INVENTORY CYCLES IN POST-WAR JAPAN

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The purpose of this article is to clarify the position of inventory fluctuations in Japan's post-war business cycles. I shall, firstly, focus upon the lagged relation between financial loans and inventory investment and, secondly, emphasize the close bearing of the latter with cyclical changes of the propensity to import. I feel that it is very important to study this problem for the inventory cycle in Japan has so far exhibited interesting characteristics. For example, Japan's inventory investment-GNP ratio was, on average, 6.2% for the period 1951–56, whereas the corresponding ratios were 1.0% in the United States, 1.6% in the United Kingdom and 2.5% in the West Germany. The Japanese ratio surpasses that of any other country.[1] This leads us to suspect that the Japanese inventory-GNP ratio may also have been higher. Given equal rates of growth, a high (low) inventory investment-GNP ratio can be derived from a high (low) inventory-GNP ratio by the acceleration principle. In addition, Japan's relatively high rate of growth has raised her high inventory investment-GNP ratio. I feel therefore that the role of inventory fluctuations in economic changes have been much more important in Japan than in other countries. This is one outstanding feature of Japanese business cycle picture. We can indicate other points too, but extensive analyses involving the latter are not relevant to this paper. Let us concentrate our attention upon two important inventory problems, i.e., the relation between financial loans and inventory investment, and the relation between inventory investment and the propensity to import.

I. *Financial Loans and Inventory Investment*

In Japan operating funds of business firms are financed extensively by financial institutions. The more developed a country is, the less her dependence upon financial institutions is, for in more developed economies a high capital accumulation might enable firms to finance even their short-term funds from their internal

[1] Why is Japanese inventory-GNP ratio higher than in other countries? Those economies in which there is a relatively high growth potential should have higher inventory / GNP ratios. Under such conditions, business firms would carry more inventories. Second reason may lie in the fact that the Japanese dependence on raw materials from foreign countries leads her to hold a relatively higher inventory ratio. The relatively higher inventory-sales ratio can be demonstrated also from international comparisons of combined firms' balance sheets.

accumulation. In Japan the reverse situation prevails. Therefore, it might be expected that the movement of inventory investment has a close connection with the incremental change of outstanding financial loans.

Our problem is to find how changes in financial loans are interrelated with changes in inventory investment. As quarterly time-series of financial loans, we can use the increments of outstanding loans, either in relation to the loan accounts of *all financial institutions* (except Bank of Japan) or to the *operating loan* accounts of *all banks* (which excludes Bank of Japan, various financial institutions for small business, agriculture, forestry and fishery, securities finance corporations, government financial institutions, Trust Fund Bureau, and insurance companies). As regards inventory investment of all industry, we have computed quarterly series of corporate inventoy investment from the Ministry of Finance data, "Hojin Kigyo Tokei" (Corporate Enterprise Survey), since we cannot get satisfactory quarterly series of inventory investment from national income statistics. Moveover, the inventory investment series of national income statistics in Japan are not adjusted with respect to price changes, i.e., they are unadjusted as to inventory valuation changes. This is why we have used an independent estimate from national income statistics, athough the scope of inventory investment is limited to the corporate enterprise sector.

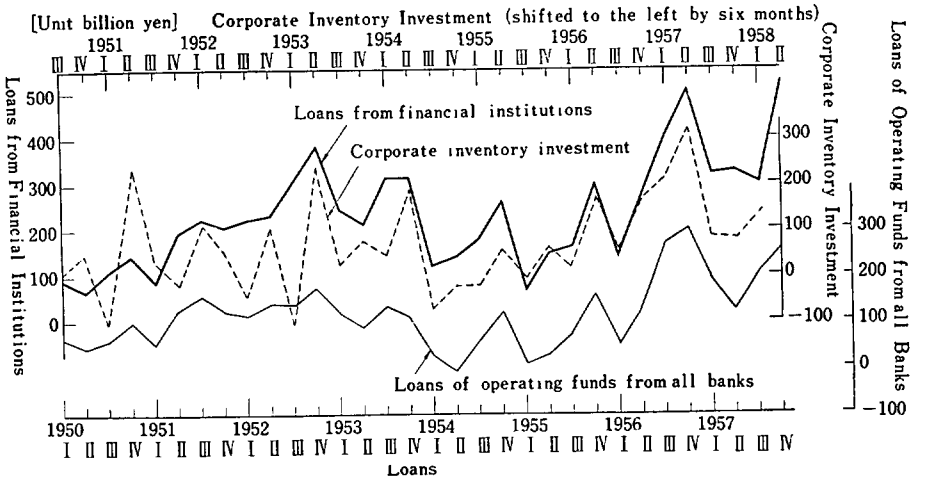
Table 1 *Financial Loans and Inventory Investment*

(Unit: billion yen)

		Corporate Inventory Investment of All Industry	Increments in Outstanding Loans of Financial Institutions	Increments of Outstanding Loans of Operating Funds of All Banks
1950	I		93.3	58.2
	II	15.9	69.5	41.3
	III	5.8	110.4	58.2
	IV	42.5	141.6	98.9
1951	I	-106.7	88.0	50.4
	II	241.1	193.7	122.7
	III	32.3	217.5	157.3
	IV	-21.3	204.9	119.7
1952	I	110.2	220.3	109.0
	II	50.1	236.5	136.5
	III	-47.1	304.8	134.5
	IV	106.5	382.2	176.8
1953	I	-109.2	245.0	116.2
	II	228.9	211.9	84.7
	III	23.7	312.3	132.3
	IV	75.1	310.2	109.3
1954	I	44.1	121.4	23.6
	II	188.0	140.0	-8.0
	III	-72.6	177.8	59.8
	IV	-24.6	256.9	117.9
1955	I	-19.1	71.6	8.5
	II	59.6	148.1	22.3
	III	-12.6	162.2	72.0
	IV	61.4	296.1	156.9
1956	I	18.2	145.0	44.2
	II	173.3	275.4	114.3
	III	52.7	404.1	267.7
	IV	168.8	503.3	298.6
1957	I	208.1	319.1	180.1
	II	315.3	326.0	119.3
	III	83.0	300.2	204.9
	IV	78.0	522.5	256.1
1958	I	128.6	235.4	86.3

In Table 1, we can see the basic data which are necessary for our analysis. Chart 1 depicts the lagged covariation of financial loans and inventory investment for the period 1953–57. However, before 1952, there exists no clear correlation between them. One of the reasons is that the further we go back before 1952, the more the "Corporate Enterprise Survey" may decrease in reliability. Another reason is that during the three years at the middle of which the Korean boom occurred, the ups and downs of business fluctuations were violent, and the speculative factor appears to

Chart 1 *Loans and Inventory Investment*



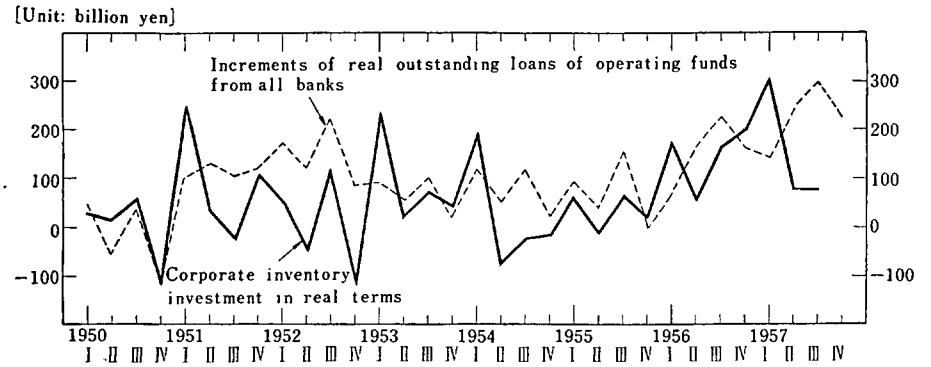
have been dominant. Furthermore, fluctuations in the special procurement demand from the U.S. Military might have disturbed systematic covariation of the two series. Anyway, the lagged covariation of loans and inventory investment is very clear from 1953 onward, whether we take the statistics of loans of all financial institutions (except Bank of Japan) or loans of operating funds of all banks. The result obtained is that as far as the period 1953–57 is concerned bank loans lead inventory investment by six months. If this correlation is reliable it will be a very useful tool for our economic policy, for then it will be apparent that a tight-money policy will not take effect fully for six months. We need not worry about the ineffectiveness of the policy before six months elapse.

The above is a tentative empirical finding. This is true in the main but should probably be amended in some respects. My finding has undergone severe criticisms which appear to be fatal in the eyes of casual readers. Let us mention them:

1) My finding presumes that loans go ahead of inventory investment, i.e., the precedence of funds over commodity transactions. However, inventory investment is financed by short-term operating funds which are mainly supplied by discounting commercial bills. If it were true, inventory investment should go ahead of bank loans. My result does, therefore, involve something wrong from the point of view of the "banking principle." According to the "banking principle," commodity transactions are a *cause* and not an *effect* of monetary circulations.

2) My statistical analysis has started from *nominal* increments of outstanding loans. However, a critic starts from increments of *real* outstanding loans and presents a chart showing a *simultaneous* movement between real loans and real inventory investment (Chart 2).

Chart 2 *Δ(L/P) and Inventory Investment*



In this case, denoting outstanding loans by L, we start from ΔL and a critic starts from Δ(L/P) where P is the wholesale price index. This criticism can be a statistical reinforcement to the theoretical criticism in (1) above. If loans and inventory investment are simultaneously convariant, the precedence of loans over inventory investment can be statistically denied. However, as seen in Chart 2, Δ(L/P) and inventory investment do not show any simultaneous movement since 1956.

3). The third criticism is more important and seems to be more fatal to my finding. Every year, loans will seasonally increase between October and December, and every year inventory investment will seasonally rise between April and June. In Japan, manufacturers concentrate imports of raw materials between April and June. Therefore, my finding may be a *spurious* correlation between two independent seasonal variations.

My answers to the above criticisms are as follows:

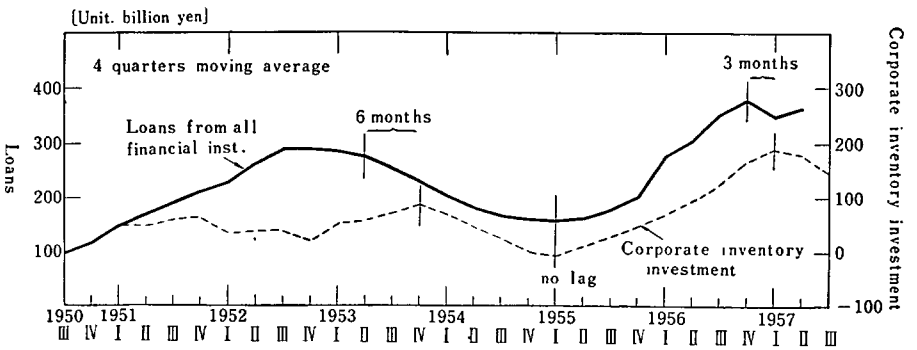
1). Although the critic supposes that the whole of operating funds is financed by discounting commercial bills, the percentage share of operating funds (all banks) financed by discounting bills is only 35% between 1950–58 in Japan. Further, fixed investment was relatively rigid in the post-war recessions of the Japanese economy partly owing to the buffer of high ratio of outstanding orders for machinery to its delivery which was in turn made feasible by the high growth potential of the Japanese economy. Therefore, a tight money policy cannot always suppress equipment funds, the demand for which is very intense even in recessions. If this is supposed to be inevitable, and if the tightening of short-term operating funds were supposed to be impossible because they are results rather than causes of changes in inventories, then the so-called tight money policy cannot be enforced. However, the White Paper of 1958 emphasized that a tight money policy was the sole master in the first phase of the recession in 1957. If the description of the White Paper is true, we cannot but arrive at a conclusion that the critic's opinion is too strict in rejecting the initiative of financial institutions. Actually the initiative of "finance" is more effective and

active especially at the upper turning point of fluctuations.

2) We cannot accept the second statistical criticism. The critic starts from the increments of *real* outstanding loans, i.e., from Δ(L/P). Δ(L/P) will continue to rise even in the earlier phase of the recession initiated by a tight money policy, owing to a decline of prices P brought about by the decrease of ΔL. Therefore Δ(L/P) already involves a *result* of a tight money policy—a decline of prices. $-\Delta$P is a result of $-\Delta$L, and it is a misleading procedure for us to start from Δ(L/P), for it is not a starting point. We should thus compare ΔL rather than Δ(L/P) with changes in inventories.

3) The third criticism which decries my finding as an accidental lagged correlation between two independent seasonal variations is most important. However, from Chart 1, we feel that even if seasonal variations are removed from two series respectively the conclusion on the lagged correlation between them will not break down. Further, if there exists some causal connection between two seasonal variations, it is not good to remove them away from original data, especially when the patterns of two seasonal fluctuations are different. We cannot completely assume this possibility away from our two series, when two seasonal variations are not independent.

Chart 3 *Lags When Smoothed Out by the Moving Average*



Be that as it may, it is interesting to look for consequences when seasonal fluctuations are removed. There are a few methods of eliminating seasonal changes, but each method has its own defects. Seasonal pattern may not be invariant in various phases of the business cycle, and it may change gradually as time elapses. We have tried the simplest way of eliminating seasonal fluctuation, i.e., 4 quarters moving average. Chart 3 depicts two series smoothed out by moving average.

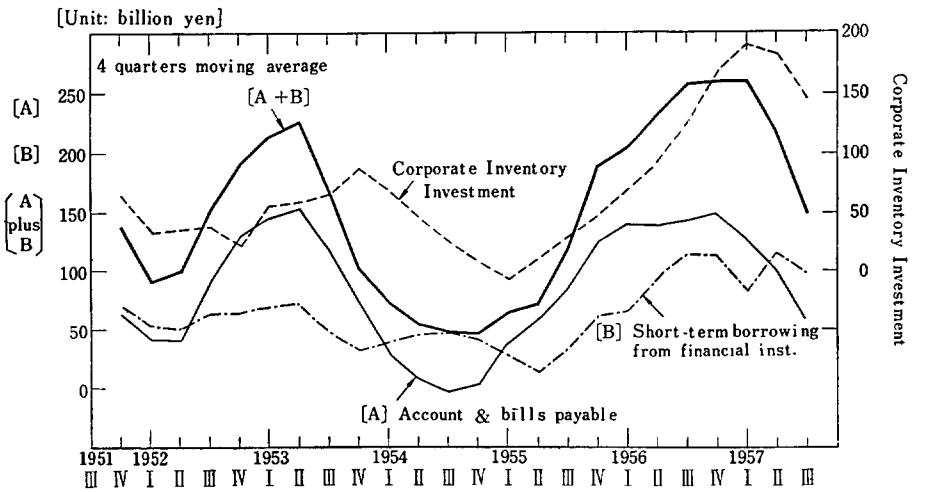
In this Chart, we see clearly a six-month or longer lag of inventory investment over financial loans in the 1953–54 recession. But only a three-month lag in the 1957 recession. By eliminating seasonal fluctuations, we have lost the regularity of lags. However, it was confirmed that financial loans always go ahead of inventory investment by three or six months and not the reverse. We see another important new phenomenon in that changes of the two series coincide

in the upturn of 1954–55 without time lag. If we could accept this, our conclusion would be that in the downturn caused by a tight money policy there arise lags of inventory investment by six or three months, but in the upturn there occurs no lagged variation. This seems to suggest that, although a tight money policy entails a lagged downturn of inventory investment, firms will begin to purchase raw materials and stockpile, when their business outlook becomes favorable, by drawing bills and without requiring any borrowing from banks. In other words, there is an asymmetry between the downturn and the upturn in the mode of inventory changes. In the downturn of 1953–54 or 1957, bank loans were a cause and, in the upturn of 1954–55, they were an effect. This is a *tentative* conclusion with the reservation that a method of eliminating seasonal fluctuation was correct. However, we may get different conclusions if we employ different methods.

We used financial loans data from financial statistics. We can also use corresponding data from "Corporate Enterprise Survey" (combined corporate business statemants). However, operating loans in financial statistics are not in the same definition as the short-term borrowing from financial institutions in "Corporate Enterprise Survey." Although the former includes the amounts of bills discounted, the latter excludes it, because business firms get money only by crossing out the account of "bills receivable" when they discount bills they hold. Borrowing by discounting bills does not emerge as borrowing in the firm's balance sheet. We take up two series from *Corporate Enterprise Survey*, "account and bills payable" and "borrowings from financial institutions." One relates to the inter-firm credit and another relates to the financial credit. By applying four quarters moving average, we can depict the leads or lags of these series in relation to the movement of inventory investment (Chart 4).

In Chart 4, we see three series to be compared with inventory investment,

Chart 4 *Borrowing, Account & Bills Payable and Corporate Inventory Investment*



—"account payable (incl. bills payable)," "short-term borrowing from financial institutions," and sum of the two ("total credit"). In this Chart, we find once again the lag of inventory investment and the lead of the other three series. Total credit (sum of account payable and short-term borrowing) leads by six months in the 1953–54 recession and by several months in the 1957 recession. In the 1957 recession it is difficult to ascertain the upper turning point of total credit, for from 1956 III to 1957 I the levels of total credit are almost constant. We may say the turning point is 1956 III or 1956 IV or 1957 I. If we lay emphasis upon the initial impact of the tight money policy, we should take 1956 III. Then the six-month lag can be said to exist both in 1953–54 recession and 1957 recession. If we look at the short-term borrowing, the six-month lag still prevails. However, we see an interesting phenomenon,—the revivals of short-term borrowing at the midst of the two recessions. This may be called the "inventory financing" in the depression. There is another point to be carefully noted that "account payable (incl. bills payable)" oscillates more violently than "short-term borrowing." We recognize its clear six month lead in 1953–54 recession and its three month lead in the 1957 recession. Strange to say, even at the bottom of 1954 recession, the inter-firm credit precedes inventory investment by six months.

There remains much to be explored and re-examined. My original tentative finding underwent a few critisisms. Although the accuracy of the period of lag was blurred a little, I feel confident that the substance of my empirical hypothesis still survives. Of course it should be re-examined by industries, and checked by different statistical data. Our analysis is still good-in process, but it has made clear some aspects of the cause and effect of a tight money policy.

II. *Inventory Changes and the Propensity to Import*

According to the Keynesian tradition, several economists attempted to compute the linear import functions in Japan, but a casual look at the basic data makes me hesitate to follow this routine. Let me depict a simple graph which correlates the index of the volume of imports of raw materials with that of the volume of industrial production (Chart 5).

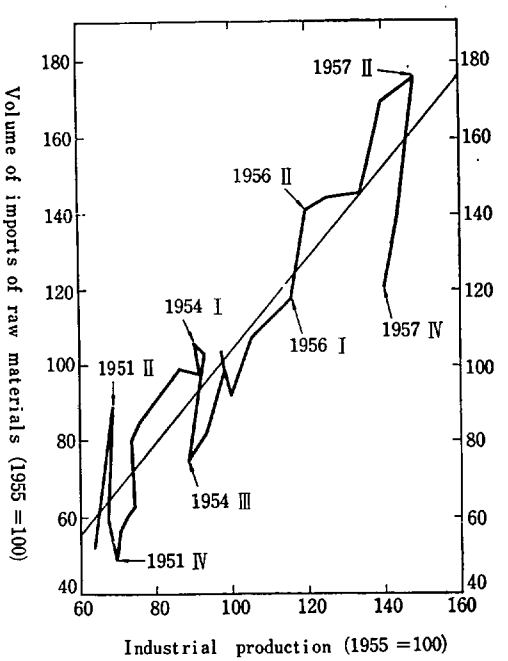
As can be seen from Chart 5, we may fit a linear relation between imports of raw materials and industrial production. For the period 1950–1957 (1950= yearly and 1951–57=quarterly data), we get the following relation.

$$M_t = -16.45 + 1.2017 O_t \; ; \quad R^2 = 0.8645 \cdots\cdots\cdots\cdots\cdots\cdots (1)$$

The correlation arrived at is very good, but the relation cannot be projected to the phases of boom or depression. The deviations from the straight line fitted by the least square method are not random. They reflect very exactly the process of business cycle, i.e., in booms the deviations scatter to above the line and in depressions the reverse prevails. For the years, 1951 (Korean boom), 1953 and

1956–57, the deviations scatter upwards, and for the years, 1952, 1954 and 1957, they scatter downwards. Therefore, a glance at the chart suggests that some cyclical factor should be introduced in the import function together with the level of production. We find an asymmetry of changes in the propensity to import in booms and depressions. The import of raw materials in a boom are greater than those in a depression even under the same level of industrial production.

Chart 5 *Imports of Raw Materials and Industrial Production*



Various equations can be fitted to the various phases of business fluctuations. Import function in the upswing (1954 III–1957 II):

$$M_t=-68.60+1.6689O_t\ ;$$

$$R^2=0.9635\cdots\cdots\cdots\cdots(2)$$

Import function connecting booms (1951 II, 1952 IV, 1953, 1954 I, II, 1956, 1957I, II) ;

$$M_t=-2.46+1.1787O_t\ ;\quad R^2=0.8223\cdots\cdots\cdots\cdots(3)$$

Import function connecting depressions (1951 III, IV, 1952 I, II, III, 1954 III, IV, 1955 I, 1957 III, IV) :

$$M_t=-14.58+1.0375O_t\ ;\quad R^2=0.9220\cdots\cdots\cdots\cdots(4)$$

Regression coefficients computed in relation to equations (3) and (4) are close to the regression coefficient of (1) and around unity. However, the regression coefficient in the upswing import function (2) is much higher than these, i.e., 1.6689. This constant cannot be used for the future projection in a sense of long-run as well as short-run predictions. The relation biased with the boom period cannot be extrapolated to the long-run normal relation. It also cannot be extrapolated to the coming period of depression, because in depressions we see a sudden cyclical decline in the propensity to import. Nevertheless, the White Paper of 1957 expressed an opinion that a rise in the propensity to import in 1956

has a semi-long-run structural tendency. This point of view was changed in face of the sharp decline in the propensity to import in the 1957–58 recession in the White Paper of 1958.

Thus, some cyclical factor should be injected in the import function. We have attempted to construct an equation taking account of this. Denoting corporate inventory investment by V_t and the rate of increase in industrial production compared with the same quarter of the preceding year by O_t/O_{t-4}, we get,

$$M_t = -98.34 + 1.03910 O_t + 0.01004 V_t + 0.77887 \ (O_t/O_{t-4}) \ ;$$
$$R^2 = 0.9485 \cdots\cdots\cdots\cdots (5)$$

Readers may be aware of an improvement of the coefficient of determination R^2 from 0.8645 (in the simple linear one variable equation) to 0.9485. This means a considerable part of the systematic deviation from equation (1) can be explained by the additional variables V_t and O_t/O_{t-4}. The cyclical nature of variations of the propensity to import is now made clear.

Cyclicality of the import ratio depends in part upon fluctuations in the requirements of raw materials per unit of industrial production. It is the changes in imported raw materials *consumed* divided by industrial production. Another important factor is the changes in imported inventories. The importance of the latter can be illustrated by a simple numerical example. Assuming that the normal inventory ratio is 30% as compared with current production and the unit raw material requirement is constant (20%), the following example can be constructed:

Table 2

Period	Production	Inventories of imported raw materials	Imported raw materials proportionate to production	Total imports of raw materials
1	100	30	20 (100)	20 (100)
2	110	33 (+3)	22 (110)	25 (125)
3	125	38 (+5)	25 (125)	30 (150)
4	142	43 (+5)	28 (142)	33 (165)
5	142	43 (0)	28 (142)	28 (142)
6	130	39 (−4)	26 (130)	22 (110)

Total imports of raw materials consist of two parts; one part is proportional to industrial production (20%), and another part is induced by assumed entrepreneurial behavior—the maintenance of normal inventory ratio 30%, and expressed by the increments of inventories. The result obtained indicates more violent fluctuations in imports of raw materials than in industrial production. Thus a mere halt in the rise of production (142→142) entails a decline in imports of raw materials (33→28). A decline of production from 142 to 130 (8.45% decrease) causes a drastic decline in imports (28→22). This means a 21.43% decline. The production of 110 in the boom corresponds to raw materials imports of 25, while the production of 130 in recession corresponds to the low level of imports of 22. The import ratio is 22.7% versus 16.9%. This application of the acceleration principle thus explains why imports and the import ratio decrease sharply in depression while production is constant or falls slighly. The above interpretation applies not

only to imports of crude raw materials (cotton, iron ore etc.), but also to imports of semi-finished raw materials, such as steel. Moreover, even finished products may be under the rule of this empirical law, in so far as they are imported as stocks of foreign trade merchants.

In the above analysis, we assumed a constancy in the ratio between imported raw materials consumed and industrial production. However, such an assumption is not realistic. It may change as time elapses. Therefore, it is necessary to introduce another device by which we can throw light upon the problem of inventories and imports.

Our device is very simple, but very useful. Denoting imported crude raw materials consumed by M_c, the volume of imports of crude raw materials by M, and industrial production by O, we get the following identity.

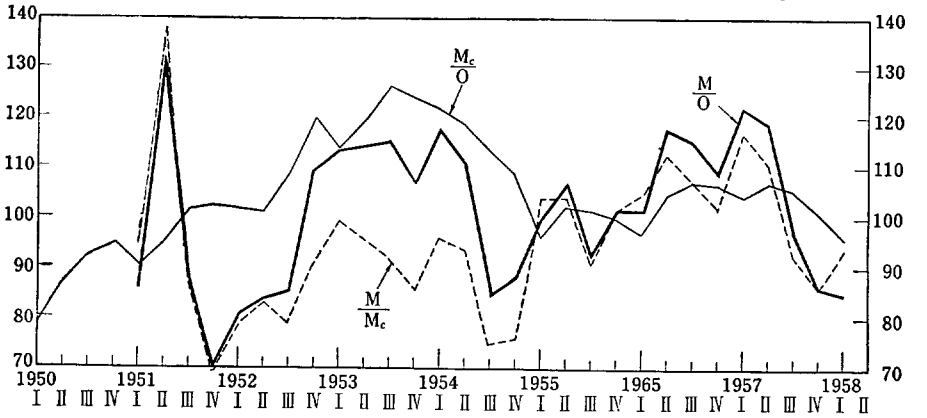
$$\frac{M}{O}=\frac{M_c}{O}\cdot\frac{M}{M_c} \qquad \cdots\cdots(6)$$

M/O is the import ratio or the propensity to import in physical terms in manufacturing industry. M_c/O is the unit crude raw material requirement or the ratio of imported crude raw materials consumed and industrial production. M/M_c is a barometer representing the variations in inventories of imported crude raw materials, since the difference between M and M_c is the inventory investment in relation to imported crude raw materials. By constructing this identity, we can evaluate the relative variations of M_c/O and M/M_c in explaining the changes of M/O. Although equation (6) is an identity, we can assume decidedly that M_c/O and M/M_c are independent variables and M/O is a dependent variable.

In Japan we have recently had the so-called "inventory controversy" especially between Mr. Osamu Shimomura and Mr. Yonosuke Goto. Both are famous and able government economists, and the latter has long been a contributor to the White Paper published by the Economic Planning Board. Heated controversy culminated in the estimation of accumulated inventories of imported crude raw materials during fiscal year 1956. Shimomura estimated it 500–600 million dollars, while Goto estimated it at less than 200 million dollars. An intermediate estimate by the Ministry of Finance was about 300 million dollars. Anyway, Shimomura's emphasis was laid upon the role of inventory accumulation in bringing about the balance-of-payments difficulty in fiscal year 1956. In this sense, the increasing imports in 1956 were of cyclical nature, and could be overcome without a strong tight money policy in his opinion. On the contrary, Goto's judgment was that the rising import ratio from 1956 on was of semi-structural character, and a tight money policy to prevent an acceleration of this tendency was inevitable. Setting aside the urgency of a tight money policy, the developments afterwards have demonstrated clearly the cyclical, not structural, nature of the rising import ratio in 1956.

The writer wrote an essay criticizing Goto's (and consequently the White Paper's) arguments just after the publication of the 1957 White Paper and as-

Chart 6 *Industrial Production, Imports, Inventory Changes and Unit Mc requirement*



M/O=imports of crude raw materials divided by industrial production
Mc/O=imported crude raw materials consumed divided by industrial production
M/Mc=imports of crude raw materials divided by industrial consumption of them

serting the cyclicality of the import ratio. Then does our standpoint agree with Shimomura's? Not necessarily so. His estimation of 600 million dollars as accumulated imported raw materials should be re-examined carefully and I have many doubts about the procedure of his estimation. However, we cannot go into a detailed discussion of it here. Instead, one simple graph is presented in order to make clear the role of inventory accumulation in changes of the import ratio. This is shown in Chart 6, and actual figures are put in equation (6), using the Ministry of International Trade and Industry's data. Goto arrived at a conclusion which treated lightly the role of inventory accumulation from the above data, but it is interesting that we have reached the opposite conclusion which emphasizes the role of inventory accumulation from the same data.

Chart 6 shows that the correlation between M_c/O and M/O is very slight, while the relation between M/O and M/M_c is extremely close. The covariation between M/O and M/M_c reflects the importance of inventory accumulation (or decumulation) due to imported raw materials in relation to the oscillation of the import ratio (M/O).

Between 1951 and 1957, we get the following relations:

$$M/O=43.873+0.5415\ (M_c/O)\quad R^2=0.1116\ (R=0.3341)\cdots\cdots(7)$$
$$M/O=20.714+0.8532\ (M/M_c)\quad R^2=0.6820\ (R=0.8259).....(8)$$

These indicate how close the relation is between M/O and M/M_c and how slight a relation exists between M/O and M_c/O. The two conflicting points of view in the "inventory controversy" attach greater importance to either M/M_c or M_c/O. Shimomura regards M/M_c as decidedly important and Goto regards M_c/O as decidedly important. I think our simple analysis throws some light upon the controversy. The tool used here is merely a tautological identity, but it is extremely ironical that sometimes one is unaware of the "unnoticed tautology,"

being inovolved in an unnecessary confusion.

The period 1951–57 is too long. "Inventory controversy" took up a shorter period, so if we restrict our analysis to the period 1955–57, then we get the following relations:

$$M/O=-62.095+1.6318\ (M_c/O)\ ;\quad R^2=0.3238\ (R=0.5690)\ldots\ (9)$$

$$M/O=-11.328+1.1390\ (M/M_c);\quad R^2=0.8774\ (R=0.9367)\ldots\ (10)$$

The shorter the period of observation, the greater the role of inventory accumulation becomes. On the one hand, in the 1956 boom, the ratio between imported crude raw materials consumed and industrial production was almost invariant. On the other hand, the close covariation between inventory accumulation and the import ratio was remarkable. Goto's hypothesis applies to 1953 rather than 1956, for up to 1953 M_c/O follows a rising trend. Along with many other factors, we can point out the fact that up to 1953 the imports of cotton and other natural textile raw materials increased, but from 1953 on the production of synthetic textiles exhibits a drastic increase which caused a relative decline in the unit imported raw material requirement in relation to the textile industry.

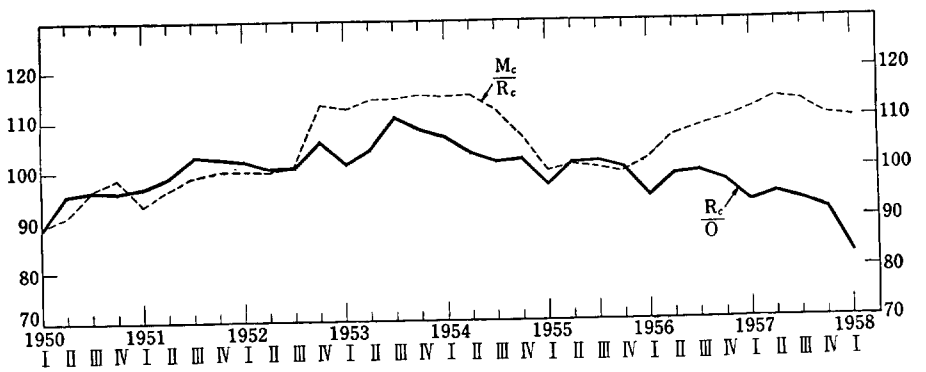
The unit imported crude raw material requirement M_c/O can be further decomposed as follows:

$$\frac{M_c}{O}=\frac{M_c}{R_c}\cdot\frac{R_c}{O}\qquad\ldots\ldots\ldots\ldots\ldots\ldots(11)$$

where R_c stands for *total* crude raw materials consumed.

Again, we can depict the movements of the two components (Chart 7).

Chart 7 *Movements of Mc/Rc and Rc/O*



Mc/Rc=Imported crude raw materials consumed divided by total crude raw materials consumed
Rc/O=Total crude raw materials consumed divided by industrial prodution

Chart 7 indicates that the movement of M_c/R_c is fairly cyclical, but that of R_c/O is not so. Except for seasonal fluctuations, R_c/O rises up to 1953, and declines after 1953. Why R_c/O shows seasonal drops in the 1 quarter (January to March) between 1955 and 1957 is clear. After 1955, the index of industrial production was revised and the production of food and kindred products was included. However the latter shows a drastic increase between January and March, (e.g., in 1957

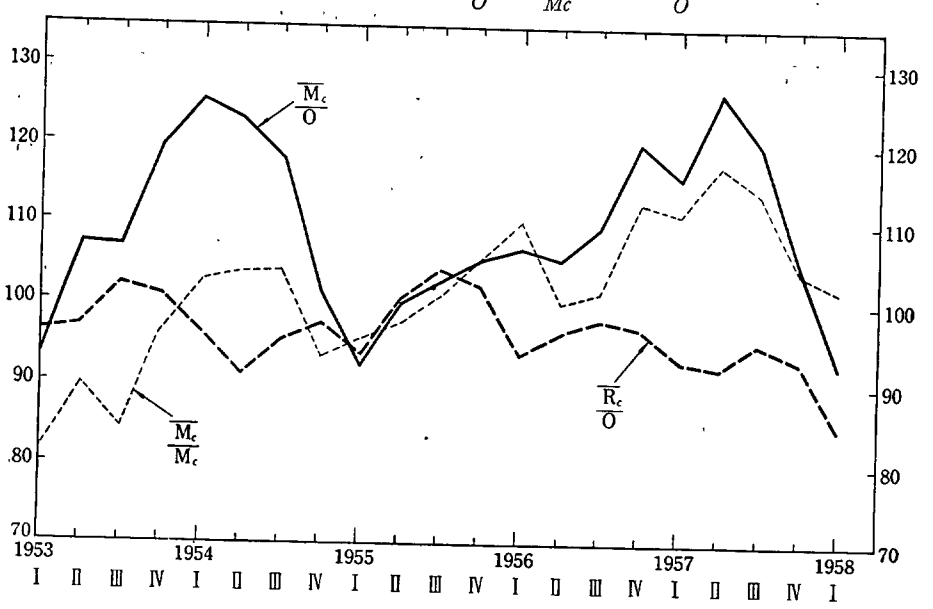
its production index was 100.5 in January, 164.9 in February, 202.1 in March and 99.8 in April). The sudden seasonal increase in food production in this quarter raises the index of industrial production in the same quarter of every year, so it decreased seasonally R_c/O.

From 1955 onwards, R_c/O shows a declining trend, but M_c/R_c follows a cyclical upswing. The reason why M_c/O was fairly constant in this period is that the cyclical upswing of M_c/R_c was cancelled by the down trend of R_c/O. The cyclicality of M_c/R_c can be easily understood, for imports of crude raw materials are, so to say, the marginal supplies, as compared with the supplies from the domestic sector.

So far we have taken up the crude raw materials only. However, we should not neglect the semi-finished raw materials, like steel, chemical intermediate products, etc. We can compute the ratio of semi-finished raw materials consumed to industrial production $\overline{R}_c/O$, the ratio of *imported* semi-finished raw materials consumed to industrial production $\overline{M}_c/O$, and the ratio of *imported* semi-finished raw materials consumed to the *imported* crude raw materials consumed $(\overline{M}_c/M_c)$. The movements of these ratio are seen in Chart 8.

The amount of imports of semi-finished raw materials is relatively small as compared with crude raw materials, but it is important to observe this behavior. Although $\overline{R}_c/O$ does not show any marked trend, $\overline{M}_c/O$ shows a conspicuous cycle the amplitude of which is greater than that of M_c/O.

Chart 8 *Movements of* $\frac{\overline{M}c}{O}$ $\frac{\overline{M}c}{Mc}$ *and* $\frac{\overline{R}c}{O}$



$\overline{M}c$ and $\overline{R}c$ relate to semi-finished raw materials, and Mc ralates to crude raw materials.

On the other hand, $\overline{M}_c/M_c$ trends upwards. In the "inventory controversy", the argument has centered around the fluctuations in imports of crude raw materials only, but as $\overline{M}_c/M_c$ is growing steadily and the amplitude of $\overline{M}_c/O$ is greater than M_c/O, it will be more urgent to take up semi-finished raw materials into our analysis. However, we must postpone this to our future studies.

III. *Conclusions*

The above is an analysis of the post-war Japanese inventory cycles. It treats only a few aspects of these cycles but we obtain some conclusion from our analysis:

1) As Japanese business firms depends upon supplies from finanical institutions for their operating funds, there can be seen a close causal connection between financial loans and their inventory investment. When the basic data were used without eliminating seasonal fluctuations, financial loans lead always by six months. However, even if seasonal change is eliminated, the hypothesis of lead of loans over inventory investment does not collapse, although the length of lag becomes less accurate, six or three months. This may be a useful relation in judging the consequences of a tight money policy.

2) The violent cyclicality of the propensity to import (or the import ratio) urges us to introduce some cyclical factors into the import function. A simple Keynesian import function will not be a useful tool in our forecasting. Even under the same level of output, the imports of raw materials will be systematically larger in a boom than in a depression. The introduction as additional variables of inventory invenstment and the rate of increase of production as compared with the same quarter of the preceding year is recommended.

3) In order to throw some light upon the confused state of the so-called "inventory controversy" in Japan, we have derived a simple solution. It makes clear that in the post-war economy the changes in inventories of imported raw materials were a much more important factor in bringing about fluctuations of the propensity to import. Some technical coefficient between imported raw materials consumed and industrial production is not very important. This does not mean that our analysis justifies the numerical validity of Shimomura's estimate on the inventory accumulation of imported raw materials amounting to 600 million dollars. With the same data by which one-side debator in the "inventory controversy" attempted to neglect the importance of inventory fluctuations, our analysis arrived at an opposite conculsion.

In the Japanese economy, whose growth potential is relatively high, and whose dependence upon the supplies of foreign raw materials is also high, the normal inventory ratio of entrepreneurs should consequently be high. This high normal inventory ratio brings about the high inventory investment–GNP ratio, on the one hand, and a violent fluctuation of the latter ratio in the business

cycle.

The violent movement in the inventory investment has something to do with that of imports of raw materials. Thus, in an economy in which a high normal inventory ratio prevails, it may be dangerous to compute the short-run marginal propensity to import, if one neglects the influence of inventory fluctuations. Also it is not reasonable to extrapolate the short-run tendency of the import ratio due to the inventory accumulation as a long-run trend.

Thus, the inventory cycle is one of the most important foci in the analysis of the short-run fluctuation of the Japanese economy. Volatile ups and downs in inventory investment in the business cycle are a background for the basic instability of the Japanese business cycle. At the same time, the same phenomenon has suppressed the apparent balance-of-payments ceiling in expansion phases. The business cycle and the balance-of-payments problems may be understood apart from analyses of the inventory cycle in some other countries, but not in the Japanese economy.