year)



(3) AIC Estimated from Time Varying Autoregressive Coefficient Model
(sample period 1954 I ~ 1986 II)

a. Personal Consumption

Case 1 assuming no structural shift 356.5

Case 2 assuming a structural shift (in one period)

1970	I	346.9	1974	I	332.9	1978	I	330.0
	II	344.6		II	341.5		II	330.3
	III	344.1		III	323.6		III	331.2
	IV	343.0		IV	336.0		IV	344.1
1971	I	343.2	1975	I	326.3	1979	I	344.5
	II	343.1		II	324.0		II	344.7
	III	343.0		III	341.8		III	342.9
	IV	339.4		IV	345.0		IV	336.3
1972	I	339.5	1976	I	347.0	1980	I	340.9
	II	338.1		II	344.2		II	345.5
	III	338.3		III	323.8		III	345.3
	IV	335.1		IV	322.1*		IV	348.6
1973	I	334.7	1977	I	333.0			
	II	332.8		II	333.0			
	III	331.6		III	331.5			
	IV	332.2		IV	331.6			

b. Housing Investment

Case 1 assuming no structural shift 344.7

Case 2 assuming a structural shift (in one period)

1970	I	347.3	1974	I	342.3	1978	I	346.5
	II	344.5		II	344.5		II	346.6
	III	348.3		III	348.3		III	346.6
	IV	349.2		IV	349.2		IV	345.1
1971	I	350.3	1975	I	347.5	1979	I	344.3
	II	349.2		II	345.9		II	346.8
	III	348.3		III	352.1		III	347.0
	IV	346.7		IV	345.3		IV	347.1
1972	I	346.6	1976	I	346.8	1980	I	346.8
	II	345.8		II	345.8		II	347.4
	III	347.1		III	346.2		III	348.3
	IV	345.6		IV	342.5		IV	350.1
1973	I	344.8	1977	I	345.5			
	II	344.0		II	343.0			
	III	342.1		III	343.7			
	IV	339.3*		IV	344.5			

* minimum AIC

(4) Transfer Income (percent change over the previous year)

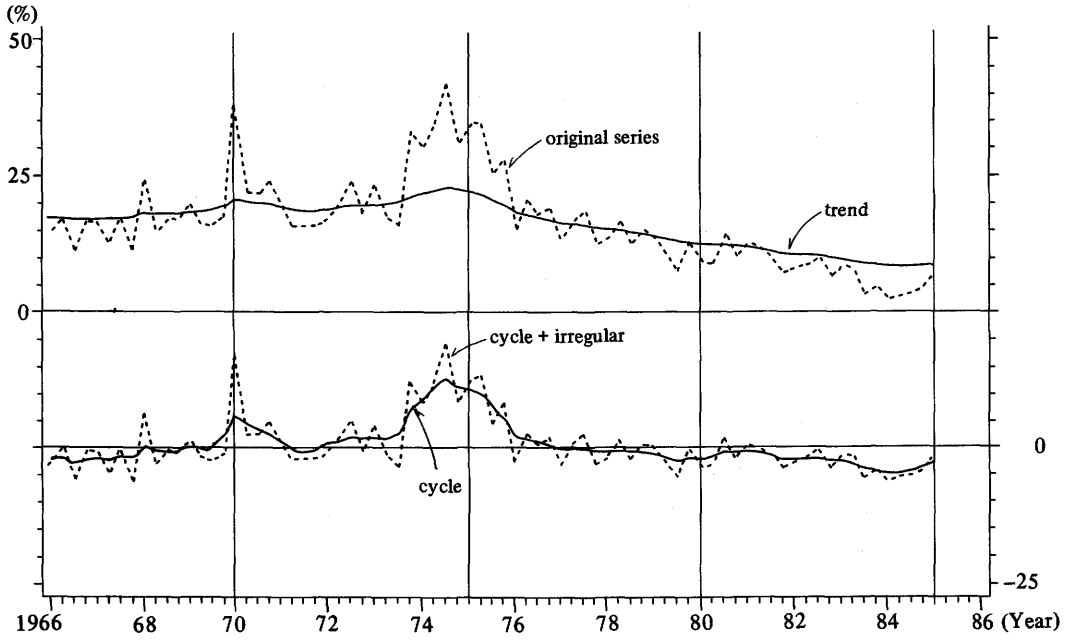
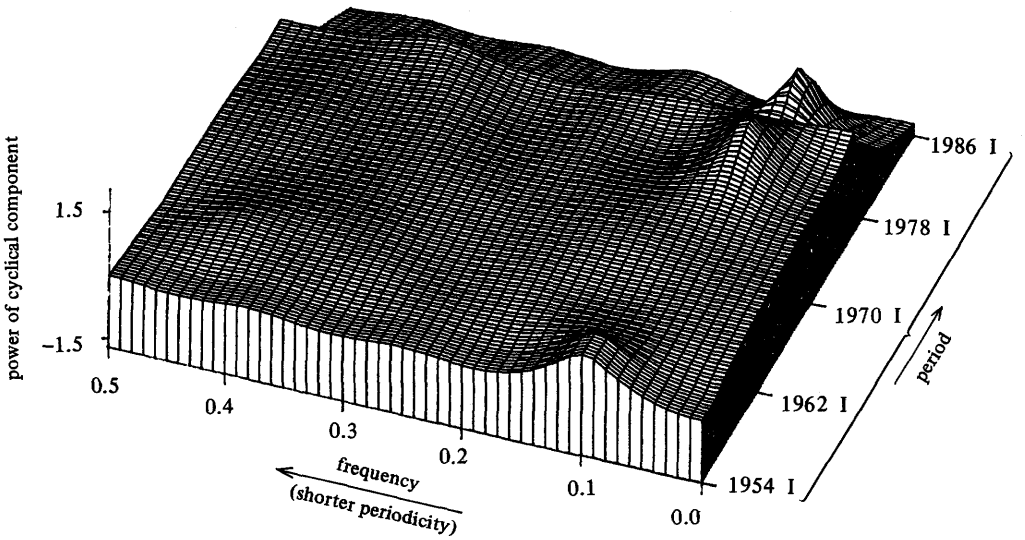


Figure 9. Personal Consumption

assuming a structural shift (in one period)



In the case of housing investment, however, there is only a small difference in AIC between the case in which structural change occur and the case in which no major structural change is assumed. However, in the case of personal consumption, which has a larger weight in GNP, it is comparatively clear that cyclical fluctuations have become more stable. It is thus possible to conclude that spending in the household sector has been stabilizing. This stabilization may be mainly due to the rising ratio of social transfers to earnings for the household sector, reflecting the improvement of the social security system[11] and that the fluctuations of these transfers have become more stable in the 1980s.

2. Corporate Investment

A. Inventory Investment

Inventory investment, based on the difference from the corresponding period of the previous year on a national accounts basis (Figure 10–1), has shown no discernible change in trend. As regards cyclical pattern, there may have been a structural change around 1976 (Figure 10–2), but this change must have been gentle as there is no significant difference in the AIC for the case in which change occurs compared with the case in which no structural change is assumed. Figure 10 also suggests that inventory investment cycles have a period of 2.5 to 3 years.

Another approach to measuring inventory cycles uses the producer's inventory ratio to shipments, based on the industrial production index. This ratio seems closely linked to trends in mining and manufacturing production and to reflect business activities. Cycles in the producer's inventory ratio to shipments, measured in terms of the difference from the previous year, show a clear negative correlation with cycles in GNP, but no significant change in inventory cycles (Figure 10–3).

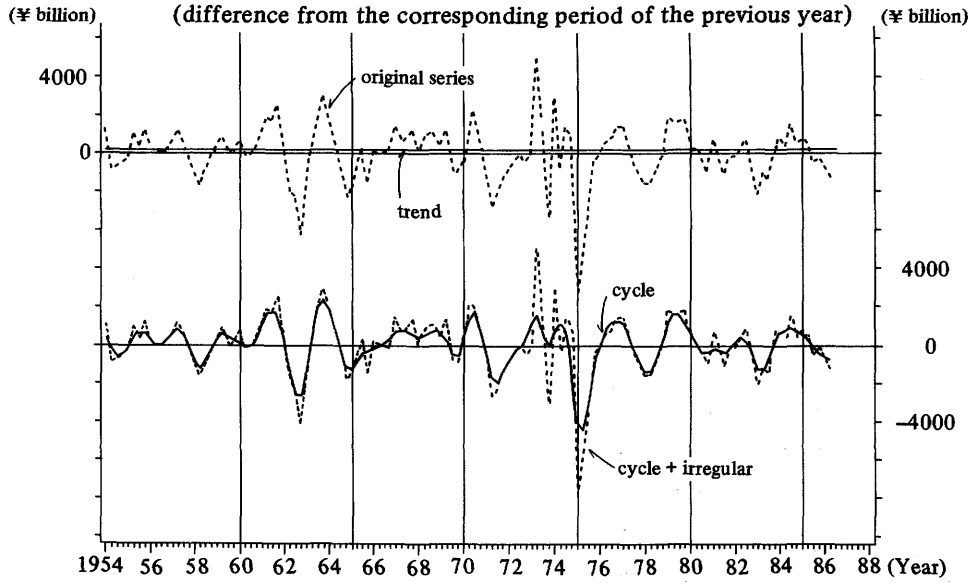
To the extent that inventory investment continues to show large fluctuations, it makes to produce large fluctuations in GNP. However, the impact of inventory cycles has become smaller, because the importance of inventory investment in GNP has declined markedly due to recent changes in economic structure (from the 1965–74 average of 2.2% to the 1980–85 average of 0.7%).

11. Based on SNA statistics, the ratio of transfer income from the government sector to disposable household income has increased markedly in recent years compared with the early 1970s. Also, cyclical fluctuations in transfer income, centering in social security, have become stable since 1976 (Figure 8–4).

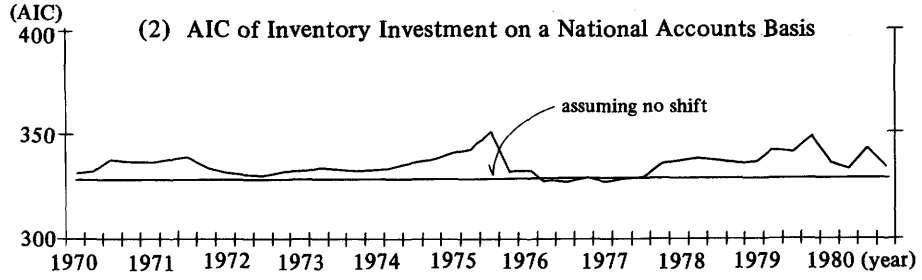
	1970~72 Average	1982~84 Average
Share of Transfer Income	8.1%	14.6%
Share of Asset Income	10.1%	16.6%

Figure 10. Inventory Investment

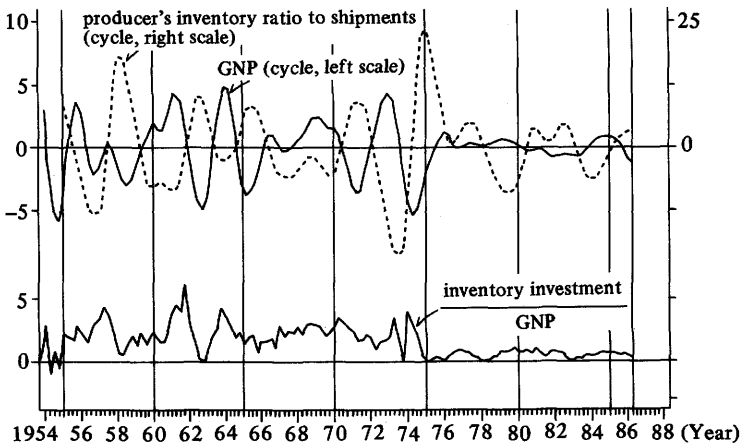
(1) Inventory Investment on a National Accounts Basis
(difference from the corresponding period of the previous year)



(2) AIC of Inventory Investment on a National Accounts Basis



(3) Relationships of GNP and Producer's Inventory Ratio to Shipments
(difference from the corresponding period of the previous year)



B. Plant and Equipment Investment

Plant and equipment investment has shown a marked downward shift in the first half of 1970s, from over +15% in the 1960s to +3~4% in the mid-1970s, and then recoverd to +6~7% in the 1980s (Figure 11–1). Cyclical fluctuations have seen a gradual fall in amplitude as well. Since the latter half of the 1970s, in particular, the fluctuation has become smaller, and, at the same time, the cycles lengthened (Figure 12). A structural change in the cyclical pattern appears to have occurred around 1975, judging from the AIC, though the difference of the AIC is smaller compared to the case in which no structural change assumed.

The changes of plant and equipment investment by type show that negative correlation has emerged in recent years between cycles in machine orders and cycles in planned construction costs. This negative correlation implies that it has worked as a factor in reducing the amplitude of investment cycles even when the time lags in the execution of investment are considered (Figure 13–1).

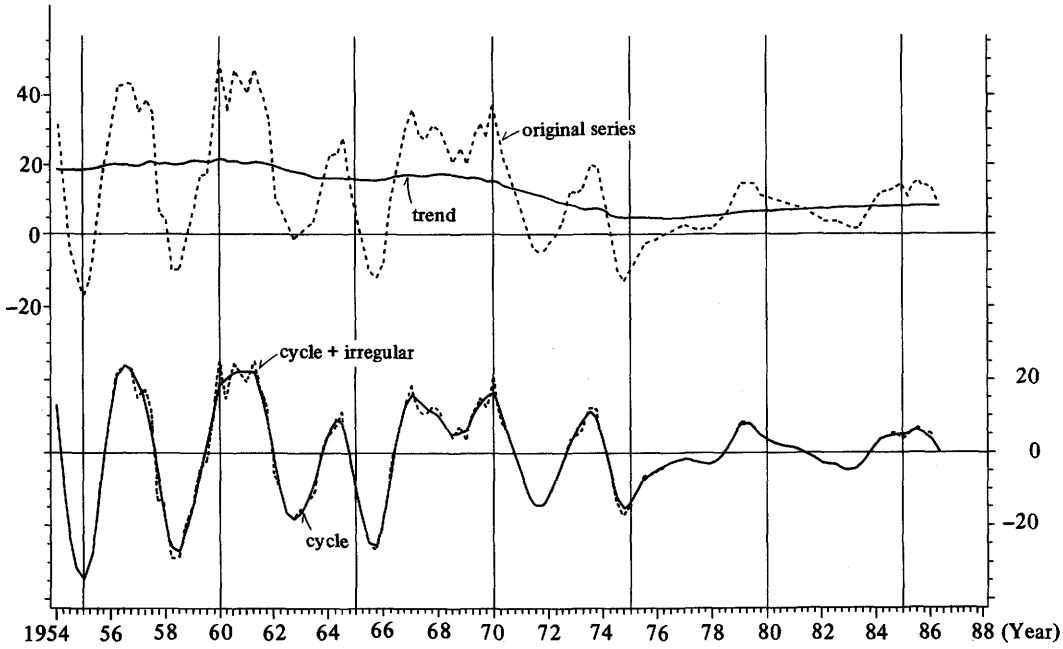
Observing the movements by major industries, tertiary industry declines its growth trend, but this tendency is mild and maintains over +7% growth in recent years (Figure 11–2). The smaller AIC for this series compared with the case in which no structural change was assumed suggests that structural change has developed gradually. If a major change did occur, it might be around 1980 (Figure 11–4). By type of investment, even the tertiary industry, the correlation has become negative in recent years between fluctuations in machine orders and those in planned construction costs (Figure 13–3). Data based on a narrower definition of the service industry show that the growth trend has remained at around +15%, and that the amplitude has contracted considerably, though gradually, since the beginning of the 1970s (Figures 11–3, 11–4). It can be argued that the growth trend in plant and equipment investment as a whole has remained relatively high and its cycles have become more stable due to the increase in relative importance of tertiary industry, which reflects the growth of the service sector in economic activity increasing from 36% in 1969–70 to 46% in 1984–85.[12]

In manufacturing industry, the growth trend fell markedly in the mid-1970s, and was even negative at some periods. But, then the trend recovered and has remained between +7% and +8% in recent years (Figure 14–1). The cycles seem to have declined gradually in amplitude, although, judging from the AIC, the change was gradual rather than sudden. In contrast to the tertiary sector, machine orders and planned construction costs correlated positively (Figure 13–2). Within manufacturing, there was a contrast movement between processing and materials industries. The growth trend is still at a relatively high level in processing industry (+13–14%),

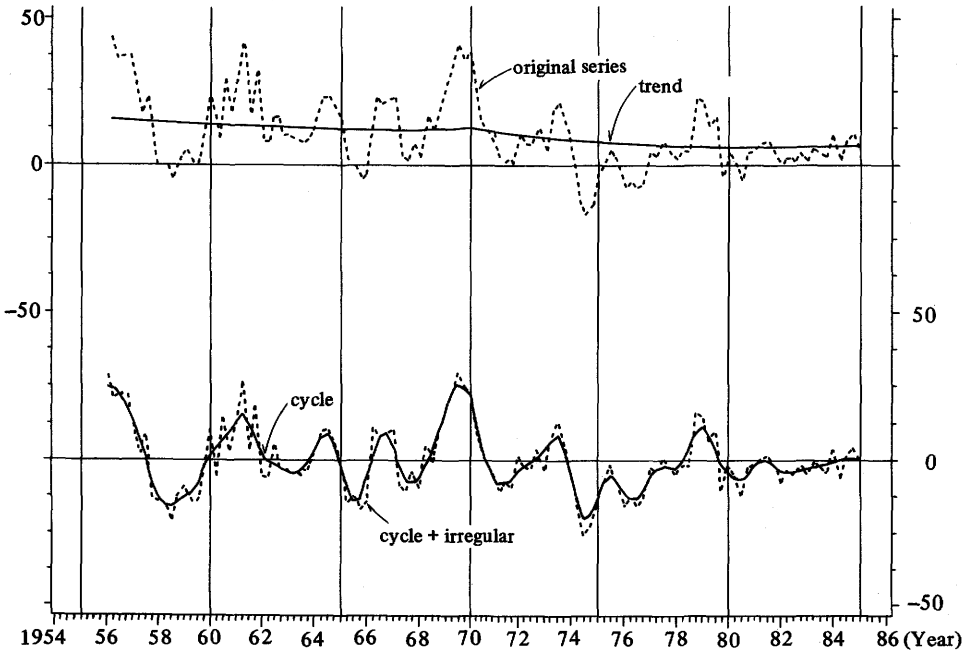
12. For an empirical analysis of the impact of the growth of the service sector on business cycles and investment activity, see Horiye (1984).

Figure 11. Plant and Equipment Investment (percent change over the previous year)

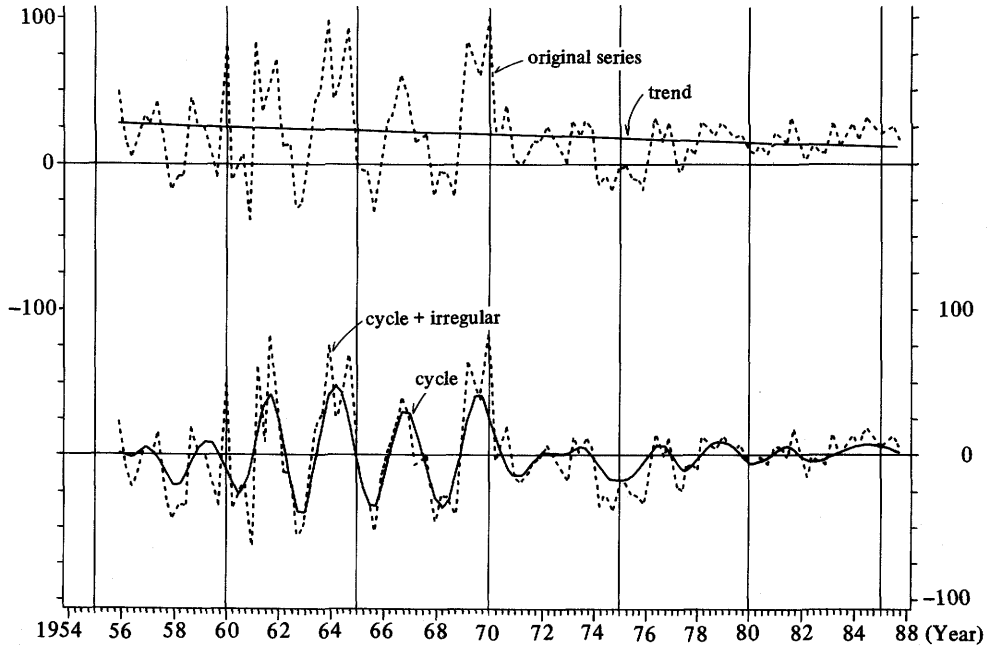
(1) Plant and Equipment Investment (national accounts basis)



(2) Tertiary Industry



(3) Service Industry



(4) AIC

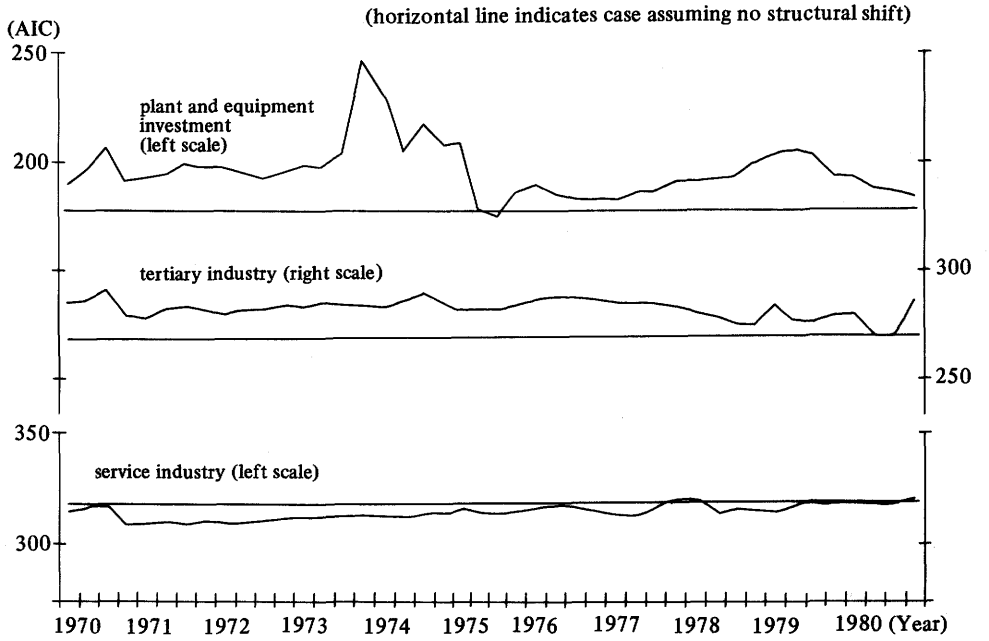


Figure 12. Plant and Equipment Investment

assuming a structural shift (in one period)

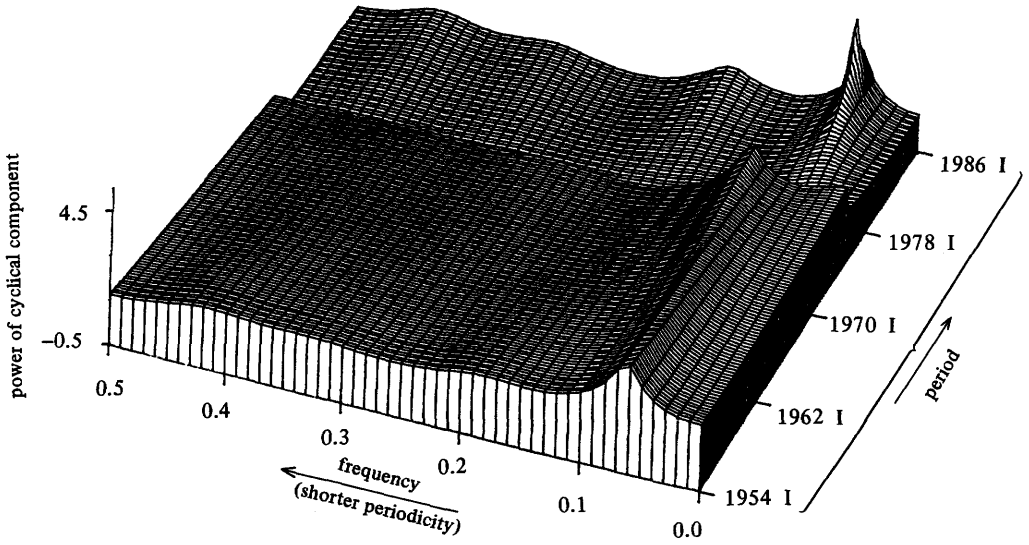
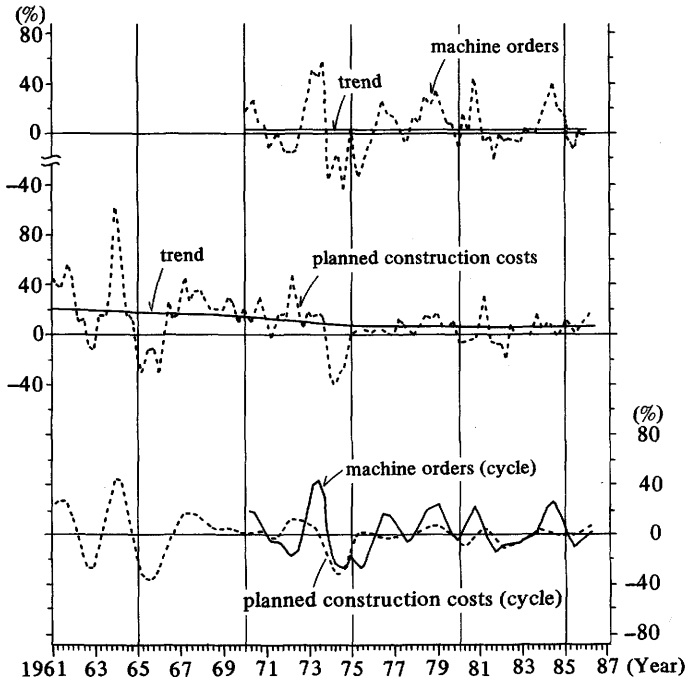
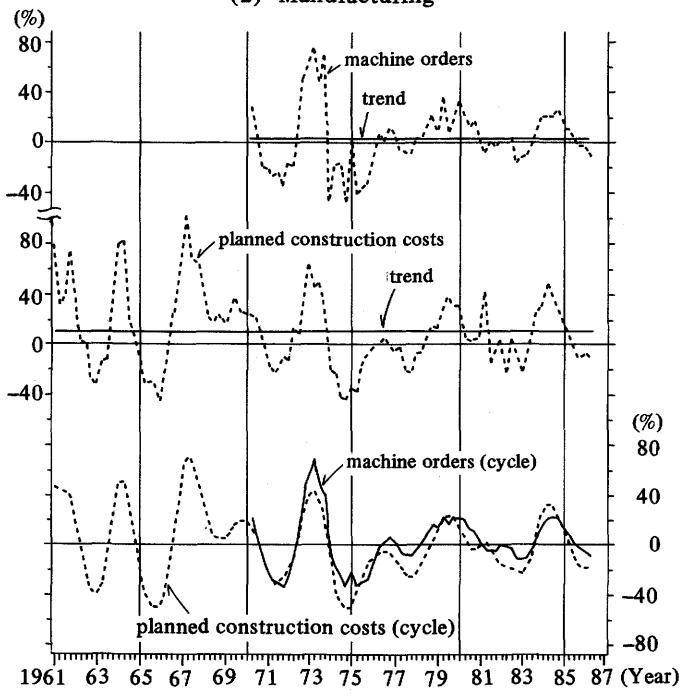


Figure 13. Machine Orders and Planned Construction Costs (in real terms, percent change over the previous year)

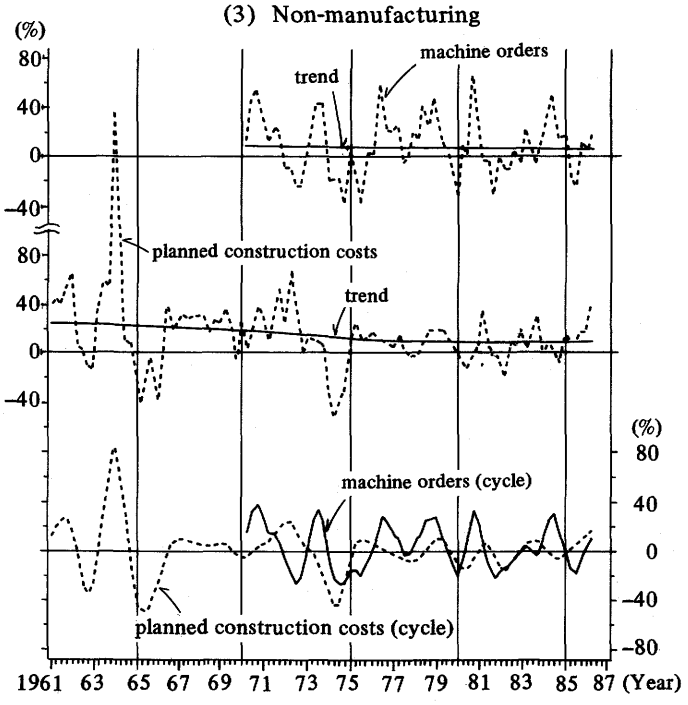
(1) Total Industry



(2) Manufacturing



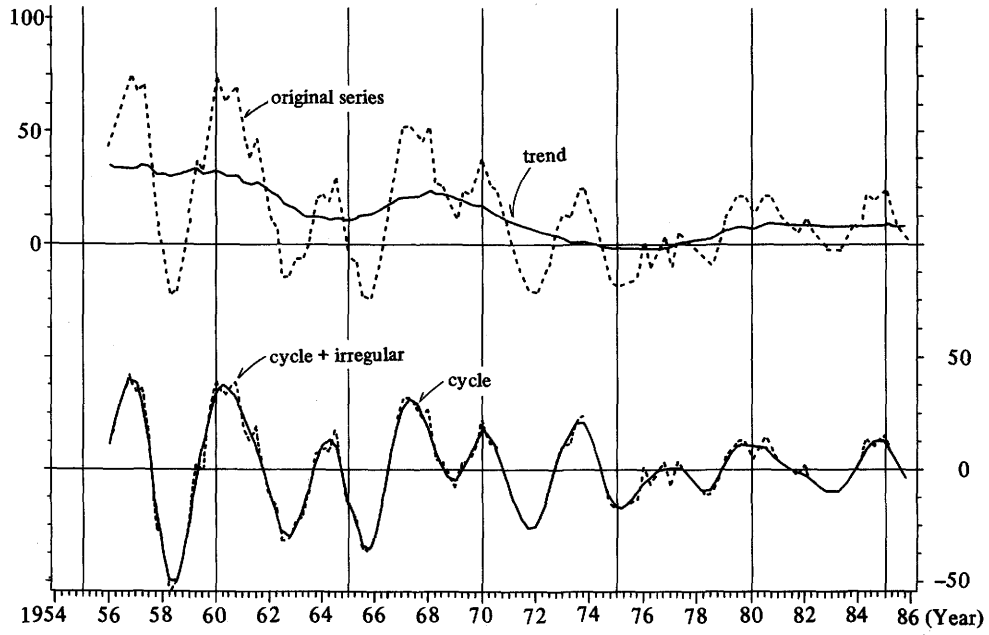
(3) Non-manufacturing



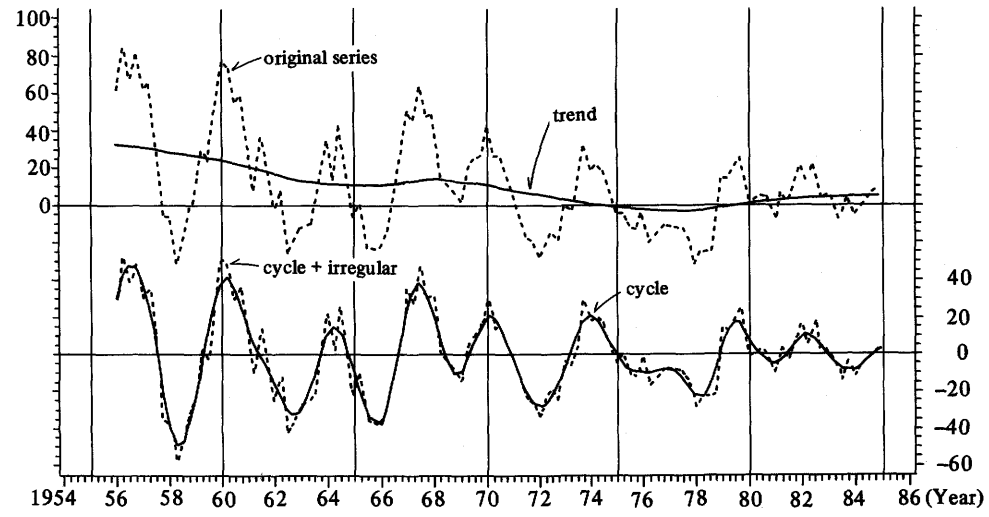
Note: Machine orders are deflated by the WPI for Capital Goods; Planned construction costs are deflated by the WPI for construction goods.

Figure 14. Plant and Equipment Investment in Major Industries (percent change over the previous year)

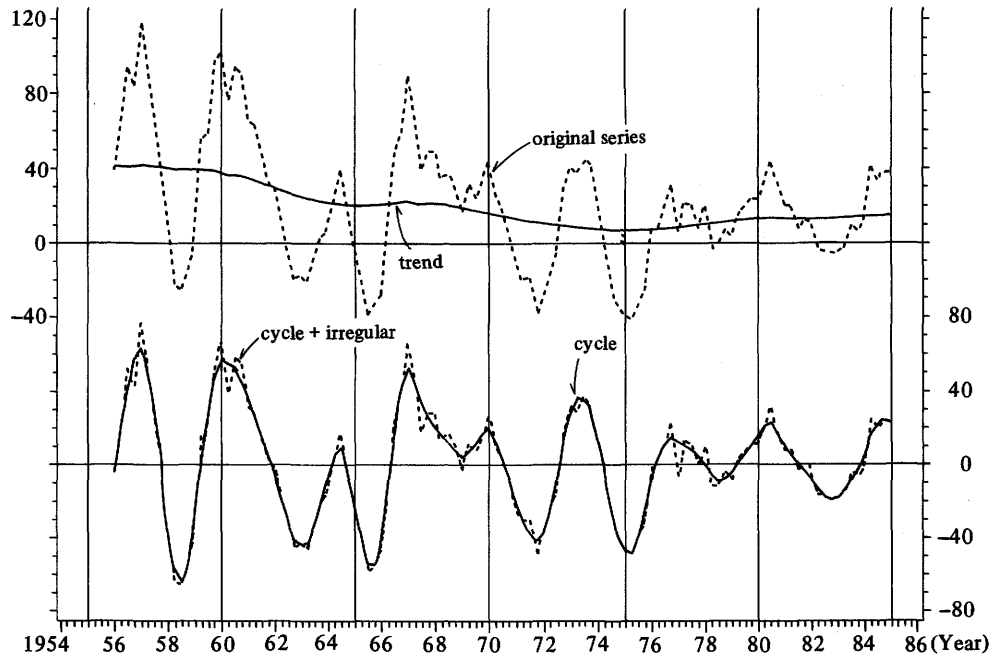
(1) Manufacturing



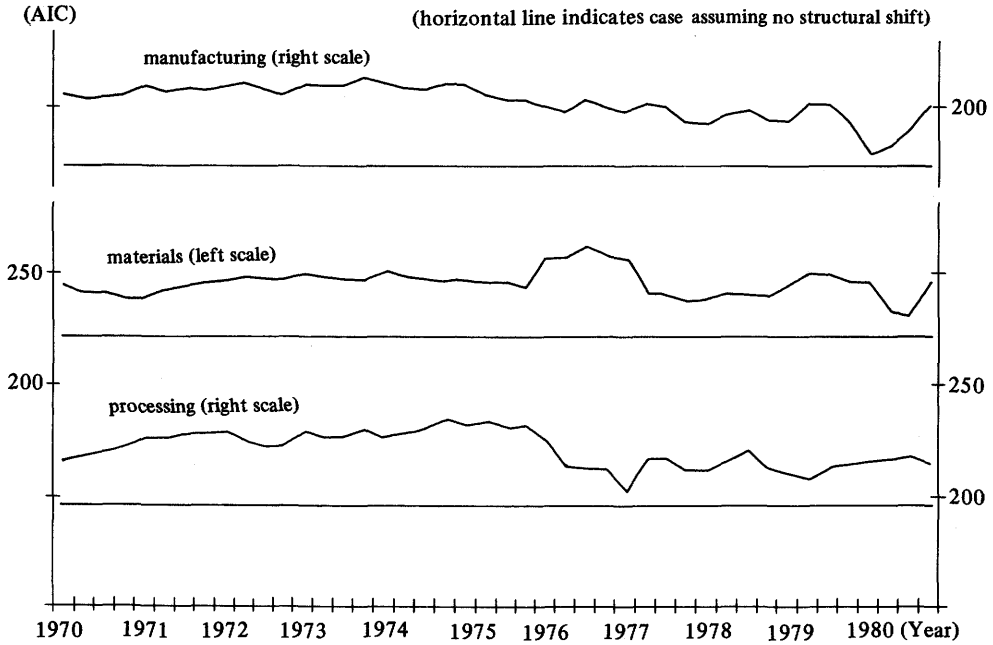
(2) Materials Industries



(3) Processing Industries



(4) AIC



Note: 1. Material industries comprise textiles, chemicals, basic metals, pulp, paper and paper products.
2. Processing industries comprise machinery, electrical machinery and transport equipment.

though below the level in the 1960s, whereas it has fallen markedly in the materials industry to around +5% in recent years. Also Figure 14 depicts that for both sectors the amplitude of cycles seems to have contracted. Although the periods of major changes occurred at different times in both industries, the AIC suggests that a relatively major change occurred around 1977 for the processing industry and around 1980 for the materials industry. As in other cases, however, the AIC values indicate that structural change in cycles has been gradual.

Let us now examine more in detail the variability in plant and equipment investment as a whole and those in various industries based on variance coefficients, using growth rates from the corresponding period of the previous year and SNA data (Table 5).

The variance coefficient for plant and equipment investment as a whole dropped from 1.21 for the period 1966–75 to 0.84 for the period 1976–85 and, in particular, it stabilized even lower, 0.57, in the period 1980–85. This finding is consistent with the result obtained by checking for structural changes on the basis of the AIC. These downward tendencies were particularly marked in general machinery, electrical machinery, transportation machinery and service industries. As was pointed out before, the growth of plant and equipment investment has been stable and relatively high in these industries, reflecting the rapid growth of demand. As a result, the relative importance of these industries has increased, from 18.5% in 1970 to 22.0% in 1980 and to 31.0% in 1984, thus these industries play a role in stabilizing investment as a whole.

In many other industries (food, paper and pulp, primary metals, construction, wholesale, retail, etc.), variance coefficient has increased from the latter half of the 1970s onward or since the beginning of the 1980s, with the result that the unweighted average variance coefficient for the 17 industries increased from 2.17 to 5.11. The above findings from time series data in SNA statistics are supported by findings from cross-section data (with pooled data from five-year periods) from individual businesses by industries taken from the Bank of Japan's *Financial Statements of Principal Enterprises*. These data show that the only decreases in variance coefficient were in industries such as normal steel, heavy electrical machinery, wholesale and real estate (Table 6).

An apparent contrast by industries, however, contributes to stabilizing investment activities as a whole, even though the average variance coefficient for individual industries has increased. That is, during the high growth period, most industries or firms raised and lowered investment simultaneously, but after the mid-1970s there were decoupling phenomena in investment among industries and even among firms within an industry. The result devotes more stable fluctuations in investment as a whole.

This is also shown by correlation coefficients between investment in individual

Table 5. Variance Coefficient of Plant and Equipment Investment by Industry

(SNA basis, percent change over the previous year)

	1966 ~ 75	1976 ~ 85	1980 ~ 85
Industry Total	1.21	0.84	0.57
Manufacturing	1.96 (0.93)	1.51 (0.65)	0.85 (0.62)
Food	2.15 (0.62)	2.82 (0.17)	10.58 (0.01)
Textiles	3.80 (0.80)	3.06 (0.37)	2.34 (0.15)
Paper & Pulp	2.04 (0.69)	4.91 (0.29)	3.00 (0.13)
Chemicals	2.39 (0.55)	6.23 (0.32)	1.15 (0.22)
Primary Metals	1.99 (0.60)	19.07 (0.07)	3.31 (0.44)
Fabricated Metal Products	2.23 (0.74)	2.00 (0.27)	2.20 (0.45)
General Machinery	2.11 (0.91)	1.99 (0.44)	1.66 (0.51)
Electric Machinery	2.64 (0.87)	0.92 (0.31)	0.90 (0.90)
Transportation Equipment	2.83 (0.79)	1.94 (0.13)	1.96 (0.31)
Other Manufacturing	3.75 (0.77)	2.12 (0.55)	1.96 (0.58)
Construction	1.18 (0.67)	2.66 (0.02)	5.11 (0.01)
Wholesale Trade	1.67 (0.74)	4.85 (0.34)	9.13 (0.21)
Retail Trade	1.10 (0.57)	7.89 (0.41)	35.32 (0.01)
Finance & Insurance	1.87 (0.32)	20.13 (0.30)	1.71 (0.05)
Real Estate	2.12 (0.52)	2.84 (0.16)	2.25 (0.06)
Electricity, Gas & Water Supply	1.40 (0.31)	2.85 (0.10)	6.37 (0.13)
Services	1.54 (0.56)	0.67 (0.46)	0.48 (0.40)
Average of 17 Industries	2.17	5.11	5.26
Average of 10 Manufacturing Industries	2.59	4.51	2.91

Note: 1. For 1985, figures of manufacturing, wholesale trade, and retail trade cover the January ~ March quarter and others cover the October ~ December quarter.
2. Figures in parenthesis are correlation coefficients between plant and equipment investment for the industry in question and that of all industries (on a national accounts basis).

Table 6. Variance Coefficient for Plant and Equipment Investment

Industry		Variance Coefficient by Industry				Correlation Coefficient between Each Firm and Its Industry			
		1966 ~ 70	1971 ~ 75	1976 ~ 80	1981 ~ 85	1966 ~ 70	1971 ~ 75	1976 ~ 80	1981 ~ 85
Confectionary & Dairy Foods	(5)	2.12	9.53	26.75	2.61	0.69	0.50	0.47	0.34
Other Foods	(13)	2.26	4.37	3.70	4.23	0.20	0.25	-0.11	-0.24
Synthetic Fibers	(8)	2.40	10.08	5.48	2.54	0.10	0.76	0.02	0.23
Cotton	(13)	2.21	10.21	8.02	4.59	-0.10	0.39	0.35	-0.22
Other Textiles	(11)	2.35	8.18	3.01	3.40	0.20	0.18	0.32	0.28
Paper & Pulp	(12)	2.17	5.03	3.05	2.59	0.20	0.27	0.20	-0.03
Synthetic Chemicals	(5)	3.32	3.65	5.72	6.30	0.35	0.62	0.29	0.65
Inorganic Chemicals	(13)	1.90	4.82	3.91	2.60	0.28	0.32	0.13	-0.13
Petrochemicals	(3)	2.25	2.94	4.42	7.91	0.40	0.61	0.53	-0.17
Other Organic Chemicals	(20)	1.90	5.08	4.31	2.64	0.28	0.41	0.29	0.24
Oils, Fats, Detergent & etc.	(6)	1.66	371.24	3.05	2.90	0.56	0.48	0.45	0.35
Drugs & Medicines	(9)	2.32	8.62	2.81	2.74	0.30	0.40	-0.11	0.05
Petroleum Refining	(7)	1.87	13.81	4.60	5.03	0.40	0.46	0.25	0.25
Tire & Tube	(4)	1.23	6.08	4.32	2.71	0.34	0.47	0.19	0.45
Cement	(3)	2.09	5.53	2.27	10.57	-0.17	0.34	0.49	0.23
Other Ceramics & Earthenware	(7)	2.02	5.34	5.73	2.23	0.27	0.22	-0.14	0.11
Normal Steel	(11)	7.95	4.00	5.30	3.04	-0.07	-0.06	-0.25	0.09
Specialty Steel	(14)	2.01	11.27	2.39	2.84	0.26	-0.16	0.49	0.03
Copper, Lead, Zinc Refining	(7)	2.17	41.25	2.74	3.62	0.28	0.38	0.66	0.47
Aluminum Refining	(3)	1.34	7.17	0.97	2.41	0.52	0.50	0.26	0.28
Electric Wires & Cables	(6)	1.98	9.42	2.26	2.79	0.60	0.84	0.33	0.03
Metal Products	(13)	2.68	10.63	3.02	4.83	0.50	0.31	0.30	0.17
Construction Machinery	(8)	1.38	9.52	1.99	3.68	0.43	0.49	0.28	0.16
Industrial Machinery	(19)	4.12	5.70	2.76	3.53	0.11	0.14	0.25	0.23
Office Appliances & etc.	(3)	2.65	5.10	1.37	4.15	0.52	0.12	0.61	0.37
Machine Tools & Parts	(6)	1.35	13.02	2.42	2.14	0.21	0.49	0.54	0.31
General Electrical Machinery	(4)	1.16	4.38	0.99	1.17	0.58	0.88	0.62	0.46
Heavy Electrical Machinery	(6)	2.31	5.49	2.26	2.10	0.76	0.36	0.47	0.51
Household Electrical Machinery	(12)	1.55	165.98	2.52	2.35	0.45	0.58	-0.03	0.03
Communications & Electronic Machinery	(7)	2.37	9.81	1.64	2.07	0.53	0.25	0.30	0.23
Electronic Parts	(6)	0.35	6.27	2.19	2.78	–	0.69	0.55	0.08
Automobiles	(12)	1.72	68.10	1.91	3.51	0.38	0.62	0.32	0.35
Automobile Parts	(16)	3.43	19.62	2.39	3.14	0.65	0.59	0.25	0.31
Shipbuilding	(6)	2.51	4.99	2.81	5.96	0.51	0.41	0.48	0.05
Precision Instruments	(10)	1.50	12.64	1.27	2.33	0.39	0.33	0.18	0.50
Wholesale	(52)	5.69	5.75	4.01	2.85	0.08	-0.02	-0.09	0.00
Department Stores	(14)	2.64	4.51	3.03	2.23	0.25	0.43	0.16	-0.02
Convienience Stores	(8)	–	1.38	6.51	3.64	–	0.64	0.45	0.20
Construction	(41)	5.26	9.08	3.12	4.16	0.07	0.01	0.15	0.19
Real Estate	(15)	4.29	5.45	4.95	3.10	-0.01	-0.04	0.03	-0.16
Railway	(19)	6.09	4.99	5.92	3.37	0.08	0.41	0.04	0.14
Transportation	(7)	3.31	4.77	3.31	4.03	-0.04	0.94	0.00	0.32
Shipping	(19)	4.41	5.60	3.25	4.23	-0.01	0.05	0.03	0.29
Warehouse	(6)	1.74	20.05	1.89	2.34	0.50	0.27	0.44	0.44
Electricity	(9)	1.32	2.41	1.75	9.92	0.43	0.54	0.74	0.05
Gas	(5)	0.89	2.47	9.56	3.44	0.31	0.09	0.35	0.54
Hotels	(9)	2.43	4.43	3.05	2.15	0.17	0.07	0.05	0.15
Movie Productions	(4)	1.98	287.71	2.48	1.95	0.05	0.34	0.27	0.87
Recreation	(7)	3.56	2.71	3.15	4.07	0.17	0.39	0.05	-0.23
Other Services	(8)	2.06	3.70	5.54	2.64	0.88	0.02	0.54	0.62

Note: 1. Pooled data for each firm for 5-year; thus, the number of data used is five times the number of firms.
2. Based on percent changes, defalted by plant and equipment investment deflator.
3. Figures in parentheses are the numbers of firms in the 1985 survey.

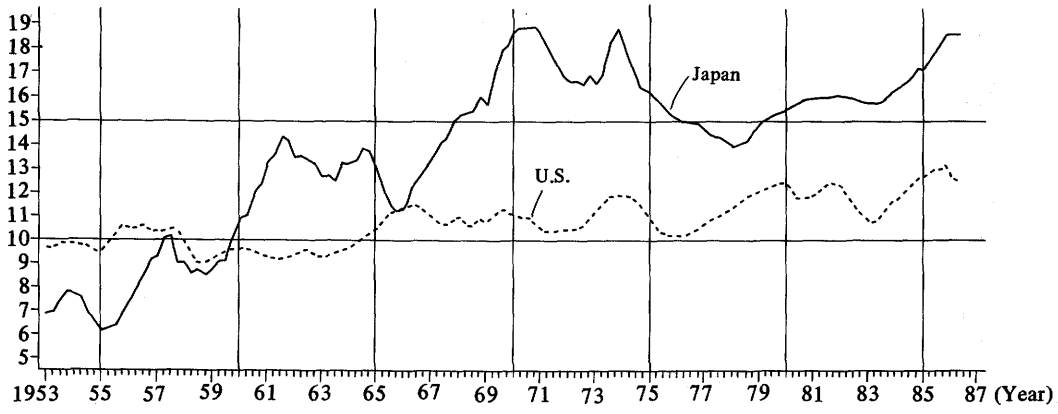
Source: Bank of Japan, *Financial Statements of Principal Enterprises.*

industries and total investment, and between investment in an industry and that in each business in the industry concerned (Tables 5 and 6). These correlation coefficients dropped substantially from the beginning of the 1980s, except in industries such as electrical machinery and services.

To review the results so far, there have been three factors causing more stable cycles in plant and equipment investment: (1) investment in machinery and services industries has maintained a high and more stable level and hence increase in importance, (2) industry-level or firm-level investment in other industries has been decoupled chronologically, but it produced stabilizing effects, and (3) it is, however, necessary to examine investment cycles in a larger context, by ascertaining how fluctuations in investment affected final demand.

One approach to this more broadly defined analysis is to examine changes in the ratio (on a nominal basis) of plant and equipment investment to GNP, and to regard peaks and troughs in it as turning points in business cycles (for example, see Shinohara 1961). This method has the advantages that it is easy to collect time series data and also that the differences between deflators for specific demand components and the average deflator can be used as a source of information. A problem arises, however, when we consider the recent trends in prices. The rate of increase of wages has been high compared with that of prices of investment goods, and, as a result, there is a possibility that investment on a nominal basis may be structurally underestimated. Moreover, the alternative of the ratio of investment to GNP in real terms also has a drawback: the pattern of changes in this ratio is clearly different from that of fluctuations in real GNP. After falling toward 1978, this ratio has increased substantially in recent years to a level close to its past peak around 1970 (Figure 15). As neither of the ratio-based indicators was adequate, the growth from the corresponding period of the previous year for the series was used here as in the

Figure 15. Ratio of Plant and Equipment Investment to GNP (in real terms)



case of other demand components.

Finally, let us compare the characteristics of demand components examined above with those of the U.S. (Figure 16, Table 7). In the U.S., we find that (1) the trends have hardly changed and (2) the cyclical patterns have been a gradual contraction in the fluctuations of personal consumption from the latter half of the 1970s and an increase in the amplitude of fluctuations in inventory investment. But other demand components have shown no signs of major structural change and have continued to fluctuate greatly.

To summarize the results of sections III and IV: larger changes occurred in trends in personal consumption, housing investment and plant and equipment investment in Japan, but the contraction of the amplitude of cycles in government expenditure (and, as a result, of personal consumption) and in plant and equipment investment stabilized cyclical patterns. Although the impact of business cycles in the U.S. on Japan's exports increased, the effect was so far not strong enough to increase fluctuations in GNP as a whole.

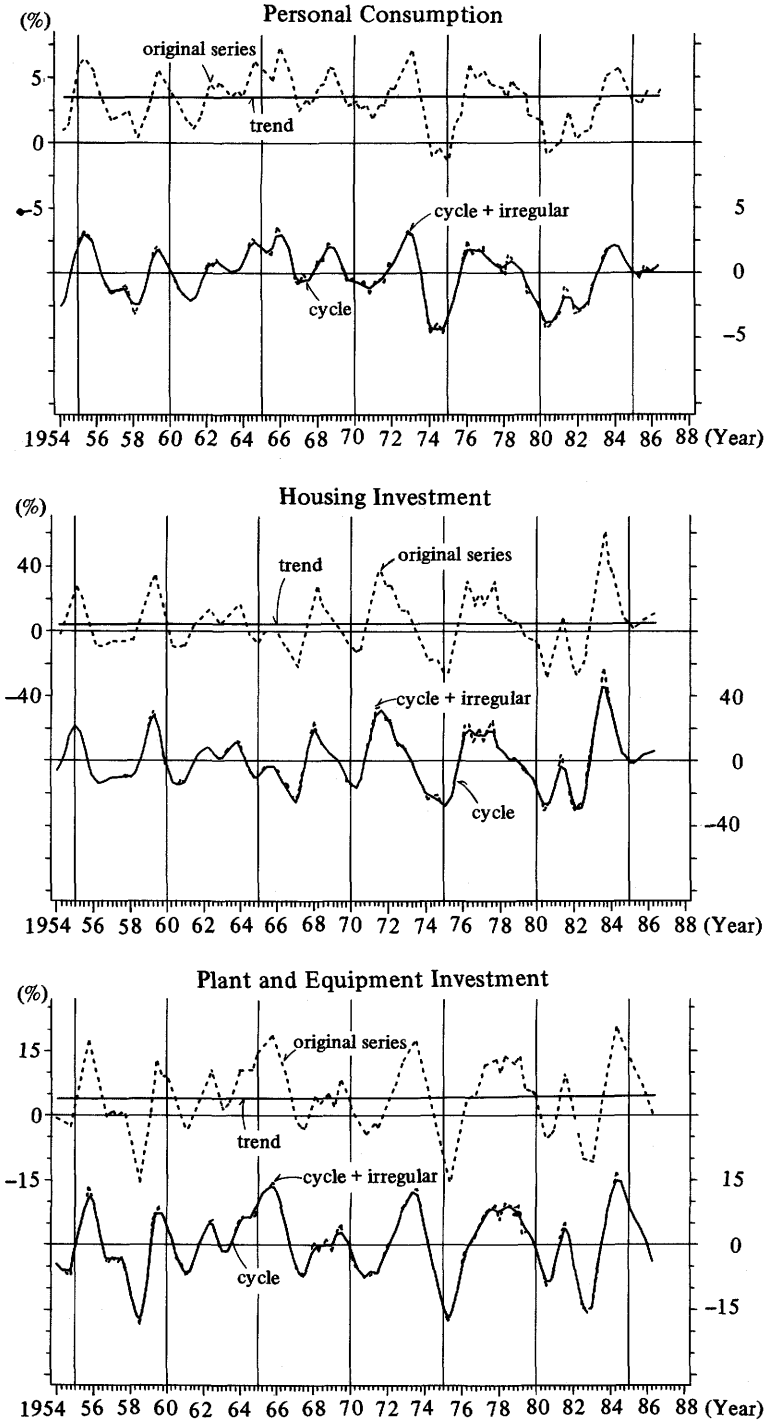
V. Relationships among Demand Components

Based on the above discussion concentrated on cycles of individual demand components, let us now examine the interactions among components using a VAR model. At first, we employed three factors, that is, domestic private demand (the total of personal consumption, housing investment and private corporate investment), exports and government expenditure including transfer payments.

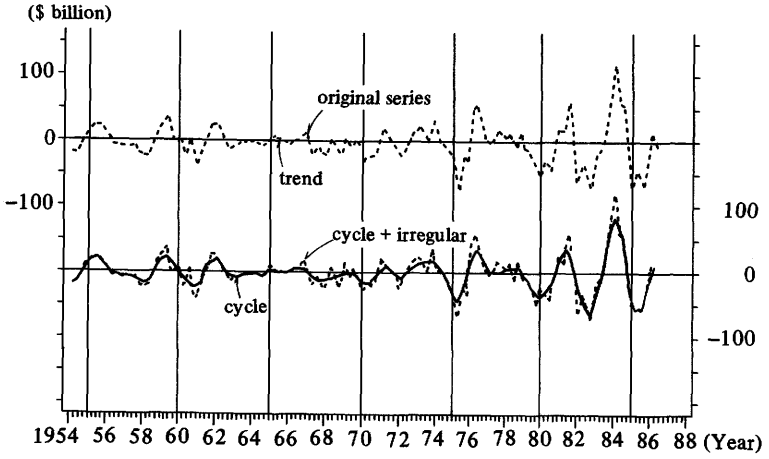
Before 1975, private domestic demand seems to have been little influenced by exports and government expenditure, but did exert some influence on exports (Table 8). Since 1976, there have been two developments: (1) the autonomous component of private domestic demand has declined considerably, and that of exports has risen; and (2) the influence of exports and government expenditure on private domestic demand increased substantially.[13] The decline of the autonomous component of private domestic demand may be attributable to a decrease in autonomous plant and equipment investment accompanying technological innovation. The rise in the autonomous component of exports, on the other hand, is probably due to the growth of exchange-rate-related price effects and the relative decline of income effects.

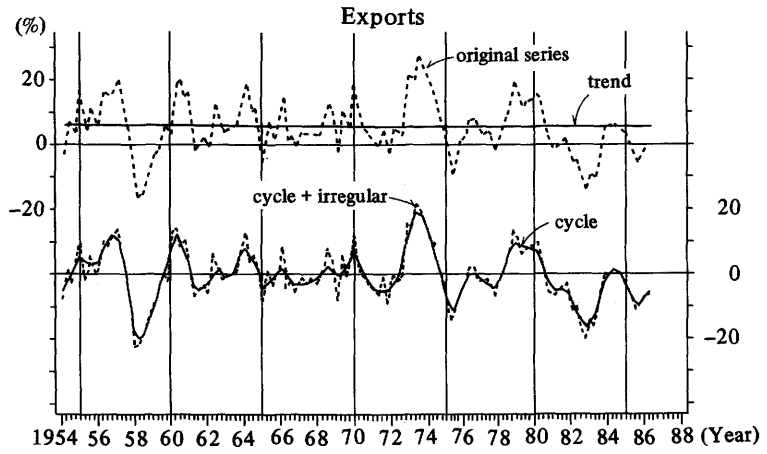
13. With regard to the phase of since 1976, the results concerning private domestic demand somewhat vary between the first case of ordering variables listed in Table 8 and the other two. However, the argument given in footnote 5 probably supports the conclusion here.

Figure 16. GNP Components of the U.S. (percent change over the previous year)



Inventory Investment (difference from the corresponding period of the previous year)





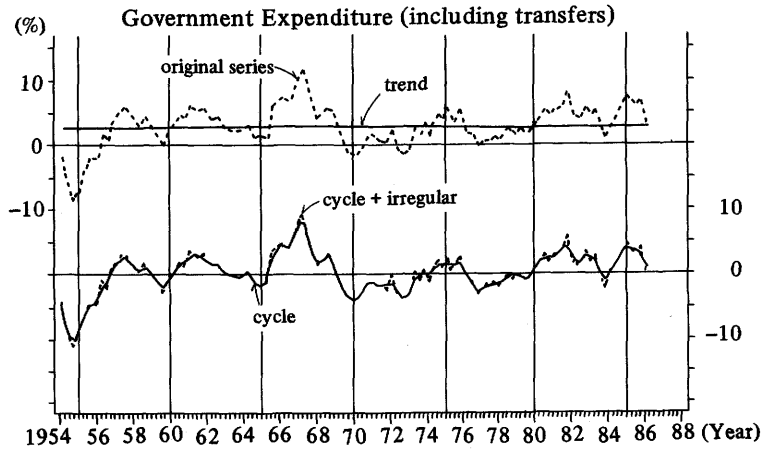


Table 7. AIC Estimated from the Time Varying AR Coefficient Models for the U.S.

(sample period: 1954 I ~ 1986 II)

		Personal Consumption (240)	Housing Investment (237)	Plant and Equipment Investment (185)	Inventory Investment (318)	Government Expenditure (228)	Exports (324)
1970	I	267	296	217	344	250	326
	II	267	295	226	346	251	327
	III	266	292	224	343	248	328
	IV	265	294	217	345	254	329
1971	I	267	290	222	345	256	328
	II	268	291	221	344	254	328
	III	268	291	219	342	254	329
	IV	264	293	217	342	255	327
1972	I	266	290	216	341	252	330
	II	266	292	221	338	250	328
	III	267	288	222	338	261	331
	IV	263	282	218	338	254	334
1973	I	267	287	221	338	248	338
	II	266	288	220	338	235	345
	III	270	287	221	336	248	354
	IV	232	286	220	336	243	347
1974	I	272	285	225	342	260	347
	II	263	285	228	341	248	344
	III	263	283	227	341	253	339
	IV	270	284	222	340	254	340
1975	I	273	290	220	343	256	336
	II	269	290	216	361	252	339
	III	268	286	211	361	251	337
	IV	268	289	216	345	248	339
1976	I	265	291	214	347	248	338
	II	267	289	214	359	248	336
	III	234	286	209	343	256	339
	IV	234	291	214	336	254	334
1977	I	265	292	219	333	255	335
	II	264	286	215	330	250	336
	III	233	287	214	328	249	335
	IV	231	287	215	335	249	332
1978	I	259	295	212	333	247	334
	II	226	292	215	332	248	334
	III	226	288	220	332	245	338
	IV	255	287	216	331	248	323
1979	I	254	286	216	334	247	338
	II	255	276	216	335	245	333
	III	256	274	217	335	244	333
	IV	228	271	211	336	248	333
1980	I	253	269	206	334	247	334
	II	253	263	208	334	250	340
	III	233	265	207	334	251	332
	IV	237	267	198	334	247	358

Note: 1. Figures in parentheses are AIC when no structural shift was assumed.
2. Government expenditure includes transfers.

Table 8. Relationships among Private Domestic Demand, Exports and Government Expenditure

Variance Decomposition by VAR Models

Order of Variables		1955 I ~ 75 IV (model order: 4) (1) Private Domestic Demand	(2) Exports	(3) Government Expenditure	1976 I ~ 85 IV (model order: 2) (1) Private Domestic Demand	(2) Exports	(3) Government Expenditure
(1) (2) (3)	Private Domestic Demand	94	3	3	73	12	16
	Exports	20	76	4	9	90	1
	Government Expenditure	14	4	82	11	11	78
(2) (1) (3)	Private Domestic Demand	90	7	3	51	34	16
	Exports	14	81	4	6	93	1
	Government Expenditure	15	2	82	17	5	78
(2) (3) (1)	Private Domestic Demand	87	7	6	56	32	12
	Exports	13	81	6	6	91	3
	Government Expenditure	12	2	86	3	4	93

Reference: Correlation of Residuals

	1955 I ~ 75 IV Private Domestic Demand	Exports	Government Expenditure	1976 I ~ 85 IV Private Domestic Demand	Exports	Government Expenditure
Private Domestic Demand	1.000	-0.201	-0.095	1.000	-0.387	-0.296
Exports	-0.201	1.000	-0.066	-0.387	1.000	-0.116
Government Expenditure	-0.095	-0.066	1.000	-0.296	-0.116	1.000

Note: Government expenditure includes transfers.

Next, let us examine the relationships of financial variables[14] to private domestic demand by adding them to the VAR models. First, a model that includes long-term real interest rates (Table 9) shows that the autonomous component of exports increased after 1976, that of government expenditure was roughly unchanged, and that of private domestic demand declined substantially. In addition, influence of exogenous factors such as exports, government expenditure and long-term real interest rates increased. Over the years, the influence of long-term real interest rates has increased vis-à-vis private domestic demand but decreased somewhat vis-à-vis exports and government expenditure. On the other hand, the autonomy of interest rates has declined substantially, and they have come to be influenced greatly by

14. For financial variables, long-term interest rates (the yield on longest-term government bonds), short-term interest rates (weighted average of call and bill rates) and money supply (average balance of M_2+CDs) were used, each converted into real terms by an expected rate of inflation (five-term weighted average of GNP deflator). Short-term interest rates were used to measure directly the effect of fluctuations in interest rates on real GNP, the final objective of policy.

Table 9. Relationships among Private Domestic Demand, Exports, Government Expenditure and Long-term Interest Rate

Variance Decomposition by VAR Models

Order of variables \ Explanatory variable		1955 III ~ 75 IV (model order: 2) (1) Private Domestic Demand	(2) Exports	(3) Government Expenditure	(4) Long-term Interest Rate	1976 I ~ 85 IV (model order: 3) (1) Private Domestic Demand	(2) Exports	(3) Government Expenditure	(4) Long-term Interest Rate
(1)(2)(3)(4)	Private Domestic Demand	84	4	4	9	46	13	20	21
	Exports	15	70	4	12	4	85	4	7
	Government Expenditure	7	1	74	18	13	9	68	10
	Long-term Interest Rate	1	2	24	72	4	28	48	20
(2)(3)(4)(1)	Private Domestic Demand	70	15	5	10	40	20	19	21
	Exports	10	75	3	12	3	86	3	7
	Government Expenditure	4	2	75	19	5	8	77	9
	Long-term Interest Rate	2	5	25	71	7	30	44	19
(3)(2)(1)(4)	Private Domestic Demand	71	15	5	9	40	21	18	21
	Exports	10	75	3	12	3	87	3	7
	Government Expenditure	4	2	75	18	5	8	77	10
	Long-term Interest Rate	1	2	25	72	6	32	41	20
(4)(3)(2)(1)	Private Domestic Demand	70	14	5	11	40	19	28	13
	Exports	10	76	3	12	3	85	6	7
	Government Expenditure	4	1	76	19	5	9	68	18
	Long-term Interest Rate	2	0	23	75	7	34	27	32

fluctuations in government expenditure and exports. The decline of the autonomous component of long-term real interest rates can be interpreted as indicating two facts: (1) foreign interest rates have affected domestic long-term interest rates because of increasingly active international capital movements, and (2) increasing fiscal deficits have exercised considerable influence on long-term interest rates because of financial market liberalization.

The phenomenon of an increased autonomous component of exports and a decreased autonomous component of private domestic demand and of interest rates can also be detected when short-term interest rates are used as a financial variable (Table 10). There are some differences in results: the influence of interest rates on private domestic demand has not changed significantly; instead, the reverse influence of private domestic demand on interest rates has increased considerably. The latter strengthening may be explained—apart from the effect of measures of financial market liberalization—by the increasing attention paid by the Bank of Japan to the trends in private domestic demand when adjusting short-term interest rates.[15]

15. Similar calculations indicated that the influences of exports and government expenditure on interest rates were not stable. This point requires further investigation.

Table 10. Relationships among Private Domestic Demand, Exports, Government Expenditure and Short-term Interest Rate

Variance Decomposition by VAR Models

Order of variables \ Explanatory variable		1955 III ~ 75 IV (model order: 3) (1) Private Domestic Demand	(2) Exports	(3) Government Expenditure	(4) Short-term Interest Rate	1976 I ~ 85 IV (model order: 2) (1) Private Domestic Demand	(2) Exports	(3) Government Expenditure	(4) Short-term Interest Rate
(1)(2)(3)(4)	Private Domestic Demand	79	1	3	17	71	7	7	15
	Exports	26	64	4	6	11	78	4	8
	Government Expenditure	9	1	78	12	22	6	68	4
	Short-term Interest Rate	1	2	23	74	41	8	8	43
(2)(3)(4)(1)	Private Domestic Demand	68	11	3	18	52	27	6	15
	Exports	15	75	4	7	11	80	1	9
	Government Expenditure	6	2	79	13	9	4	81	5
	Short-term Interest Rate	1	0	24	74	26	24	1	49
(3)(2)(1)(4)	Private Domestic Demand	69	11	3	17	53	27	6	15
	Exports	15	74	5	6	12	79	1	8
	Government Expenditure	7	2	79	12	11	4	81	4
	Short-term Interest Rate	1	1	24	74	32	24	1	43
(4)(3)(2)(1)	Private Domestic Demand	68	11	2	19	52	28	6	15
	Exports	15	74	5	7	11	79	1	9
	Government Expenditure	6	2	77	14	9	4	81	5
	Short-term Interest Rate	1	1	27	71	26	27	1	46

Table 11. Relationships among Private Domestic Demand, Exports, Government Expenditure and Money Supply

Variance Decomposition by VAR Models

Order of variables \ Explanatory variable		1955 IV ~ 75 IV (model order: 3) (1) Private Domestic Demand	(2) Exports	(3) Government Expenditure	(4) Money Supply	1976 I ~ 85 IV (model order: 2) (1) Private Domestic Demand	(2) Exports	(3) Government Expenditure	(4) Money Supply
(1)(2)(3)(4)	Private Domestic Demand	61	3	10	26	67	17	3	13
	Exports	3	65	2	29	3	89	5	4
	Government Expenditure	12	2	80	6	6	8	81	5
	Money Supply	5	10	2	83	15	25	10	51
(2)(3)(4)(1)*	Private Domestic Demand	57	5	10	29	46	18	3	33
	Exports	2	66	2	30	8	85	5	1
	Government Expenditure	10	1	82	7	7	7	82	4
	Money Supply	4	9	2	85	3	28	9	60
(3)(2)(1)(4)	Private Domestic Demand	59	5	10	26	66	17	4	13
	Exports	3	65	3	29	6	84	6	4
	Government Expenditure	11	1	82	6	6	7	82	5
	Money Supply	7	9	2	83	12	27	10	51
(4)(3)(2)(1)	Private Domestic Demand	57	5	10	29	46	17	2	35
	Exports	2	65	3	30	8	71	3	18
	Government Expenditure	10	1	82	8	7	6	72	15
	Money Supply	4	6	2	88	3	18	1	77

Reference: Correlation of Residuals

VAR Models used in Table 9

	1955 III ~ 75 IV				1976 I ~ 85 IV			
	Private Domestic Demand	Exports	Government Expenditure	Long-term Interest Rate	Private Domestic Demand	Exports	Government Expenditure	Long-term Interest Rate
Private Domestic Demand	1.00	−0.25	−0.09	−0.07	1.00	−0.32	−0.36	−0.25
Exports	−0.25	1.00	0.01	0.10	−0.32	1.00	0.04	0.08
Government Expenditure	−0.09	0.01	1.00	−0.04	−0.36	0.04	1.00	0.37
Long-term Interest Rate	−0.07	0.10	−0.04	1.00	−0.25	0.08	0.37	1.00

VAR Models used in Table 10

	1955 III ~ 75 IV				1976 I ~ 85 IV			
	Private Domestic Demand	Exports	Government Expenditure	Short-term Interest Rate	Private Domestic Demand	Exports	Government Expenditure	Short-term Interest Rate
Private Domestic Demand	1.00	−0.27	−0.02	−0.03	1.00	−0.38	−0.36	0.07
Exports	−0.27	1.00	−0.06	0.01	−0.38	1.00	−0.04	0.09
Government Expenditure	−0.02	−0.06	1.00	0.06	−0.36	−0.04	1.00	0.02
Short-term Interest Rate	−0.03	0.01	0.06	1.00	0.07	0.09	0.02	1.00

VAR Models used in Table 11

	1955 IV ~ 75 IV				1976 I ~ 85 IV			
	Private Domestic Demand	Exports	Government Expenditure	Money Supply	Private Domestic Demand	Exports	Government Expenditure	Money Supply
Private Domestic Demand	1.00	0.10	0.13	−0.07	1.00	0.11	−0.00	0.35
Exports	0.10	1.00	−0.05	0.09	0.11	1.00	0.07	0.33
Government Expenditure	0.13	−0.05	1.00	−0.31	−0.00	0.07	1.00	−0.35
Money Supply	−0.07	0.09	−0.31	1.00	0.35	0.33	−0.35	1.00

With money supply as the financial variable, one also obtains the results that the autonomous component of exports increased after 1976 while that of government expenditure was practically unchanged (Table 11). But again there were differences: the influence of exports on private domestic demand increased, while that of money supply on private domestic demand was not clear when compared with the period before 1975. Also, the autonomous component of private domestic demand itself showed no significant change. In view of the high correlation between residuals for the period since 1976, further study of this point is necessary.

VI. Economic Fluctuations and Shocks

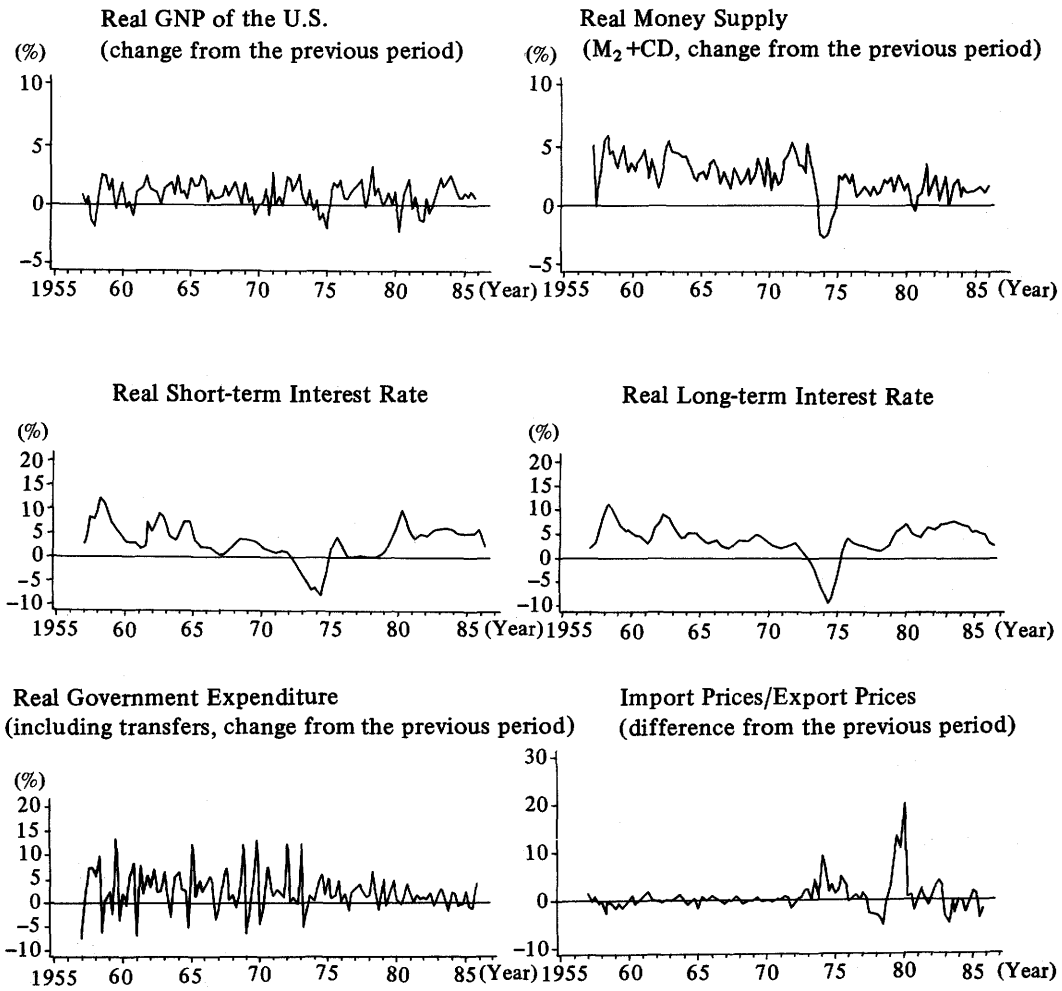
Based on the view that economic fluctuations are caused by shocks or unexpected changes in various economic variables, let us examine statistically the shock of the major variables used in the VAR models of the preceding section. An analytical point to shock can be considered from source as well as persistence of shocks. Examination of the interrelation between shocks to economic factors contributes to the discussion of variability of economic activities and of alternative economic policies. Followings are preliminary examination of statistical feature of shocks.

The rates of change or differences from the previous term for each of the major series are shown in Figure 17. The figure depicts that the U.S. real GNP has shown large fluctuations for the entire period covered. Real money supply has shown relatively smaller fluctuations, after showing a large drop around 1973–74 under the impact of deflator shocks. Real interest rates, both long and short-term, have fluctuated relatively less in recent years, though short-term rates variability is a little larger. Government expenditure began to fluctuate less since about 1975 and terms of trade fluctuations have become larger after 1970s.

These patterns of shocks may be analyzed with a multi-state Kalman filter developed by Bomhoff (1983) and Kool (1982) and used by Bomhoff (1982, 1983) and Meltzer (1985).[16] The model they used was based on three equations expressing a temporary shock and a permanent shock to the level of the series, as well as a permanent shock to the rate of change. This paper, however, uses the rate of change or the difference from the previous term as the basic series, and therefore deals with

16. This method is designed basically to extract data movements that cannot be explained by the past data, that is, measurement of a kind of pre-estimated error. For details, see Bomhoff (1983, Appendix A).

Figure 17. Shocks of Major Factors



Note: 1. All series seasonally adjusted except real long- and short-term interest rates.
2. Interest rate series shown until 1986 II; other series shown until 1985 IV.

two types of shocks, temporary and permanent shocks to changes. [17]

The results are given in Table 12. Let us examine them focusing on developments since 1976. Although the permanent shocks to real GNP in the U.S. has decreased and temporary shocks has increased, there has been no significant change in the pattern of shocks (Figure 17). The permanent shocks to the real money

17. A large variance of temporary shocks suggests that the forecast for the near future has a large uncertainty, while a large variance of permanent shocks implies that the forecast for the distant future has a large uncertainty.

Table 12. Variance by Type of Shocks

(Period)	Temporary Shocks (1957 I ~ 75 IV)	Temporary Shocks (1976 I ~ 85 IV)	Permanent Shocks (1957 I ~ 75 IV)	Permanent Shocks (1976 I ~ 85 IV)
U.S. Real GNP	0.70	0.77	0.53	0.40
Real Money Supply	0.62	0.32	0.74	0.79
(Nominal Money Supply)	(0.28)	(0.25)	(0.50)	(0.43)
Real Short-term Interest Rate	0.36	0.04	1.29	0.94
Real Long-term Interest Rate	0.28	0.03	1.15	0.60
Real Government Expenditure	3.66	1.73	2.27	0.36
Import Prices/Export Prices	1.02	2.49	0.71	2.16

supply has shown a slight increase, partially because of deflator fluctuations, but has experienced a much decreased level of temporary shocks. For the nominal money supply, both temporary and permanent shocks have been fewer, and this shows plainly the shift of the mid-1970s to attaching importance to the money supply. Reflecting the more stable management of money supply, both permanent and temporary shocks to long- and short-term interest rates were reduced. Both types of shocks were also considerably decreased for real government expenditure, which shows the stabilizing effects observed in section III. In contrast, both types of shocks to the ratio of import prices to export prices (the reciprocal of the terms of trade) have increased conspicuously since 1976, reflecting fluctuations in crude oil prices and exchange rates. This lowered stability may have contributed to the rise of the autonomous components of exports seen earlier.

The relationship between these shocks to exogenous variables and fluctuations in Japanese real GNP are of interest, but it is a reasonable guess that the results of such an examination would support the previous results of this paper. One particularly interesting question is the continual stability of Japan's real GNP after 1976 despite larger shock of the terms of trade.

VII. Conclusion

The most important result of this paper is the finding that the cycles in GNP and private domestic demand have become more stable contracting fluctuations. This has occurred despite the lowered stability of some factors such as exports or the business cycles in the U.S., their main source of variation; the best guess at present stage will be the smaller amplitude and longer periodicity of fluctuations in government

expenditure, the stabilizing effects of smaller fluctuations in money supply,[18] and the smaller amplitude of fluctuations in plant investment due to the growth of services.

These results have an important implication for the present: the stabilizing effects of domestic factors ought to operate even in the face of destabilizing effects from the appreciation of the yen. The possibility of autonomous recovery is therefore greater than in earlier periods. But, on the other hand, we should bear strongly in mind the increase of instability in the world economy.

There are, however, some limitations to this analysis that must be pointed out. No theoretical framework has been provided to explain the increased stability of plant and equipment investment, and as a result we do not elucidate the relationship between final demand and trends in investment by industry. It has also been difficult to come to definite conclusions within VAR models because of problems such as lag structures. These limitations are to be addressed by further research.

18. See Naniwa (1986) concerning the lower amplitude of fluctuations in money supply.

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