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An Alternative Method to Estimate WiP Inventory for Cultivated Assets *

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Abstract

There is a huge difference between inventory stock measurement that are compiled according to the 1968 SNA versus the 1993 SNA for Japan's national accounts. This leads to non-negligible differences for productivity measures when inventories are treated as a capital input. The main source of the difference is due to the treatment of work-in-progress (WiP) inventories for cultivated assets. The objectives of this paper are to describe the problems with the current estimates for WiP inventories of cultivated assets in Japan's national accounts and to propose an alternative method of dealing with these assets. We argue that the 1993 SNA recommendations have been inappropriately introduced in the current production and wealth accounts for Japan and that the current 1993-SNA version estimates for WiP inventory stocks of cultivated assets (CAWiP) are implausible.

As an alternative to the "perpetual inventory method" used for the current estimates for CAWiP, we propose a "realized inventory method" (RIM), where inventory stocks over the past periods are backwardly estimated based on the realized values of cultivated assets to be sold. RIM can provide alternative estimates that we argue are more realistic and can also help with distinguishing CAWiP and non-cultivated biological resources, with the latter being as a non-produced asset, of which the natural growth should not be described in production account.

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An Alternative Method to Estimate WiP Inventory for Cultivated Assets

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> ”In following the paths of historical development [...] in the direction of time, the analyst finds himself, in most instances, engaged in the rather thankless task of trying to derive known from unknown or, at least, better-known from less well-known facts. Would it not be much more efficient to reverse this procedure? By establishing the base of his operations, i.e., the principal store of primary factual information in the present or a very recent past, and then moving on backward with the help of theoretical weapons step by step toward the more and more distant past, the analytical historian could make most effective use of the limited amount of direct factual information to which he usually has access.” Wassily Leontief (1963)

1 Introduction

In the 1993 System of National Accounts (United Nations, 1993), cultivated assets are defined as one of tangible fixed assets, if they are "used repeatedly or continuously over periods of time of more than one year to produce other goods or services" (paragraph 10.83) under the direct control, responsibility and management of institutional units.[*1] Immature cultivated assets are not treated as fixed assets unless produced for own use, but are treated as work-in-progress (WiP) inventories. In addition, the 1993 SNA recommends that "livestock raised for products yielded only on slaughter, such as fowl and fish raised commercially, trees and other vegetation yielding once-only products on destruction" should be treated as WiP inventories (AN. 1221). In this paper, we refer to the cultivated assets can be treated as WiP inventories as "CAWiP" for short.

There is a huge difference between inventory stock measurement that are compiled according to the 1968 SNA versus the 1993 SNA for Japan's national accounts. As of the end of 1980, the revised estimate of the total inventory stock based on the 1993 SNA procedures is 33.0 trillion yen (about 50 percent) larger than the estimate based on the 1968 SNA.[*2] This difference leads to non-negligible impacts on productivity measures when considering inventories as a capital input. The main source of the difference is due to the treatment of WiP inventories for cultivated assets. The objectives of this paper are to describe the problems of the current estimates for WiP inventories for cultivated assets in Japan's national accounts and to propose an alternative method of dealing with these assets.

When Japan's national accounts are compiled based on the 1968 SNA (henceforth 1968 JNA), the

[*1] Cultivated assets (AN.1114) include livestock for breeding, dairy, draught, etc (AN.11141) and trees (including vines and shrubs) cultivated for fruits and nuts, for sap and resin or for bark and leaf products (AN.11142). In the 1968 SNA, "there was an anomaly whereby natural growth in breeding animals was treated as fixed capital but natural growth of forests was not." (Harrison, 2005, p.245)

[*2] The current Japanese national accounts based on the 1993 SNA is backwardly estimated only until 1980.

natural growth of cultivated assets is not treated as part of inventories.[*3] However, on the basis of the recommendations in the 1993 SNA, in the current Japanese national accounts (henceforth 1993 JNA), the growth of cultivated assets is counted as WiP inventories. In section 2, we examine the current estimates for both the production and wealth accounts. we argue that the 1993 SNA recommendation for CAWiP has been inappropriately implemented in the current Japanese production and wealth accounts and that the estimates for CAWiP in the 1993 JNA are implausible.

To improve these estimates, in section 3, we propose "realized inventory method" (RIM) as an alternative to the "perpetual inventory method" (PIM) for estimating the WiP inventory for cultivated assets, CAWiP. RIM is based on the simple fact that cultivated assets to be sold necessarily have grown over the past periods required for maturation. In contrast to PIM where inventory stock is defined by the accumulated value of past inventory changes, with RIM the inventory stocks over the past periods are backwardly estimated based on the realized values of the cultivated assets to be sold. Whereas PIM is following the path of inventory accumulation in the direction of time, this procedure is reversed in RIM. For cultivated assets to be sold, the factual shipment information may be better-known than the value of the natural growth which is not directly observable. RIM, as formulated here, can provide alternative stock estimates which have the advantage of being consistent with the actual shipments over time.

There are also problems with distinguishing between cultivated assets and "non-cultivated biological resources" (AN.213) in the 1993 SNA. Non-cultivated asset is defined as a non-produced asset, of which the natural growth should not be described in production account. The RIM approach can also help with this distinction. Our estimates are presented in section 4. Section 5 concludes.

2 Problems with Current Estimates

2.1 Cultivated Assets

In the seven-digit commodity classification of the 2000 Benchmark Input-Output Table (Ministry of Internal Affairs and Communications; MIC), the natural growth of cultivated assets is described in thirteen commodity categories:

- (a) 0114011.Citrus fruits (Kankitsu)
- (b) 0114012.Apples (Ringo)
- (c) 0114019.Other fruits (Sonota no Kajitsu)
- (d) 0115029.Other crops for beverages (Sonota no Inryo-Sakumotsu)
- (e) 0121019.Other dairy farming products (Sonota no Rakunou-Seisanbutsu)

[*3] In the 1968 SNA (United Nations, 1968), livestock raised for slaughter, all chickens, other fowl, and other livestock except those are treated as fixed capital, are defined as inventories.

- (f) 0121021.Hen eggs (Keiran)
- (g) 0121041.Hogs (Buta)
- (h) 0116021.Seeds and seedlings (Shubyo)
- (i) 0116031.Flowers and plants (Kaki Kaboku Rui)
- (j) 0121051.Beef cattle (Nikuyou Gyu)
- (k) 0121099.Other livestock (Sonota no Chikusan).
- (l) 0211011.Silviculture (Ikurin)
- (m) 0311041.Marine culture (Kaimen Youshoku Gyo)

In (a)-(e), the natural growth of cultivated assets, are described as an increase of gross fixed capital formation (GFCF).[*4] And, the growth in (f)-(g) are treated as an increase of finished-goods inventories, since the production period of these commodities is shorter than one year. In the remined six commodities, (h)-(m), cultivated assets that can be treated as WiP inventories are included.

2.2 Production Account

We begin by examining Japan's input-output (IO) tables. The 1995 Benchmark IO Table defines CAWiP based on the 1993 SNA. In the 1990-1995-2000 Linked Input-Output (LIO) Table published by MIC in 2005, the values of WiP inventories in CAWiP for 1990 are revised to be consistent with the definition of WiP inventories in the 1995 and 2000 Benchmark IO Tables. The current methodology to estimate the value of natural growth of cultivated assets and the accuracy of the estimates are examined in section 3.1 and section 4.4, respectively. Here, we focus on a methodology to describe CAWiP in the LIO Table.

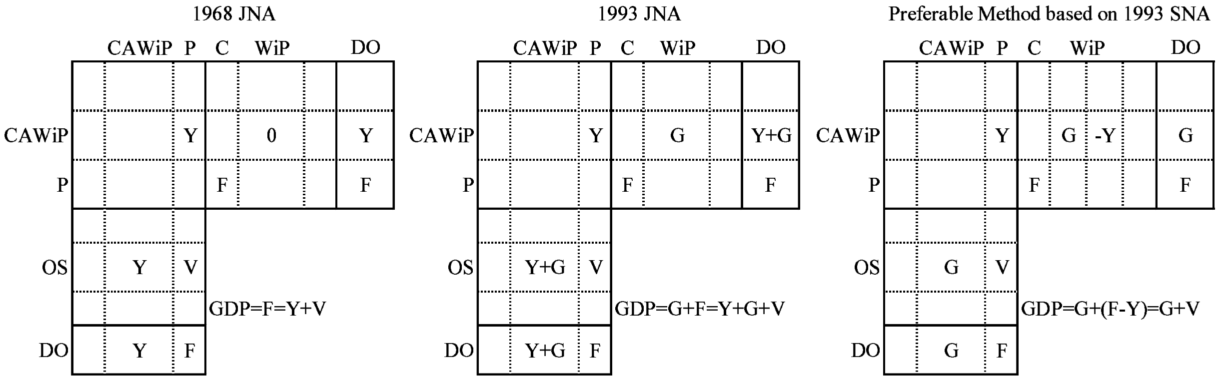
In the current estimates of WiP inventory changes in CAWiP, only the estimated value of natural growth in CAWiP is counted as an increase in WiP inventories. The increase in WiP inventory is viewed as reflecting the increases in output and operating surplus to be sustained in the input-output balance (see Appendix A provides the comparison of the original 1990 Benchmark IO Table and the 1990-1995-2000 LIO Table). Thus, in the LIO Table, the domestic output for cultivated assets is defined by the total value for shipment and natural growth.[*5]

Figure 1 illustrates three simplified IO tables in the 1968 JNA and the 1993 JNA, and also we believe a preferable method based on the 1993 SNA. In this figure, for simplicity we focus on only two sectors: CAWiP and the related processing sector (P) for food, lumber, and the like. We ignore intermediate

[*4] In the ten-digit commodity classification, cultivated assets treated as GFCF are tea trees in (d) and dairy cattle in (e).

[*5] According to the *Explanatory Report* describing the estimation method of the Benchmark IO Table, the output only for afforestation in 0211101.Silviculture is defined by the natural growth, of which the value is estimated based on physical data for afforestation. The estimated value of natural grotwh is much larger than the actual value of shipment, the difference is expediently described as the increase of WiP inventory. Thus the operating surplus in this sector is unreasonably large, whereas in practice deficit spending is quite common in the Japan's afforestation. In the LIO Table, the operating surplus occupies 42-43 percent of the domestic output in 1990 and 1995, as shown in Table 9 in Appendix A.

inputs except for the processing sector's input of CAWiP. The output of sector P is denoted by F, all of which is consumed by the household sector (C). By the 1993 JNA revision, the natural growth of CAWiP (G) is simply described as an additional increase in WiP inventories at final demand; hence that gross domestic products (GDP) also increases by G in comparison with the 1968 JNA figure.[*6] We argue, however, that neither the 1968 JNA nor the 1993 JNA treatment is fully consistent with the concept of CAWiP implicit in the 1993 SNA.



CAWiP: Cultivated assets, which can be WiP inventories based on 1993 SNA.
P: Processing sector of cultivated assets
C: Consumption
WiP: WiP inventory chnage (natural growth of CAWiP is denoted by G)
OS: Operating surplus
DO: Domestic output (CAWiP sector's shipment is Y and Processing sector's output and operating surplus are F and V, where F=Y+V)
For simplification, intermediate inputs except for processing sector's input of CAWiP are ignored in this figure

Fig. 1 Input-Output Framework for CAWiP

Our proposed approach, rooted more appropriately in the 1993 SNA guidelines, is illustrated in the third table in Figure 1. Since CAWiP is produced over a period of time by definition, Y should be interpreted as shipments rather than output produced in the given accounting period. Thus domestic output should be defined by G, which is the total value increased by the natural growth of CAWiP.[*7] The net WiP inventory change, which is defined by the inventory addition minus the inventory withdrawal, is given by G minus Y, since the WiP inventory in the CAWiP sector decreases by the amount Y that is sold to the processing sector.

A measure of GDP, compiled according to the 1968 JNA has a bias of $(G - Y)$ in comparison with our recommended alternative approach based on the 1993 SNA. Also, the 1993 JNA overestimates GDP by

[*6] In the production index statistics by Statistics of Agriculture, Forestry and Fisheries; "*The Index Numbers of Agricultural, Forestry and Fishery Production*", we find the same inappropriate definition for output $(Y + G)$ for dairy cattle, beef cattle, and so forth.

[*7] G includes not only natural growth of immature CAWiP to be sold in periods to come, but also growth of CAWiP to be sold in the given period.

Y.[*8] The consumption value F may retain the value of CAWiP as the intermediate input Y. However, Y should not be counted as the value added in this period since it includes the value added from the past periods. We argue that the method used to describe CAWiP in the current Japanese production account is inappropriate. [*9] [*10]

2.3 Wealth Account

Figure 2 compares the inventory stock estimates at current prices in the 1968 JNA and the 1993 JNA produced by Economic and Social Research Institute (ESRI), Cabinet Office.[*11]. The 1993 JNA estimates are currently available only from 1980. As of the end of 1980, the total inventory stock is 65.5 trillion yen in the 1968 JNA and 98.5 trillion yen in the 1993 JNA. The difference is huge (33.0 trillion yen). Figure 2(a) traces what we argue are the sources of the difference in total inventory stock over the period of 1980-1998. Most of the difference is caused by the treatment of WiP inventory stock in the 1993 JNA. In the capital measures given in Nomura (2004), although the fixed capital stocks were estimated based on the 1993 JNA, the estimates for inventory stock were based on the 1968 JNA to avoid the huge gap between the 1968 JNA and 1993 JNA figures.

The huge difference of the WiP inventory stock in Figure 2(b) is mainly due to the shift of natural forest stock, which was categorized as a non-produced asset in the 1968 JNA.[*12] In the 1993 JNA, tangible non-produced assets consist of land – land underlying buildings and structures, land underlying cultivation, and other land (including underlying forests)–, subsoil assets, and fisheries. The current Japanese national accounts does not define non-cultivated biological resources as tangible non-produced assets.

Again, in the 1993 SNA recommendations, non-cultivated biological resources (AN.213) consists of “animals and plants that yield both once-only and repeat products over which ownership rights are

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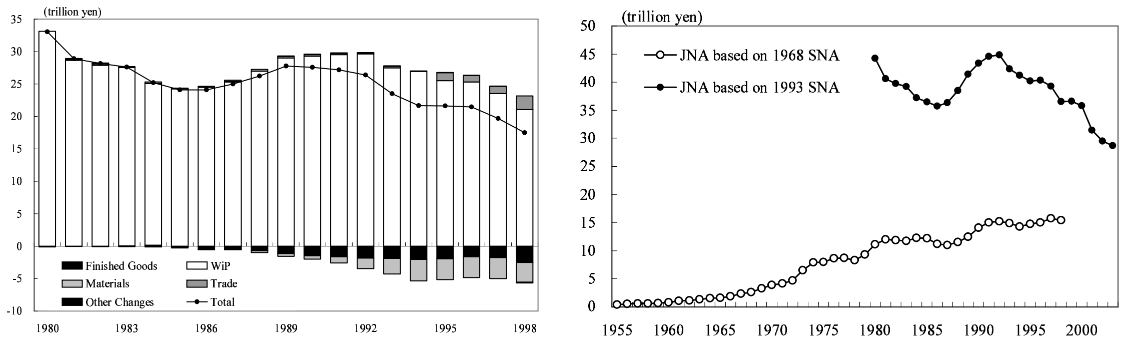
[*8] The RIM estimates for natural growth G in section 4.4 show the current estimates for G in the 1993 JNA are unreasonably small. The revision of G offsets some of the upward GDP bias in the 1993 JNA.

[*9] This may be not a particular problem in Japan’s production account. In the 2000 Input-Output Table in Canada, the output for 0249.Logs is 7681 million Canadian dollar (about 557.4 billion yen). It has 3.5 times larger than the shipment value (161.5 billion yen) in Japan (the relative scale between Canada and Japan is consistent with that by physical data for the forest production statistics by FAO – Food and Agriculture Organization of the United Nations). However, the WiP inventory addition for 0249.Logs is only 369 (4.8 percent of the output) and the inventory withdrawal is zero.

[*10] Another problem is in the treatment of dairy cattle in (e)Other dairy farming products, of which the natural growth is described as an increase of GFCF. When aged dairy cattle are slaughtered, its value is counted as a produced output. Here, the inputs should be counted as a decrease of GFCF as well as the treatment of scrap use. In the current production account, however, the input-side figure is described nowhere; hence it overestimates the operating surplus.

[*11] The final report for the 1968 JNA is given in the *Annual Report on National Accounts, 2000*. Figure 2 is based on this report (or earlier reports) for the 1968 JNA and the *Annual Report on National Accounts, 2005* for the 1993 JNA

[*12] In the *Annual Report on National Accounts, 1985*, the forest stock, which is treated as a non-produced asset, is evaluated at 29.6 trillion yen as of the end of 1980.



(a) Sources of the Difference in Total Inventory Stocks

(b) WiP Inventory Stock

Fig. 2 Comparison of Inventory Stock Estimates in the 1968 JNA and the 1993 JNA

enforced but for which natural growth and/or regeneration is not under the direct control, responsibility and management of institutional units. Examples are virgin forests and fisheries within the territory of the country. Only those resources that are currently, or are likely soon to be exploitable for economic purpose should be included." Figure 3 gives a picture of a flow chart for classifying any biologicals based on the 1993 SNA recommendation. At first, to be recognized as assets, biologicals must be owned by institutional units over a period of time. Biological assets are then classified into three groups: non-produced assets, fixed assets, and WiP inventories.

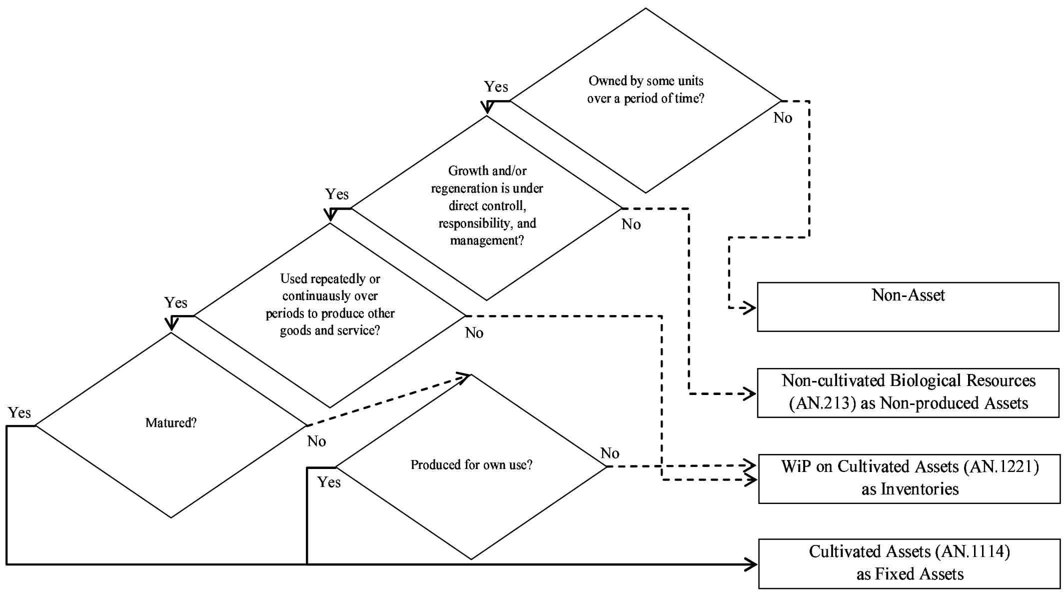


Fig. 3 Flow Chart for Classifying Biologicals based on the 1993 SNA

Some of natural forests described as WiP inventory stocks in the current Japanese national accounts should be recognized as non-cultivated biological resources. However, in practice it may be troublesome to identify only WiP inventories for cultivated assets from the whole forests. RIM may help with making distinction, as argued in section 4.4.

3 Framework

3.1 Current Approach: PIM

First, we begin with a description of our notation for defining finished products and WiP inventories:

Y_t: quantity of shipment in t
X_t: quantity of output in t
Z_t^x: quantity of inventory stock at the end of t (x=F: finished goods, x=W: WiP)
$P_t^{Z^x}$: price of inventory at the end of t (x=F: finished goods, x=W: WiP)
$\tilde{P}_t^{Z^x}$: book-value price of inventory stock at the end of t (x=F: finished goods, x=W: WiP)
ΔZ_t^x: quantity of inventory change in t (x=F: finished goods, x=W: WiP)
B_t^x: quantity of purchased inventory in t (x=F: finished goods, x=W: WiP)
G_t: quantity of growth on inventory in t
S_t^x: quantity of sold inventory in t (x=F: finished goods, x=W: WiP)
D_t^x: quantity of disposal of inventory in t (x=F: finished goods, x=W: WiP).

Output X_t is defined as shipment Y_t plus inventory change for finished goods and WiP:

$$X_t \equiv Y_t + \Delta Z_t^F + \Delta Z_t^W, \tag{1}$$

$$\Delta Z_t^F \equiv B_t^F - (S_t^F + D_t^F), \tag{2}$$

$$\Delta Z_t^W \equiv (B_t^W + G_t) - (S_t^W + D_t^W). \tag{3}$$

Equation (3) represents the WiP inventory change ΔZ_t^W as defined by the inventory addition $(B_t^W + G_t)$, which is the sum of purchased inventory and natural growth (in the case of cultivated assets), minus the inventory withdrawal $(S_t^W + D_t^W)$, which is the sum of sold inventory and disposal. By definition, cultivated assets are not treated as finished goods. The natural growth of CAWiP, G_t, is described in equation (3).

Based on the perpetual inventory method (PIM), we can define inventory stock at the end of t as follows:

$$Z_t^x \equiv Z_{t-1}^x + \Delta Z_t^x = \sum_{\tau=t}^{-\infty} \Delta Z_\tau^x \quad (x = F, W). \tag{4}$$

With PIM, inventory stocks are estimated from the past inventory changes ΔZ^x_τ ($\tau = t, t-1, t-2, \cdots$). The reliability of PIM depends on the accuracy on the estimates of inventory change ΔZ^x_t, which are not directly observed in either constant price or physical terms.

In Japan's national accounts, without the identification of each factor in inventory change in equations (2) and (3), the inventory changes are estimated by the approximate us of PIM based on the book value data for inventory stocks in corporate accounts,

$$\Delta Z^x_t = \widehat{Z}^x_t - \widehat{Z}^x_{t-1} \quad (x = F, W), \tag{5}$$

where

$$\widehat{Z}^x_t = \frac{\tilde{P}^{Z^x}_t Z^x_t}{\widehat{P}^Z_t} \quad (x = F, W). \tag{6}$$

$\tilde{P}^{Z^x}_t$ stands for the book-value prices of inventory stocks as of the end of t. In corporate accounts, only book-value inventory stocks can be observed. The book-value prices depend on the methods used to evaluate inventories such as the first-in first-out method (FIFO), the last-in first-out method (LIFO), and so forth. In the JNA, $\widehat{P}^Z_t$ is estimated as hypothetical inventory stock prices in converting the inventory stocks evaluated by the book-value prices $\tilde{P}^{Z^x}_t Z^x_t$, into the inventory stocks at constant prices $\widehat{Z}^x_t$.[*13] In the current estimates, note that $\widehat{Z}^x_t$ may not necessarily be identical to Z^x_t, which is defined by the PIM in equation (4).[*14]

To estimate commodity flow data in the interval periods between two benchmark years, the ratio of final-goods inventory change over shipment values and the ratio of WiP inventory change over output

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[*13] In the annual estimates of the JNA, inventory stock price is given as of the end of year t, $\widehat{P}^Z_t$, is defined as follows:

$$\widehat{P}^Z_t = \sum_m w^m_t P^m_t,$$

where

$$P^m_t = \begin{cases} P_{t,12} & \text{(FIFO with more than 9 rotations, current price method)} \\ \sum_{\tau=11}^{12} P_{t,\tau}/2 & \text{(FIFO with 6-8 rotations)} \\ \sum_{\tau=10}^{12} P_{t,\tau}/3 & \text{(FIFO with 4-5 rotations)} \\ \sum_{\tau=9}^{12} P_{t,\tau}/4 & \text{(FIFO with 3 rotations)} \\ \sum_{\tau=7}^{12} P_{t,\tau}/6 & \text{(FIFO with 2 rotations)} \\ \sum_{\tau=1}^{12} P_{t,\tau}/12 & \text{(FIFO with less than 1 rotation, other methods)} \\ \sum_{\tau=1}^{12} P_{t-1,\tau}/12 & \text{(LIFO)} \end{cases}$$

In this equation, m represents the number of groups classified by the rates of annual inventory rotation and the methods to evaluate inventory in corporate accounts (FIFO, LIFO, and so forth). w^m_t ($\sum_m w^m_t = 1.0$) are the weights to aggregate the hypothetical prices P^m_t; these correspond to the average monthly price assumed for each group, as described in the above equation, where $P_{t,\tau}$ stands for the price in τ-month, t-year. The ratios of annual inventory rotation are defined by the inventory addition (shipment plus inventory change) over the inventory stock.

[*14] The difference between $\widehat{Z}^x_t$ and Z^x_t may give some clues as to the appropriateness of the approximate use of PIM and may help to guide improvements in the stock estimates.

are assumed to be unchanged:

$$R_t^{Z^F} = \frac{\Delta Z_t^F}{Y_t}, \tag{7}$$

$$R_t^{Z^W} = \frac{\Delta Z_t^W}{X_t}. \tag{8}$$

In the estimation of commodity flow data, the starting point is the measurement of shipments by commodity. Using the ratios of the two inventories, the corresponding output is measured by

$$X_t = \frac{1 + R_t^{Z^F}}{1 - R_t^{Z^W}} Y_t. \tag{9}$$

This is the basic strategy used to define output when considering inventory changes for finished goods and WiP in the JNA.

In the case of cultivated assets, the WiP inventory changes ΔZ_t^W are estimated in the Benchmark IO Tables based not on equation (5), but on imprecise methodologies using physical data on cultivated assets coupled with growth assumptions. As the benchmark estimates for WiP inventory change for CAWiP are stated in Appendix A, all inventory change figures are positive, since they are defined by natural growth G_t (or $G_t - D_t^W$) rather than by ΔZ_t^W. According to the *Explanatory Report* describing the estimation method of the 2000 Benchmark IO Table, the value of natural growth in the case of beef cattle is estimated as follows:

$$G_t = \bar{P}_t(N_t^{(age<12)} * 0.4 + N_t^{(12<age>24)} * 0.8 + N_t^{(24<age)} * 1.0), \tag{10}$$

where $\bar{P}_t$ is the unit price of the beef cattle to be sold and N_t^{Φ} represents the number of the cultivating cattle in each monthly age-group Φ. Equation (10) implies the cattle under 12 months old grow by 40 percent value of the cattle to be sold in this period t. In the case of unchanged $\bar{P}_t$, the total value of the natural growth over the cultivating periods is 1.2-2.2 times of the cattle to be sold, since the 30-month-old cattle will be sold on average. We may not bring any reasons why the total growth value over the cultivating periods exceeds the shipment value. It is reasonable that both values are identical, as assumed in RIM.[*15]

In commodity flow data, the figures for ΔZ_t^W for CAWiP in the between-years are estimated by assuming a constant ratio of WiP inventory change for CAWiP over output $R_t^{Z^W}$ in equation (8). Since the estimates for ΔZ_t^W in the commodity flow data will invariably be positive, the inventory stock value Z_t^W defined by PIM will increase monotonously. Clearly it will overestimate the WiP inventory stock. As a non-depreciable asset, the upward bias in the estimate will not be automatically reduced over multiple time periods.

[*15] If equation (10) represents the stock value of the cultivating cattle as of the end of period t, it can be appropriate.

3.2 Alternative Approach: RIM

Next, we propose "realized inventory method" (RIM) as an alternative approach for estimating WiP inventories in CAWiP. The RIM approach is based on the simple fact that cultivated assets to be sold must have grown over the past periods required for maturation. By definition, there is no inventory of CAWiP for finished goods: $\Delta Z_t^F = 0$. In equation (3), we assume that there is no purchase of immature CAWiP from other economic units; all CAWiP to be sold must be mature:

$$B_t^W = 0, \tag{11}$$

$$S_t^W = Y_t. \tag{12}$$

Substituting these two assumptions into the equations (3) and (1), we have

$$\Delta Z_t^W = G_t - D_t^W - Y_t, \tag{13}$$

$$X_t = G_t - D_t^W. \tag{14}$$

The definition of inventory change in equation (13) is consistent with the approach we recommend for describing CAWiP in the IO table in Figure 1.

Consider a cultivated asset to be sold in t, Y_t, which has grown up in τ ($\tau = t, t-1, t-2, \cdots$). Let $Y_{t-1}^{(t)}$ indicate the asset value evaluated in constant price as of the end of $t-1$. Also, define $G_t^{(t)}$ and $D_t^{W(t)}$, respectively, as the values in t for the natural growth and disposal of $Y_{t-1}^{(t)}$, so that $Y_t = Y_{t-1}^{(t)} + G_t^{(t)} - D_t^{W(t)}$ is a quantity balance equation. Similarly, the asset value as of the end of $t-2$ and the growth and the disposal in $t-1$ are defined as $Y_{t-2}^{(t)}$, $D_{t-1}^{(t)}$, and $G_{t-1}^{(t)}$, respectively, with $Y_{t-1}^{(t)} = Y_{t-2}^{(t)} + G_{t-1}^{(t)} - D_{t-1}^{W(t)}$. Thus Y_t can be decomposed into $G_\tau^{(t)}$ and $D_\tau^{W(t)}$ ($\tau = t, t-1, t-2, \cdots$) as:

$$Y_t = \sum_t^{-\infty} (G_\tau^{(t)} - D_\tau^{W(t)}). \tag{15}$$

Defining the rates of disposal and growth from $t-1$ to t as d_0 ($\equiv D_t^{W(t)} / Y_{t-1}^{(t)}$) and g_0 ($\equiv G_t^{(t)} / (Y_{t-1}^{(t)} - D_t^{W(t)})$), the quantity balance is given by $Y_t = (1+g_0)(1-d_0)Y_{t-1}^{(t)}$.[*16] Also, from $t-2$ to $t-1$, it is assumed that d_1 and g_1 are the ratios of disposal and growth in $t-1$, we can write $Y_{t-1}^{(t)}$ as $(1+g_1)(1-d_1)Y_{t-2}^{(t)}$. The ratios of disposal and growth in $t-\tau$ are defined as:

$$d_\tau = \frac{D_{t-\tau}^{W(t)}}{Y_{t-\tau-1}^{(t)}}, \tag{16}$$

$$g_\tau = \frac{G_{t-\tau}^{(t)}}{Y_{t-\tau-1}^{(t)} - D_{t-\tau}^{W(t)}}. \tag{17}$$

[*16] Alternatively, d_0 and g_0 can be defined as $D_t^{W(t)} / (Y_{t-1}^{(t)} + G_t^{(t)})$ and $G_t^{(t)} / Y_{t-1}^{(t)}$, respectively.

Using these ratios, $G_t^{(t)}$ and $D_t^{W(t)}$ are proportional to Y_t: $g_0/(1+g_0)Y_t$ and $d_0/\{(1+g_0)(1-d_0)\}Y_t$, respectively. Similarly, $G_{t-1}^{(t)}$ and $D_{t-1}^{W(t)}$ in $t-1$ are proportional to the volume of the shipment in t, Y_t: $g_1/\{(1+g_0)(1+g_1)(1-d_0)\}Y_t$ and $d_1/\{(1+g_0)(1+g_1)(1-d_0)(1-d_1)\}Y_t$, respectively. Thus, $G_\tau^{(t)}$ and $D_\tau^{W(t)}$ $(\tau = t, t-1, \cdots)$ are given by:

$$G_\tau^{(t)} = g_{t-\tau}^* Y_t, \tag{18}$$

$$D_\tau^{W(t)} = d_{t-\tau}^* Y_t. \tag{19}$$

Past growth and disposal are proportional to the volume of the shipment in t, Y_t, using the coefficients $g_{t-\tau}^*$ and $d_{t-\tau}^*$ $(\tau = t, t-1, \cdots)$ which are given by:

$$g_{t-\tau}^* = \frac{g_{t-\tau}}{\Pi_{\tau'=t}^{\tau}(1+g_{t-\tau'})\Pi_{\tau'=t}^{\tau}(1-d_{t-\tau'-1})}, \tag{20}$$

$$d_{t-\tau}^* = \frac{d_{t-\tau}}{\Pi_{\tau'=t}^{\tau}(1+g_{t-\tau'})\Pi_{\tau'=t}^{\tau}(1-d_{t-\tau'})}. \tag{21}$$

We measure σ_τ $(\tau = 0, 1, \cdots)$ as the difference between g_τ^* and d_τ^* :

$$\sigma_\tau = g_\tau^* - d_\tau^*. \tag{22}$$

From the equations (18)-(21), and (15), the sum of σ_τ satisfies

$$\sum_{\tau}^{\infty}(g_\tau^* - d_\tau^*) = \sum_{\tau}^{\infty}\sigma_\tau = 1. \tag{23}$$

The σ_τ $(\tau = 0, 1, \cdots)$ are the coefficients used for allocating the shipment volume in t, Y_t, as past net growth increments for periods $t-\tau$; that is, we have

$$Y_t = \sigma_0 Y_t + \sigma_1 Y_t + \sigma_2 Y_t + \cdots = \sum_{\tau=0}^{\infty}\sigma_\tau Y_t. \tag{24}$$

The growth allocation coefficients, σ_τ, reflect the distribution of both growth and disposal for cultivated assets. The term $\sigma_\tau Y_t$ represents the net-growth in $t-\tau$ required for the sales that will be realized of Y_t in t.

Table 1 illustrates the growth allocation of shipments from $t-3$ to $t+3$, based on equation (24). In each row, the cultivated asset to be sold in other periods is allocated according to the growth needed to achieve the final quantities to be sold. Thus, each column represents the growth value in the same period for the assets to be sold in subsequent periods. In the column for t, the sum of the values yields the output in t, given by X_t defined as

$$X_t = (G_t - D_t^W) = \sigma_0 Y_t + \sigma_1 Y_{t+1} + \sigma_2 Y_{t+2} + \sigma_3 Y_{t+3} + \cdots = \sum_{\tau=0}^{\infty}\sigma_\tau Y_{t+\tau} \tag{25}$$

Table. 1 Growth Allocation of Cultivated Assets

	t+3	t+2	t+1	t	$t-1$	$t-2$	$t-3$	$\cdots$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\cdots$
$Y_{t+3}\rightarrow$	$\sigma_0 Y_{t+3}$	$\sigma_1 Y_{t+3}$	$\sigma_2 Y_{t+2}$	$\sigma_3 Y_{t+3}$	$\sigma_4 Y_{t+3}$	$\sigma_5 Y_{t+3}$	$\sigma_6 Y_{t+3}$	$\cdots$
$Y_{t+2}\rightarrow$	0	$\sigma_0 Y_{t+2}$	$\sigma_1 Y_{t+2}$	$\sigma_2 Y_{t+2}$	$\sigma_3 Y_{t+2}$	$\sigma_4 Y_{t+2}$	$\sigma_5 Y_{t+2}$	$\cdots$
$Y_{t+1}\rightarrow$	0	0	$\sigma_0 Y_{t+1}$	$\sigma_1 Y_{t+1}$	$\sigma_2 Y_{t+1}$	$\sigma_3 Y_{t+1}$	$\sigma_4 Y_{t+1}$	$\cdots$
$Y_t\rightarrow$	0	0	0	$\sigma_0 Y_t$	$\sigma_1 Y_t$	$\sigma_2 Y_t$	$\sigma_3 Y_t$	$\cdots$
$Y_{t-1}\rightarrow$	0	0	0	0	$\sigma_0 Y_{t-1}$	$\sigma_1 Y_{t-1}$	$\sigma_2 Y_{t-1}$	$\cdots$
$Y_{t-2}\rightarrow$	0	0	0	0	0	$\sigma_0 Y_{t-2}$	$\sigma_1 Y_{t-2}$	$\cdots$
$Y_{t-3}\rightarrow$	0	0	0	0	0	0	$\sigma_0 Y_{t-3}$	$\cdots$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\cdots$

In the special case of constant shipments ($Y_t = \bar{Y}$), X_t will be identical to $\bar{Y}$. Using equation (22), we divide X_t in equation (25) into G_t and D_t^W,

$$G_t = \sum_{\tau=0}^{\infty} g_\tau^* Y_{t+\tau}, \tag{26}$$

$$D_t^W = \sum_{\tau=0}^{\infty} d_\tau^* Y_{t+\tau}. \tag{27}$$

The values of growth and disposal in t are computed from the observed shipments in subsequent periods: $Y_{t+\tau}$ ($\tau = 0, 1, \cdots$). Substituting equation (25) into (13), inventory changes for cultivated assets are given by

$$\Delta Z_t^W = \sum_{\tau=0}^{\infty} \sigma_\tau Y_{t+\tau} - Y_t. \tag{28}$$

In the special case of steady constant shipments over periods, the inventory change denoted by ΔZ_t approaches 0 due to the condition for the growth-allocation coefficients given in equation (23). From equation (4) and (23), the WiP inventory stock at the end of t can be computed using

$$Z_t^W = \sum_{t}^{\infty} \left(\sum_{\tau'=0}^{\infty} \sigma_{\tau'} Y_{\tau+\tau'} - Y_\tau \right) = \sum_{\tau=1}^{\infty} \sigma_\tau^* Y_{t+\tau}, \tag{29}$$

where the parameter σ_τ^* is given by:

$$\sigma_\tau^* = \sum_{\tau'=\tau}^{\infty} \sigma_{\tau'}. \tag{30}$$

The growth values surrounded with lines in the upper right of Figure 1 represent the inventory stock at the end of t. Using RIM, the inventory stock can be defined by the shipments in periods to come as $Y_{t+\tau}$ ($\tau = 1, 2, \cdots$). Again, in the case of steady shipment ($Y_t = \bar{Y}$), the output X_t will be identical to $\bar{Y}$ and the inventory stock Z_t^W will be constant; thus the $\sum_{\tau=1}^{\infty} \sigma_\tau^*$ represents the inventory stock coefficient ($\bar{Z}^W/\bar{X}$). If we have an appropriate scenario for describing natural growth and disposal over cultivation periods as the two key parameters (g_τ and d_τ), with RIM we can calculate the reasonable volume of inventory stock, which are fully consistent with shipments over time. RIM estimates can be used to assess the appropriateness of the PIM estimates and to provide alternative estimates for CAWiP inventory.

4 Measurement

4.1 Data

Table 2 represents the classification for seventeen cultivated assets to be measured in this paper. This classification is almost based on the ten-digit commodity classification of the 2000 Benchmark IO Table.*17

Table. 2 Classification of Cultivated Assets as WiP Inventories

	CAWiP classification	ref: 7-digit classification
(1)	0116021100.Seeds and seedlings (Shubyo)	0116021.Seeds and seedlings
(2)	0116031100.Flowers and plants (Kaki Kaboku Rui)	0116031.Flowers and plants
(3)	0121051100.Beef cattle (Nikuyo Gyu)	0121051.Beef cattle
(4)	0121099102.Racehorse (Keishuba)	0121099.Other livestock
(5)	0211011100.Saplings (Ikubyo)	0211011.Silviculture
(6)	0211011201.Japanese cedars (Sugi)	
(7)	0211011202.Japanese cypresses (Hinoki)	
(8)	0211011203.Japanese red or black pines (Akamatsu, Kuromatsu)	
(9)	0211011204.Larch, white or spruce firs (Karamatsu, Ezomatsu, Todomatsu)	
(10)	0211011205.Other conifers (Sonota no Shinyoju)	
(11)	0211011206.Broadleaf trees (Koyoju)	
(12)	0311041101.Yellowtails (Buri Rui)	0311041.Marine culture
(13)	0311041102.Breams (Madai)	
(14)	0311041201.Scallops (Hotate Gai)	
(15)	0311041202.Oysters (Kaki Rui)	
(16)	0311041401.Pearls (Shinju)	
(17)	0311041503.Laver (Itanoshi)	

The data required for RIM is shipments over periods. We estimate annual shipment data for each cultivated asset during 1955-2004, using physical shipment data from many historical statistics produced by the Ministry of Agriculture, Forestry and Fisheries (MAFF) and economic data from the Benchmark IO Tables with the ten-digit commodity classification, the Linked IO Tables and the Extended IO Tables (Ministry of Economy, Trade and Industry: METI). The main problem is that shipment or output are defined including the estimated value of natural growth for cultivated assets in some statistics as the Linked IO Table and *The Index Numbers of Agricultural, Forestry and Fishery Production* (MAFF), as we

*17 In the ten-digit commodity classification of the 2000 Benchmark IO Table, there is detail commodities for 02110111.Saplings and no details in 02110112.Afforestation. We define an aggregate asset for Saplings and separately treat the details of Afforestation as (6)-(11) in Table 2, since the shipment volume for afforestation is 91 times larger than that of Saplings in the 2000 Benchmark IO Table.

examined in section 2.2. We carefully avoided to use inappropriate data.[*18]

The biological assets except afforestation, (6)-(11), have relatively short cultivation periods. We proportionally split our annual estimates for shipment into monthly shipment amounts.

4.2 Growth and Disposal Rates

We defined six parameters (g_τ, d_τ, g^*_τ, d^*_τ, σ_τ, and σ^*_τ) in section 3.2. The key parameters are g_τ and d_τ. To describe a net growth path reflects both natural growth and disposal for each cultivated asset, we use the hyperbolic function:[*19]

$$f_\tau = \frac{T - \tau}{T - \beta\tau}. \tag{31}$$

The hyperbolic growth function $f_\tau (T \geq \tau \geq 0)$ has two parameters T (12 months $< T$) and β ($-\infty < \beta < 1$). When β is 0 or $0 < \beta < 1$, the hyperbolic growth function will be straight-line or concave, respectively. When $\beta < 0$, the hyperbolic growth function can approximate the geometric distribution. T stands for the average cultivation period from birth ($\tau = T$) to the time of shipment ($\tau = 0$) for biologicals.

Also, to define a disposal distribution, we use the geometric function with a constant mortality rate d as:

$$M = 1 - (1 - d)^T, \tag{32}$$

where M represents the mortality rate in the whole cultivation period. Given the values for three parameters (T, β, and M), and with d_τ and g_τ are defined as

$$d_\tau = d = 1 - (1 - M)^{1/T}, \tag{33}$$
$$g_\tau = \frac{dT - \beta(1 + d\tau)}{(1 - d)(T - \beta\tau)}. \tag{34}$$

4.3 Parameters

We set three parameters to describe growth and disposal in each cultivated asset, as given in Table 3.[*20] The average cultivation periods of length T range 14-36 months with the exception of afforestation, (6)-(11), in which T is set over 35 years (420 months). Using these parameters, net growth distributions

[*18] Using the unit prices for each asset in the 2000 Benchmark IO Table, the physical shipment data is evaluated at 2000 constant prices. Also, to evaluate RIM estimates in current prices, we estimate deflators for each cultivated asset.

[*19] The growth function gives a schedule for the cultivated value associated with pure aging at a point in time, normalizing the value of shipped asset at one. Likewise the age-price profile as an aging model for fixed assets, f_τ gives an age-price profile as a growth model for cultivated assets.

[*20] On the basis of reports that describe the actual cultivated periods and interview with producers and the Ministry of Agriculture, Forestry and Fisheries (MAFF), the parameter values are set.

f_τ are shown in Figure 5. The intersection with the x-axis represents the period of birth, and time goes from this period to the period of sale at the origin in the figure.

Table. 3 Parameter Sets to Describe Natural Growth and Disposal

		T	β	M
(1)	Seeds and seedlings	18	-5.0	0.20
(2)	Flowers and plants	24	0.3	0.20
(3)	Beef cattle	30	0.2	0.08
(4)	Racehorse	24	0.3	0.08
(5)	Saplings	36	-3.0	0.30
(6)	Japanese cedars	480	-1.3	0.10
(7)	Japanese cypresses	600	-1.3	0.10
(8)	Japanese red or black pines	420	-1.3	0.10
(9)	Larch, white or spruce firs	420	-1.3	0.10
(10)	Other conifers	480	-1.3	0.10
(11)	Broadleaf trees	720	-1.3	0.15
(12)	Yellowtails	24	0.2	0.30
(13)	Breams	27	0.1	0.30
(14)	Scallops	24	-5.0	0.70
(15)	Oysters	18	-5.0	0.70
(16)	Pearls	36	-7.0	0.50
(17)	Laver	14	-5.0	0.20

T: average cultivation months.

Table 4 shows the movements over months for the six parameters (g_τ, d_τ, g^*_τ, d^*_τ, σ_τ, and σ^*_τ) for the cases of (3) Beef cattle and (15) Oysters. For Beef cattle, σ^*_1 (or σ^*_{15}) indicates that 99.0% (76.9%) of the value in the asset to be sold one month later (fifteen months later) is already embodied in the WiP inventory stock at the end of the present period. For Oysters, since T and β are smaller and M is larger for Beef cattle, only 73.9% (or 3.2%) of the value of the asset to be sold one month later (fifteen months later) is embodied in the present stock. The sum of the σ^*_τ ($\tau = 1, \cdots, T$) represents the ratio of the WiP inventory stock at the end of the present period over the monthly output for the special case of steady shipments in periods to come. Thus, the monthly-base coefficient of the WiP inventory stock is 15.6 for Beef cattle and 3.7 for Oysters.

4.4 Estimated Results

Given the value of shipments at constant prices, Y_t, the RIM estimates for Z^W_t, G_t, D^W_t, ΔZ^W_t, and X_t in contstant and current prices are shown in Table 8 for the seventeen cultivated assets.[*21] Note that the PIM does not work well around the starting periods for measurement, whereas RIM does not work

[*21] In the table, Z^W_t is the WiP inventory stock at year end. Its current price stock estimate $P_t Z^W_t$ is evaluated using not the price at the year end, but the average price per year.

well toward the end period, as long as only observed data is used. We must form expectations for the shipments in periods to come. We assume here that the shipments are constant after 2004. With this static expectation, ΔZ^W_{2004} is zero, Z^W_{2004} is $\sum_{\tau=1}^{T} \sigma^*_\tau$ times larger than its monthly shipment amount, and the output X_{2004} is equal to the steady shipment amount.*22

Tables 5-7 present the aggregate results over the period of 1955-2004. In the 1990-1995-2000 Linked IO Table, the corresponding sums for WiP inventory change ($P_t \Delta Z^W_t$) are 361.5, 603.1, and 751.1 billion yen at current prices in 1990, 1995, and 2000, respectively. On the other hand, the RIM estimates for aggregate $P_t \Delta Z^W_t$ are -204.1, -79.1, and 29.9, respectively. Why are they so different? First, this is due to the different definitions used for WiP inventory change. Since WiP inventory change for a cultivated asset in the current Benchmark IO Table may be defined by natural growth G_t (or $G_t - D^W_t$) excluding the inventory *decrease* due to the shipment Y_t, as shown in Figure 1. Second, inconsistency can arise between shipment and natural growth in the current production account. The aggregate shipment is valued at 2.3, 1.9, and 1.7 trillion yen, in 1990, 1995, and 2000, respectively. If the shipment values for the cultivated asset do not change much over periods, the net growth ($G_t - D^W_t$), which provides an appropriate measure of output (X_t), will be close to the average shipment value. However, ($G_t - D^W_t$) is only 0.36, 0.60, 0.75 trillion yen in the production account, respectively. In the RIM estimates, ($G_t - D^W_t$) is 2.1, 1.8, and 1.7 trillion yen, respectively.

In the RIM estimates, we should note that the aggregates of WiP inventory changes ΔZ^W_t are negative for almost all the periods. This is mainly due to the long-term declining trend of WiP inventory stock in afforestation, (6)-(11), as shown in Figure 6 and Figure 8.*23 The average annual rate of decline for the WiP inventory stock for afforestation is 2.2% over the period of 1955-2000. Figure 7 shows values for the WiP inventory stock coefficient, which is defined as Z^W_{t-1}/X_t. On the basis of physical data for artificial afforestation areas (MAFF) is shown in Figure 4., the decline in Japan's afforestation can be seen to be more radical, with a 5.4% average annual rate of decline over the period of 1955-2000. If we accept this decline in the trend of WiP inventory stock for afforestation, negative aggregate estimates for ΔZ^W_t on cultivated assets will be predominant over these periods in Japan, as the RIM estimates indicate.

The stock value of natural forest is estimated based on the physical data in the JNA. As explained in section 2.3, all natural forest stocks (29.6 trillion yen at the end of 1980), which are defined as non-produced assets in the 1968 JNA, are shifted into the WiP inventory stock in the 1993 JNA. Based on

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*22 For cultivated assets which have short cultivation periods, the end-of-period WiP inventory stocks are lower than the annual output X_t ($= G_t - D^W_t$). In the case of (17) Laver with T = 14 months, the value of natural growth is 109.2 and the disposal is 4.6 billion yen in 2000, but the WiP inventory stock at the end of 2000 is only 23.1 billion yen (22.1% of the annual output). On the other hand, in the case of (11) Broadleaf trees with T=60 years, the end-of-period WiP inventory stock is 432.4 billion yen in 2000. Since the estimated output is 19.9 billion yen in 2000, the stock is 21.7 times larger than the annual output.

*23 The WiP inventory stock estimate of afforestation, (6)-(11), as of the end of 2000 is 2.3 trillion yen, which is 59.6% of the aggregate WiP inventory stock for Japan.

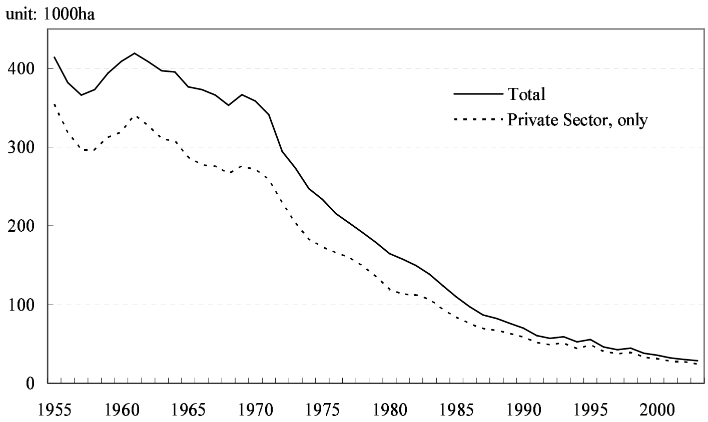

Fig. 4 Area for Artificial Afforestation in Japan

the RIM estimates, as shown in Table 7, only 7.5 trillion yen in 1980 is the value that should be counted as the WiP inventory stock for forest to be sold in periods to come. If the RIM estimates are accepted, the 1993 JNA estimates for the whole WiP inventory stock should be diminished by 24.5, 22.2, and 16.7 trillion yen in terms of current prices, as of the ends of 1980, 1990, and 2000, respectively.

In the production account, two kinds of corrections are required. The first is to consider inventory decrease by shipment Y_t, based on the suggested way for describing CAWiP in the IO table in Figure 1. The second is to revise the small estimates for natural growth ($G_t - D_t^W$) except in afforestation.[*24] The first correction decreases the current GDP and the second correction offsets some of the upward bias. As a result, 566, 682, and 721 billion yen at current prices should be subtracted from the GDP estimates in the 1990-1995-2000 Linked Benchmark IO Table, for 1990, 1995, and 2000, respectively.

5 Conclusion

The conclusions of this study are as follows

- **(i)** The framework for treating the cultivated asset work-in-progress (WiP) inventory in the current production account is inappropriate.
- **(ii)** The inventory stock in the current wealth account is considerably overestimated because it includes natural forest that should be treated as part of non-produced assets.
- **(iii)** The current estimate of WiP inventory change, which is evaluated based on imprecise methodologies using physical data on cultivated assets coupled with growth assumptions, is not consistent

[*24] As described in section 2.2, the output for afforestation is defined by the estimated value of natural growth. The estimate for $G_t - D_t^W$ is 840.5 billion yen in the 2000 Benchmark IO Table. It is much larger than the shipment value (161.5) and the RIM estimate for $G_t - D_t^W$ (144.9).

with the production scale of cultivated assets.

(iv) RIM (realized inventory method) proposed in this paper can consistently describe the relationship among shipment and inventory stock and change.

(v) The RIM estimates can provide alternative, and we argue better, current estimates for the value of natural growth and inventory stock.

(vi) RIM also can be helpful for properly identifing non-cultivated biological resources as not-produced assets.

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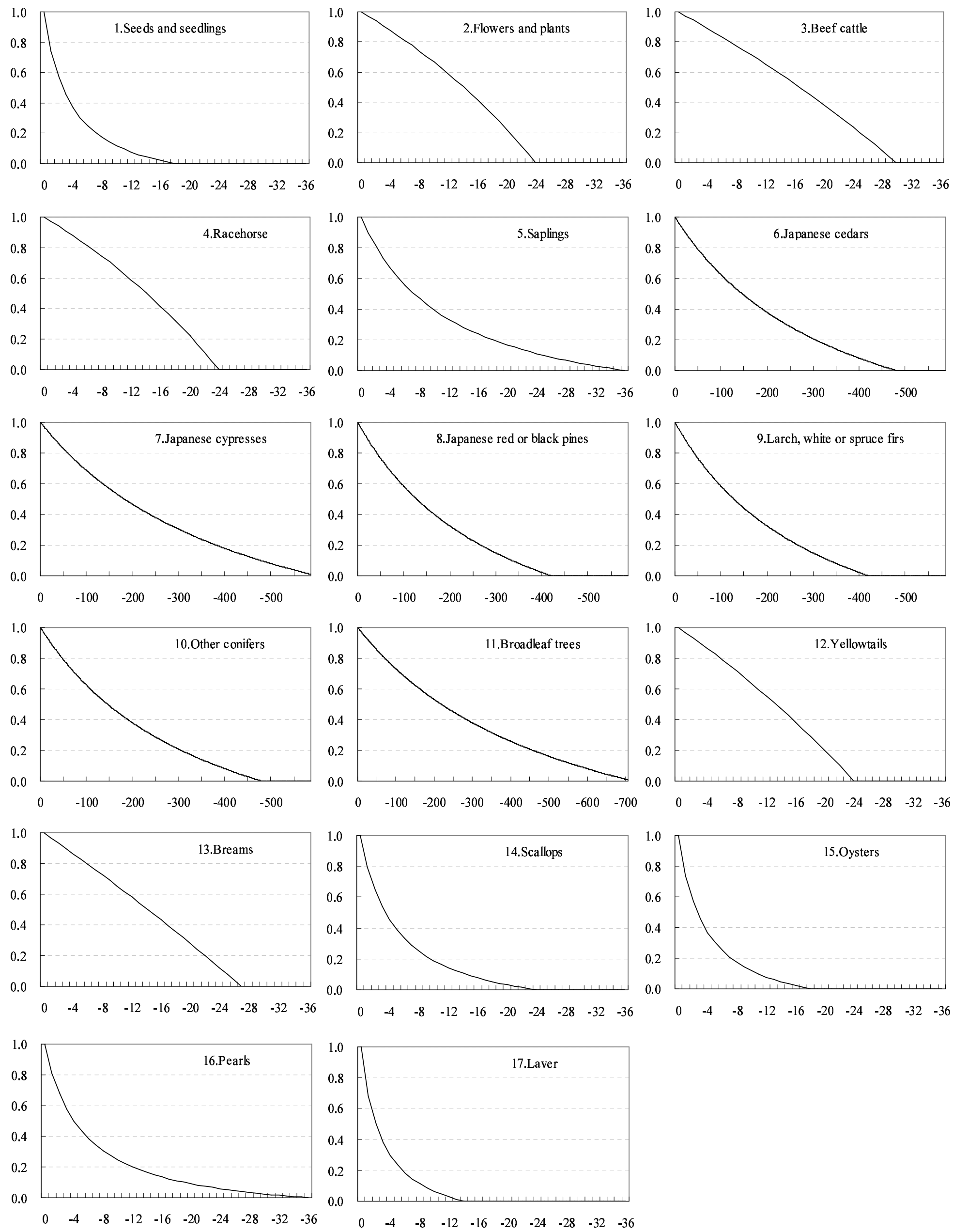

Fig. 5　Assumed Growth Distributions on Cultivated Assets

Table. 4 Parameters: d_τ, g_τ, g^*_τ, d^*_τ, σ_τ, and σ^*_τ in the Cases of Beef Cattle and Oysters

	(3) Beef cattle (T=30, β = 0.2, M=0.08)						(9) Oysters (T=18, β = −5.0, M=0.70)					
τ	d_τ	g_τ	g^*_τ	d^*_τ	σ_τ	σ^*_τ	d_τ	g_τ	g^*_τ	d^*_τ	σ_τ	σ^*_τ
0	0.003	0.030	0.030	0.003	0.027		0.065	0.447	0.309	0.048	0.261	
1	0.003	0.032	0.030	0.003	0.027	0.973	0.065	0.383	0.205	0.037	0.168	0.739
2	0.003	0.033	0.030	0.003	0.028	0.946	0.065	0.344	0.146	0.029	0.117	0.571
3	0.003	0.034	0.030	0.002	0.028	0.918	0.065	0.319	0.110	0.024	0.086	0.455
4	0.003	0.036	0.031	0.002	0.028	0.890	0.065	0.303	0.086	0.020	0.066	0.368
5	0.003	0.037	0.031	0.002	0.029	0.862	0.065	0.293	0.069	0.016	0.052	0.302
6	0.003	0.039	0.031	0.002	0.029	0.833	0.065	0.288	0.056	0.013	0.042	0.250
7	0.003	0.041	0.032	0.002	0.030	0.804	0.065	0.287	0.046	0.011	0.035	0.208
8	0.003	0.043	0.032	0.002	0.030	0.775	0.065	0.290	0.039	0.009	0.030	0.172
9	0.003	0.045	0.032	0.002	0.030	0.745	0.065	0.298	0.033	0.008	0.025	0.143
10	0.003	0.048	0.033	0.002	0.031	0.714	0.065	0.312	0.028	0.006	0.022	0.118
11	0.003	0.051	0.033	0.002	0.031	0.683	0.065	0.333	0.024	0.005	0.019	0.096
12	0.003	0.054	0.033	0.002	0.032	0.652	0.065	0.365	0.021	0.004	0.017	0.077
13	0.003	0.058	0.034	0.002	0.032	0.620	0.065	0.417	0.018	0.003	0.015	0.060
14	0.003	0.062	0.034	0.002	0.033	0.588	0.065	0.507	0.015	0.002	0.013	0.045
15	0.003	0.066	0.035	0.001	0.033	0.556	0.065	0.690	0.013	0.001	0.012	0.032
16	0.003	0.072	0.035	0.001	0.034	0.522	0.065	1.247	0.011	0.001	0.011	0.020
17	0.003	0.078	0.035	0.001	0.034	0.489	0.065	–	0.010	0.000	0.010	0.010
18	0.003	0.086	0.036	0.001	0.035	0.455						
19	0.003	0.095	0.036	0.001	0.035	0.420						
20	0.003	0.106	0.037	0.001	0.036	0.385						
21	0.003	0.119	0.037	0.001	0.036	0.349						
22	0.003	0.137	0.038	0.001	0.037	0.312						
23	0.003	0.161	0.038	0.001	0.037	0.276						
24	0.003	0.194	0.039	0.001	0.038	0.238						
25	0.003	0.243	0.039	0.000	0.039	0.200						
26	0.003	0.326	0.040	0.000	0.039	0.161						
27	0.003	0.492	0.040	0.000	0.040	0.122						
28	0.003	0.989	0.041	0.000	0.041	0.082						
29	0.003	–	0.041	0.000	0.041	0.041						
30												
sum			1.043	0.043	1.000	15.613			1.237	0.237	1.000	3.667

τ: month.

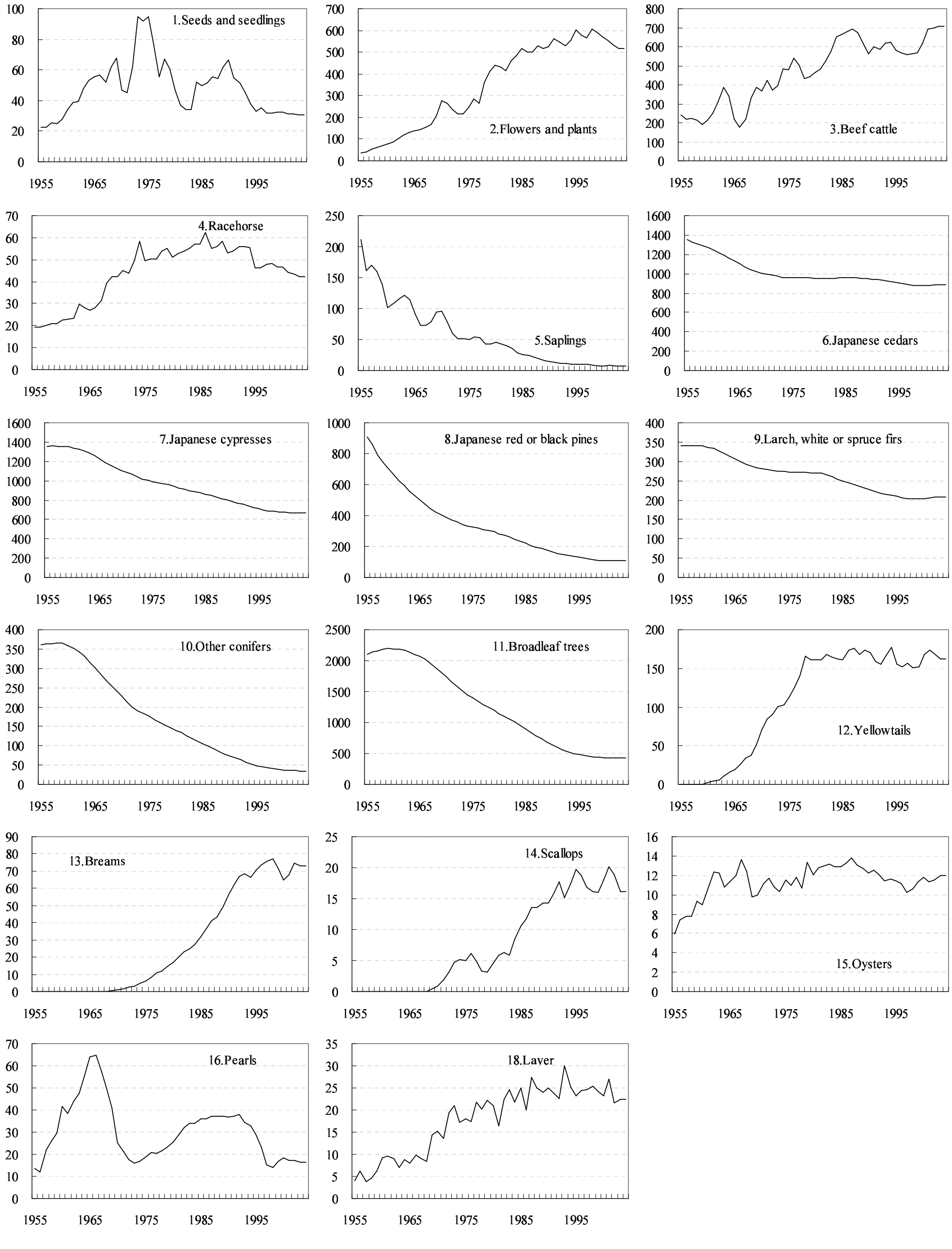

Fig. 6 WiP Inventory Stock (Z_t^W)

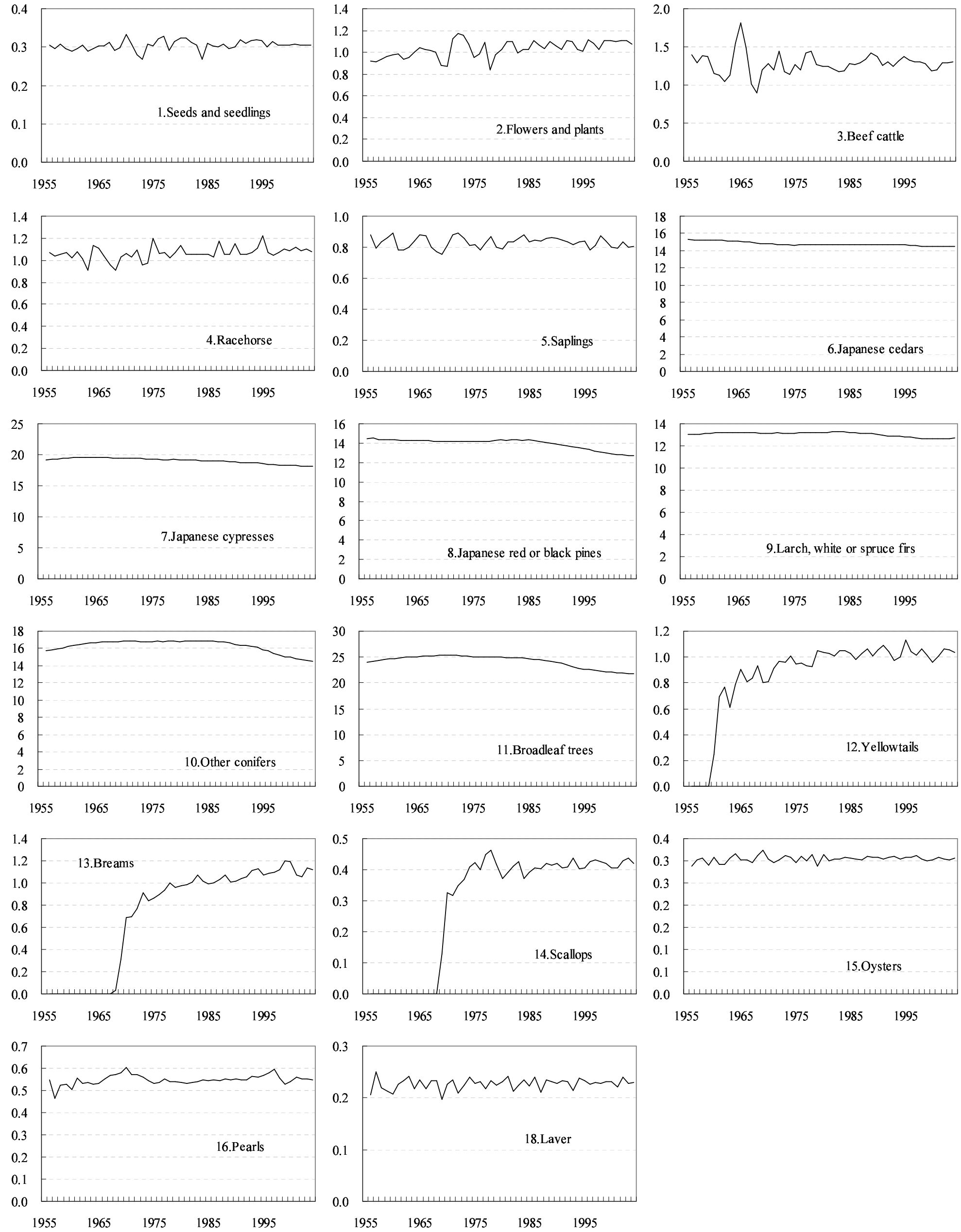

Fig. 7 WiP Inventory Stock Coefficient (Z^W_{t-1}/X_t)

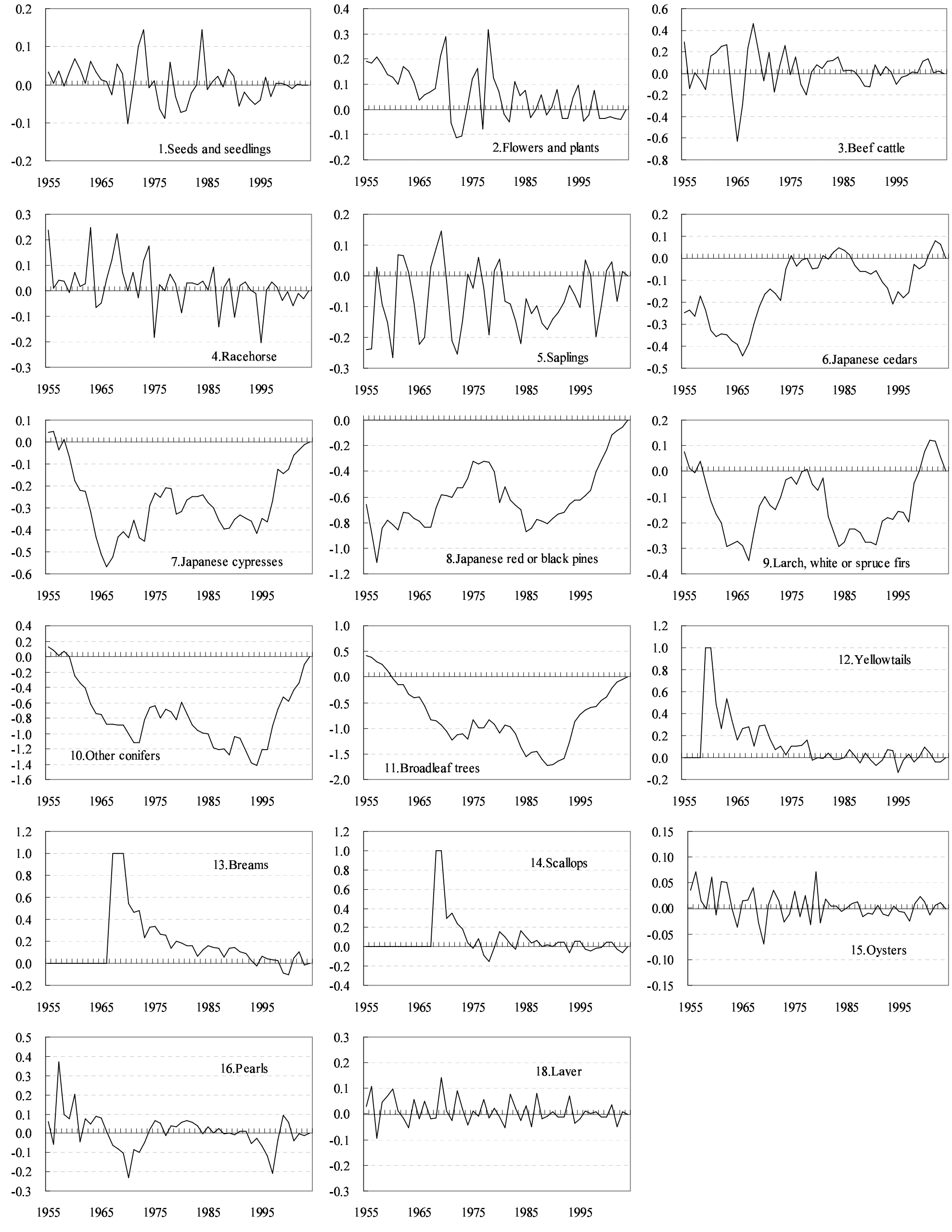

Fig. 8 WiP Inventory Change Coefficient ($\Delta Z_t^W / X_t$)

Table. 5 RIM Estimates: Total, (1)-(17)

	Z_t^W	G_t	D_t^W	ΔZ_t^W	X_t	Y_t	$P_tZ_t^W$	P_tG_t	$P_tD_t^W$	$P_t\Delta Z_t^W$	P_tX_t	P_tY_t
1955	6975020	1075843	68314	-14001	1007529	1021530	2777335	252945	12126	-16975	240819	257794
1956	6874534	1031128	64445	-100486	966683	1067169	2924670	267270	12807	-37859	254463	292322
1957	6840808	1007408	63265	-33726	944143	977869	3375292	294040	14068	-49877	279971	329848
1958	6799939	1020015	66252	-40869	953763	994632	3317441	290649	14193	-32195	276456	308651
1959	6719707	1016022	66465	-80232	949557	1029789	3273310	292266	14359	-44105	277906	322011
1960	6651787	1037038	67432	-67920	969607	1037527	3293498	314358	15731	-50538	298626	349165
1961	6599626	1091235	70048	-52161	1021187	1073348	4031716	378457	18981	-74587	359476	434063
1962	6592055	1181634	75459	-7570	1106174	1113744	3781458	385048	19642	-56605	365407	422012
1963	6581693	1265989	83108	-10363	1182880	1193243	3742829	417476	21921	-62081	395555	457636
1964	6409406	1277573	88055	-172287	1189518	1361805	3614637	419733	23001	-98696	396732	495428
1965	6141899	1228511	87149	-267508	1141362	1408870	3296992	397291	23058	-117495	374233	491728
1966	5934638	1186144	84700	-207260	1101444	1308705	3681090	438187	25459	-121202	412728	533930
1967	5809856	1216635	85451	-124783	1131183	1255966	4396355	507079	27715	-122964	479364	602328
1968	5797625	1289821	89040	-12231	1200782	1213012	4668807	556978	29558	-74876	527419	602295
1969	5782456	1393014	95066	-15169	1297948	1313117	4932442	628974	34238	-69142	594736	663878
1970	5671466	1489483	102672	-110990	1386810	1497800	4799513	658954	37850	-99520	621104	720623
1971	5564900	1434153	105066	-106566	1329087	1435653	4533969	645325	40138	-80217	605187	685404
1972	5357073	1395984	103987	-207827	1291997	1499824	4674857	706860	45072	-127054	661788	788842
1973	5267091	1476159	104401	-89983	1371758	1461741	6310588	1019641	58942	-114878	960699	1075577
1974	5253641	1581183	108755	-13450	1472429	1485879	7446346	1158920	72100	-54720	1086821	1141540
1975	5210903	1634567	112129	-42738	1522438	1565176	7101470	1238221	78113	-61847	1160107	1221954
1976	5226123	1686191	120012	15220	1566178	1550959	7434793	1437090	97574	-11283	1339516	1350799
1977	5089912	1643879	121745	-136211	1522134	1658345	7046191	1423676	102915	-111606	1320760	1432366
1978	5081933	1652386	125069	-7979	1527316	1535296	6776138	1519190	109188	-41491	1410002	1451493
1979	5050988	1727565	134734	-30946	1592831	1623777	7761747	1700114	122577	-69311	1577537	1646848
1980	5004612	1756662	140401	-46376	1616261	1662638	8648391	1800777	131557	-93442	1669220	1762662
1981	4932294	1732292	141556	-72317	1590737	1663054	7582936	1702773	131824	-86502	1570949	1657451
1982	4893853	1725388	141354	-38442	1584034	1622476	7282853	1736650	136386	-55413	1600264	1655677
1983	4909897	1815560	145733	16044	1669827	1653783	7055891	1887277	147178	-12943	1740099	1753042
1984	4930769	1906640	152359	20872	1754281	1733409	6828547	1861112	146037	-19995	1715075	1735071
1985	4887195	1997534	159607	-43575	1837928	1881502	6805837	2043696	161066	-72683	1882630	1955314
1986	4815886	2030042	164384	-71309	1865658	1936967	6659449	2032213	158250	-98235	1873963	1972198
1987	4750334	2038773	166624	-65553	1872149	1937702	6794854	2073616	157368	-97706	1916248	2013954
1988	4653537	2075479	170012	-96797	1905467	2002264	6741903	2199054	169230	-137917	2029823	2167740
1989	4509696	2021614	169336	-143841	1852278	1996120	6829426	2174991	169425	-203960	2005565	2209526
1990	4369072	2020708	168343	-140624	1852365	1992989	7078332	2303493	182697	-204097	2120796	2324893
1991	4346711	2030323	169532	-22361	1860791	1883152	7018227	2504564	200839	-36118	2303725	2339843
1992	4239754	2003306	170304	-106957	1833001	1939959	6370110	2301154	188714	-148239	2112440	2260679
1993	4191807	1996636	168380	-47948	1828256	1876204	6018746	2233668	184879	-83127	2048789	2131916
1994	4153194	2003915	169152	-38613	1834763	1873377	5657326	2157122	181635	-70920	1975487	2046407
1995	4073118	1965999	171182	-80075	1794817	1874893	5161865	2013059	173255	-79072	1839805	1918877
1996	3977807	1910029	168827	-95312	1741202	1836513	4854649	1934566	168776	-110736	1765790	1876526
1997	3911802	1890678	164003	-66005	1726675	1792680	4635101	1985106	168084	-80885	1817022	1897907
1998	3926505	1876570	162792	14703	1713778	1699076	4295107	1983156	170520	19994	1812636	1792642
1999	3882107	1880646	163652	-44398	1716994	1761392	4042075	1876751	163802	-45474	1712949	1758423
2000	3911975	1907713	163586	29868	1744127	1714259	3911975	1907713	163586	29868	1744127	1714259
2001	3973712	1945494	166858	61737	1778636	1716899	3766971	1885432	160731	57126	1724702	1667576
2002	3954625	1955154	167844	-19087	1787310	1806397	3507085	1867912	166193	-20488	1701719	1722207
2003	3939398	1914933	163648	-15228	1751285	1766512	3670561	1935871	166731	-16480	1769140	1785620
2004	3939398	1905633	161056	0	1744577	1744578	3501984	1984405	165851	0	1818554	1818555

Unit: million yen (Z_t^W, G_t, D_t^W, and ΔZ_t^W are evaluated at 2000 constant prices)
Z_t^W is the end-of-period WiP inventory stock.

Table. 6 RIM Estimates: Total excluding Afforestation, (1)-(5) and (7)-(17)

	Z_t^W	G_t	D_t^W	ΔZ_t^W	X_t	Y_t	$P_t Z_t^W$	$P_t G_t$	$P_t D_t^W$	$P_t \Delta Z_t^W$	$P_t X_t$	$P_t Y_t$
1955	555228	697090	51453	7254	645637	638383	67390	79936	4869	7478	75067	67589
1956	491630	656081	47675	-63599	608406	672004	65454	85078	5147	-4605	79932	84537
1957	522504	637286	46647	30874	590639	559765	70400	83658	5204	2741	78453	75712
1958	517922	654807	49789	-4582	605019	609600	68286	85172	5518	77	79654	79577
1959	493516	655057	50135	-24407	604922	629328	67582	89813	5794	-2547	84019	86566
1960	516125	681530	51302	22610	630228	607618	87585	111729	7146	9375	104583	95209
1961	573213	742515	54189	57087	688326	631239	100389	129996	8469	10035	121527	111492
1962	666691	839916	59887	93479	780029	686551	119488	154576	9904	17242	144672	127430
1963	784256	931512	67840	117565	863673	746108	159319	191261	12368	23825	178893	155068
1964	755737	951317	73146	-28520	878171	906691	155004	201215	13787	-5823	187427	193250
1965	632761	910849	72620	-122976	838229	961205	134029	197559	14675	-29711	182883	212594
1966	591363	877515	70575	-41398	806940	848338	140042	214907	16092	-8397	198815	207212
1967	644096	917704	71778	52733	845927	793194	162612	240684	16566	14886	224118	209232
1968	785610	1000091	75807	141514	924285	782770	223221	277988	17909	47057	260079	213022
1969	913913	1111339	82227	128303	1029112	900809	283007	339128	22131	46067	316997	270930
1970	948419	1215423	90213	34505	1125210	1090704	288541	377250	26118	11592	351133	339540
1971	989996	1167699	92995	41577	1074704	1033126	331793	382565	29156	25437	353409	327972
1972	921185	1136955	92296	-68811	1044658	1113470	352091	435158	33788	-19138	401370	420508
1973	962943	1224136	93067	41758	1131069	1089311	553163	658523	43945	28350	614577	586228
1974	1059568	1335354	97741	96625	1237613	1140988	662269	739873	54541	78597	685332	606735
1975	1091323	1393444	101364	31755	1292080	1260325	729805	843310	61779	18238	781531	763293
1976	1194172	1449127	109460	102849	1339667	1236818	930859	1032864	80838	91638	952026	860389
1977	1135731	1410960	111412	-58441	1299548	1357989	886719	1042624	86993	-23139	955631	978770
1978	1195614	1423097	114930	59882	1308166	1248284	955583	1159342	94188	33440	1065154	1031713
1979	1247360	1502003	124791	51746	1377212	1325466	1064058	1282461	105322	42988	1177139	1134151
1980	1291928	1535426	130685	44569	1404741	1360172	1119547	1329150	112098	46165	1217052	1170886
1981	1291863	1515158	132058	-65	1383100	1383165	1106569	1299373	115192	8086	1184181	1176095
1982	1331422	1511987	132055	39558	1379932	1340374	1186607	1356222	120740	45753	1235481	1189728
1983	1429031	1606149	136647	97609	1469502	1371893	1330936	1531563	132428	92267	1399135	1306868
1984	1538432	1701404	143500	109400	1557904	1448504	1370683	1523507	131911	97387	1391596	1294208
1985	1591776	1796797	150997	53344	1645800	1592456	1522584	1715966	147360	59341	1568606	1509265
1986	1611339	1833890	156026	19562	1677864	1658302	1532691	1712892	145016	23848	1567876	1544027
1987	1636553	1847054	158507	25214	1688547	1663332	1584276	1749176	144018	31236	1605158	1573922
1988	1635243	1888292	162142	-1310	1726150	1727460	1672327	1882073	156231	1548	1725842	1724294
1989	1586966	1839072	161717	-48278	1677355	1725633	1656263	1849595	156171	-57728	1693424	1751151
1990	1534435	1842643	160969	-52530	1681674	1734204	1697863	1962793	168924	-59857	1793869	1853726
1991	1592112	1856355	162382	57677	1693973	1636297	1999718	2185871	188009	91085	1997861	1906776
1992	1563219	1833191	163362	-28893	1669829	1698722	1780407	2008305	176959	-27083	1831346	1858429
1993	1584448	1830173	161632	21228	1668541	1647313	1727818	1958126	173899	21150	1784227	1763076
1994	1610021	1840851	162578	25573	1678273	1652700	1661092	1900031	171418	25875	1728614	1702739
1995	1582386	1805990	164759	-27635	1641230	1668865	1569652	1782122	164074	-6109	1618049	1624158
1996	1538406	1752732	162539	-43981	1590194	1634174	1505104	1717991	160212	-42242	1557779	1600021
1997	1515627	1735897	157838	-22779	1578059	1600838	1550816	1785217	160176	-26476	1625041	1651517
1998	1555081	1723602	156718	39454	1566884	1527430	1638224	1811559	163719	47060	1647840	1600780
1999	1532382	1728841	157639	-22700	1571202	1593902	1515846	1713295	157343	-22538	1555952	1578490
2000	1578883	1756863	157622	46501	1599241	1552740	1578883	1756863	157622	46501	1599241	1552740
2001	1645318	1795161	160923	66435	1634238	1567803	1579595	1744487	155148	61753	1589339	1527587
2002	1624313	1804833	161913	-21005	1642921	1663926	1544463	1741671	161169	-21921	1580502	1602423
2003	1606234	1764426	157710	-18079	1606716	1624796	1656125	1805730	161583	-18946	1644147	1663093
2004	1606234	1755019	155113	0	1599906	1599906	1748477	1870445	161362	0	1709083	1709083

Unit: million yen (Z_t^W, G_t, D_t^W, ΔZ_t^W, X_t, and Y_t are evaluated at 2000 constant prices)
Z_t^W is the end-of-period WiP inventory stock.

Table. 7 RIM Estimates: Total Afforestation, (6)-(11)

	Z_t^W	G_t	D_t^W	ΔZ_t^W	X_t	Y_t	$P_tZ_t^W$	P_tG_t	$P_tD_t^W$	$P_t\Delta Z_t^W$	P_tX_t	P_tY_t
1955	6419792	378753	16861	-21255	361892	383146	2709945	173009	7258	-24453	165752	190204
1956	6382904	375046	16769	-36888	358277	395165	2859216	182192	7661	-33254	174531	207785
1957	6318304	370122	16618	-64600	353504	418104	3304892	210382	8864	-52618	201518	254136
1958	6282017	365207	16463	-36287	348744	385031	3249154	205477	8676	-32272	196802	229074
1959	6226192	360965	16330	-55826	344635	400461	3205728	202453	8566	-41558	193887	235445
1960	6135661	355508	16130	-90530	339379	429909	3205913	202629	8586	-59913	194043	253956
1961	6026413	348720	15859	-109248	332861	442109	3931327	248461	10512	-84622	237950	322571
1962	5925364	341718	15573	-101049	326145	427194	3661970	230473	9738	-73847	220735	294582
1963	5797437	334476	15269	-127928	319208	447135	3583511	226215	9552	-85906	216663	302568
1964	5653670	326256	14909	-143767	311347	455114	3459633	218518	9214	-92873	209305	302177
1965	5509138	317663	14529	-144532	303134	447665	3162963	199732	8382	-87784	191350	279134
1966	5343276	308629	14124	-165862	294505	460367	3541048	223281	9368	-112805	213913	326718
1967	5165760	298930	13674	-177516	285256	462772	4233743	266395	11149	-137850	255246	393096
1968	5012015	289730	13233	-153745	276497	430242	4445586	278990	11649	-121933	267341	389274
1969	4868542	281675	12839	-143473	268835	412308	4649436	289846	12107	-115209	277739	392948
1970	4723047	274059	12459	-145495	261600	407096	4510972	281704	11733	-111112	269971	381083
1971	4574904	266455	12071	-148143	254383	402527	4202176	262760	10982	-105654	251778	357433
1972	4435888	259029	11691	-139016	247338	386354	4322766	271702	11284	-107916	260418	368334
1973	4304147	252023	11334	-131740	240689	372429	5757425	361118	14997	-143228	346121	489349
1974	4194073	245829	11013	-110075	234816	344891	6784077	419047	17559	-133316	401489	534805
1975	4119580	241123	10765	-74493	230358	304851	6371665	394911	16334	-80084	378577	458661
1976	4031951	237064	10553	-87629	226512	314141	6503934	404226	16736	-102920	387490	490410
1977	3954181	232919	10333	-77770	222586	300356	6159472	381052	15923	-88467	365130	453597
1978	3886319	229289	10139	-67862	219150	287012	5820555	359848	14999	-74931	344848	419780
1979	3803628	225562	9943	-82691	215619	298310	6697689	417653	17255	-112299	400398	512697
1980	3712683	221236	9716	-90945	211521	302465	7528844	471627	19459	-139608	452168	591776
1981	3640431	217134	9498	-72252	207637	279889	6476366	403400	16632	-94588	386768	481357
1982	3562431	213401	9299	-78000	204102	282102	6096246	380428	15646	-101166	364782	465949
1983	3480866	209411	9086	-81565	200325	281890	5724955	355714	14750	-105210	340964	446174
1984	3392338	205235	8858	-88528	196377	284905	5457864	337605	14125	-117383	323480	440862
1985	3295419	200738	8610	-96919	192128	289046	5283253	327731	13706	-132024	314025	446049
1986	3204548	196152	8358	-90871	187794	278666	5126758	319321	13234	-122083	306087	428171
1987	3113780	191719	8116	-90767	183603	274370	5210578	324440	13350	-128942	311091	440033
1988	3018294	187188	7871	-95487	179317	274804	5069576	316980	12999	-139465	303981	443446
1989	2922730	182542	7618	-95563	174923	270487	5173163	325396	13254	-146233	312142	458374
1990	2834637	178066	7375	-88093	170691	258785	5380469	340700	13773	-144240	326927	471167
1991	2754599	173968	7151	-80037	166818	246855	5018510	318693	12829	-127203	305864	433067
1992	2676535	170115	6942	-78064	163173	241237	4589703	292849	11756	-121156	281093	402249
1993	2607359	166463	6748	-69176	159715	228891	4290928	275542	10980	-104277	264562	368839
1994	2543173	163064	6574	-64186	156490	220677	3996234	257091	10217	-96794	246873	343668
1995	2490732	160009	6422	-52440	153587	206027	3592214	230937	9181	-72963	221756	294719
1996	2439401	157297	6288	-51331	151008	202339	3349545	216575	8564	-68494	208011	276505
1997	2396175	154781	6165	-43226	148616	191842	3084285	199889	7908	-54409	191981	246390
1998	2371423	152968	6074	-24752	146894	171646	2656883	171596	6801	-27066	164796	191861
1999	2349725	151805	6013	-21698	145792	167490	2526229	163456	6460	-22936	156996	179932
2000	2333092	150850	5963	-16633	144886	161519	2333092	150850	5963	-16633	144886	161519
2001	2328394	150333	5935	-4698	144398	149096	2187376	140945	5583	-4627	135363	139989
2002	2330311	150321	5932	1918	144389	142471	1962622	126241	5025	1433	121217	119784
2003	2333163	150507	5939	2852	144568	141716	2014436	130141	5148	2466	124993	122527
2004	2333163	150615	5943	0	144672	144672	1753507	113960	4488	0	109472	109472

Unit: million yen (Z_t^W, G_t, D_t^W, ΔZ_t^W, X_t, and Y_t are evaluated at 2000 constant prices)
Z_t^W is the end-of-period WiP inventory stock.

Table. 8 RIM Estimates

	1955	1960	1965	1970	1975	1980	1985	1990	1995	2000
(1) Seeds and seedlings (Shubyo)										
Z_t^W	22268	34296	55234	46698	95049	46794	49988	66371	32844	32140
G_t	70579	100817	183259	212942	316953	194901	176711	214909	124970	110463
D_t^W	3056	4366	7924	9159	13735	8408	7632	9318	5387	4776
ΔZ_t^W	2200	6507	2230	-20988	3158	-13767	-2262	4736	-4977	-216
X_t	67523	96451	175335	203782	303218	186493	169079	205591	119583	105687
Y_t	65323	89944	173104	224770	300060	200261	171341	200855	124560	105903
$P_tZ_t^W$	1801	2766	6322	7191	28376	29293	36872	54888	31268	32140
P_tG_t	5707	8132	20975	32792	94622	122009	130344	177729	118972	110463
$P_tD_t^W$	247	352	907	1411	4100	5263	5629	7706	5129	4776
$P_t\Delta Z_t^W$	178	525	255	-3232	943	-8618	-1669	3916	-4738	-216
P_tX_t	5460	7780	20068	31382	90522	116746	124714	170023	113843	105687
P_tY_t	5282	7255	19813	34614	89579	125364	126383	166107	118581	105903
(2) Flowers and plants (Kaki Kaboku Rui)										
Z_t^W	34952	79091	136506	275585	243983	438953	517663	523477	604277	568094
G_t	34877	79695	141010	262941	251629	447744	525462	548049	609011	596140
D_t^W	3468	8172	14830	26181	25001	46874	55285	57590	63758	64450
ΔZ_t^W	6008	9085	4670	68558	27498	28350	34755	4869	52739	-20020
X_t	31409	71523	126180	236759	226628	400870	470177	490460	545253	531691
Y_t	25401	62437	121509	168201	199130	372519	435421	485590	492514	551711
$P_tZ_t^W$	4103	9262	22684	61616	88126	332461	498577	572685	683438	568094
P_tG_t	4094	9333	23432	58789	90888	339119	506088	599566	688792	596140
$P_tD_t^W$	407	957	2464	5854	9030	35502	53247	63003	72110	64450
$P_t\Delta Z_t^W$	705	1064	776	15328	9932	21472	33474	5327	59648	-20020
P_tX_t	3687	8376	20968	52935	81857	303616	452841	536563	616682	531691
P_tY_t	2982	7312	20192	37607	71925	282144	419367	531236	557034	551711
(3) Beef cattle (Nikuyo Gyu)										
Z_t^W	244056	216236	220146	365709	480095	466853	662987	562540	580539	620371
G_t	178915	171807	196094	313169	398605	368458	531227	473620	474044	498059
D_t^W	7198	6670	9622	12529	16029	15016	21853	19835	20189	19560
ΔZ_t^W	49391	26170	-117170	-20101	-4583	26748	10989	-58284	-43641	54513
X_t	171717	165137	186473	300640	382576	353441	509374	453785	453855	478499
Y_t	122325	138968	303643	320742	387159	326694	498385	512069	497496	423986
$P_tZ_t^W$	40942	47591	57254	130911	425930	437136	614320	688167	535548	620371
P_tG_t	30014	37813	50999	112103	353634	345005	492232	579389	437307	498059
$P_tD_t^W$	1208	1468	2502	4485	14220	14061	20249	24265	18624	19560
$P_t\Delta Z_t^W$	8286	5760	-30473	-7196	-4066	25045	10182	-71301	-40259	54513
P_tX_t	28806	36344	48496	107618	339413	330944	471983	555124	418682	478499
P_tY_t	20521	30585	78969	114814	343479	305899	461801	626425	458941	423986
(4) Racehorse (Keishuba)										
Z_t^W	19306	22383	26810	42138	49384	51030	57262	53009	46109	46484
G_t	17564	21420	26480	41318	50675	50846	56495	53017	47423	44878
D_t^W	706	894	1144	1746	2267	2222	2365	2334	2144	1944
ΔZ_t^W	3996	1469	-1240	36	-8792	-4112	137	-5260	-9211	-210
X_t	16858	20527	25335	39572	48408	48624	54130	50683	45279	42933
Y_t	12862	19058	26575	39536	57200	52736	53993	55943	54490	43143
$P_tZ_t^W$	3224	4299	6062	14874	18089	36495	49312	51275	32365	46484
P_tG_t	2934	4114	5987	14585	18562	36364	48652	51281	33287	44878
$P_tD_t^W$	118	172	259	616	830	1589	2036	2258	1505	1944
$P_t\Delta Z_t^W$	667	282	-280	13	-3221	-2941	118	-5088	-6465	-210
P_tX_t	2816	3943	5728	13969	17731	34774	46615	49024	31783	42933
P_tY_t	2148	3660	6009	13956	20952	37715	46497	54112	38248	43143

Unit: million yen (Z_t^W, G_t, D_t^W, ΔZ_t^W, X_t, and Y_t are evaluated at 2000 constant prices)

Z_t^W is the end-of-period WiP inventory stock.

Table. 8 RIM Estimates (continued)

	1955	1960	1965	1970	1975	1980	1985	1990	1995	2000
(5) Saplings (Ikubyo)										
Z_t^W	210988	101708	91525	95140	49389	46152	26403	14040	9303	7646
G_t	330359	170223	141397	126184	69583	59620	36997	20608	13745	10273
D_t^W	29187	14802	12487	11155	6024	5223	3249	1812	1191	894
ΔZ_t^W	-56875	-37265	-22266	1554	-2458	3204	-1671	-2017	-1226	155
X_t	301172	155421	128910	115029	63559	54397	33748	18795	12554	9379
Y_t	358047	192686	151176	113475	66017	51193	35419	20812	13781	9224
$P_tZ_t^W$	11241	7985	9823	14124	19153	30186	18665	9233	7718	7646
P_tG_t	17601	13363	15175	18733	26984	38995	26155	13551	11404	10273
$P_tD_t^W$	1555	1162	1340	1656	2336	3416	2297	1192	988	894
$P_t\Delta Z_t^W$	-3030	-2925	-2390	231	-953	2096	-1181	-1326	-1017	155
P_tX_t	16046	12201	13835	17077	24648	35579	23858	12360	10416	9379
P_tY_t	19076	15127	16224	16846	25601	33483	25039	13686	11433	9224
(6) Japanese cedars (Sugi)										
Z_t^W	1350381	1244228	1102216	994674	959746	951073	958927	945479	903721	876319
G_t	93148	86761	77901	70646	67963	67407	67595	66993	64692	62806
D_t^W	3589	3316	2945	2636	2527	2509	2522	2497	2394	2311
ΔZ_t^W	-22245	-27405	-29361	-11208	817	-2960	2309	-4550	-9593	-1980
X_t	89560	83445	74956	68010	65437	64898	65073	64497	62298	60495
Y_t	111805	110849	104317	79218	64620	67858	62764	69047	71891	62475
$P_tZ_t^W$	995300	1161980	1204515	1513803	2217942	2643499	1749304	1923573	1327983	876319
P_tG_t	68655	81026	85132	107517	157061	187357	123310	136298	95062	62806
$P_tD_t^W$	2645	3097	3219	4012	5839	6974	4601	5079	3518	2311
$P_t\Delta Z_t^W$	-16396	-25593	-32086	-17058	1888	-8227	4212	-9257	-14097	-1980
P_tX_t	66010	77929	81913	103505	151222	180383	118709	131218	91544	60495
P_tY_t	82406	103522	113999	120563	149335	188610	114496	140475	105641	62475
(7) Japanese cypresses (Hinoki)										
Z_t^W	1354721	1339403	1226947	1085408	990336	924248	863974	785160	712105	673298
G_t	73488	72262	66810	59382	54176	50912	47871	44151	40640	38551
D_t^W	2851	2836	2623	2316	2100	1965	1835	1672	1516	1424
ΔZ_t^W	3044	-12121	-32857	-24915	-12006	-15479	-12772	-14992	-13688	-4631
X_t	70637	69426	64187	57066	52076	48946	46036	42479	39124	37127
Y_t	67593	81547	97044	81981	64082	64425	58808	57471	52812	41758
$P_tZ_t^W$	396466	496671	631050	1235286	1885096	2127704	1491258	1760972	1134549	673298
P_tG_t	21507	26796	34362	67582	103124	117203	82628	99022	64749	38551
$P_tD_t^W$	834	1052	1349	2635	3998	4524	3167	3749	2416	1424
$P_t\Delta Z_t^W$	891	-4495	-16899	-28355	-22854	-35633	-22044	-33625	-21808	-4631
P_tX_t	20672	25744	33013	64946	99125	112679	79461	95273	62333	37127
P_tY_t	19781	30239	49912	93301	121979	148312	101505	128898	84141	41758
(8) Japanese red or black pines (Akamatsu, Kuromatsu)										
Z_t^W	910820	662732	501456	388646	326284	282142	221443	165540	128603	109299
G_t	69192	51158	38864	29854	24618	21433	17155	13103	10450	8976
D_t^W	2813	2061	1558	1198	995	871	690	514	397	332
ΔZ_t^W	-43553	-40192	-29347	-16854	-7607	-13194	-14333	-9637	-6272	-2037
X_t	66379	49097	37306	28656	23623	20562	16464	12589	10053	8643
Y_t	109933	89288	66654	45510	31230	33756	30797	22226	16325	10680
$P_tZ_t^W$	429138	395643	292190	360140	463204	468520	314677	265724	160611	109299
P_tG_t	32600	30541	22645	27664	34949	35590	24377	21033	13051	8976
$P_tD_t^W$	1325	1230	908	1110	1412	1446	981	825	496	332
$P_t\Delta Z_t^W$	-20520	-23994	-17100	-15618	-10799	-21910	-20367	-15469	-7833	-2037
P_tX_t	31275	29310	21738	26554	33537	34144	23396	20207	12555	8643
P_tY_t	51795	53304	38838	42172	44335	56054	43764	35677	20388	10680

Unit: million yen (Z_t^W, G_t, D_t^W, ΔZ_t^W, X_t, and Y_t are evaluated at 2000 constant prices)

Z_t^W is the end-of-period WiP inventory stock.

Table. 8 RIM Estimates (continued)

	1955	1960	1965	1970	1975	1980	1985	1990	1995	2000
(9) Larch, white or spruce firs (Karamatsu, Ezomatsu, Todomatsu)										
Z_t^W	339947	337012	307032	282037	272773	269250	249356	226594	209461	204160
G_t	27086	26898	24714	22498	21599	21271	20011	18446	17203	16697
D_t^W	1020	1019	935	852	822	813	759	690	635	612
ΔZ_t^W	2028	-2994	-6492	-2117	-472	-1541	-5311	-4941	-2596	1231
X_t	26066	25878	23779	21646	20778	20458	19251	17756	16568	16085
Y_t	24039	28872	30271	23763	21249	22000	24562	22697	19164	14854
$P_t Z_t^W$	238449	299523	266339	389083	460510	731143	475133	416941	292070	204160
$P_t G_t$	18999	23906	21438	31037	36465	57762	38129	33942	23987	16697
$P_t D_t^W$	715	906	811	1176	1387	2208	1447	1270	885	612
$P_t \Delta Z_t^W$	1422	-2661	-5631	-2921	-796	-4185	-10119	-9091	-3620	1231
$P_t X_t$	18284	23000	20628	29861	35078	55554	36683	32672	23102	16085
$P_t Y_t$	16861	25660	26259	32783	35874	59740	46801	41762	26722	14854
(10) Other conifers (Sonota no Shinyoju)										
Z_t^W	361480	359574	301350	228111	174877	140136	105864	73232	48844	37607
G_t	23874	23435	19738	15001	11324	9043	6979	4948	3463	2711
D_t^W	948	955	814	622	471	377	289	200	134	101
ΔZ_t^W	2960	-5700	-14309	-14392	-6891	-5196	-6757	-4918	-4031	-1524
X_t	22926	22480	18924	14380	10854	8667	6690	4748	3329	2610
Y_t	19966	28180	33233	28772	17745	13863	13447	9666	7360	4134
$P_t Z_t^W$	125106	157682	128983	155271	197781	208223	88374	107123	61930	37607
$P_t G_t$	8263	10277	8448	10211	12807	13437	5826	7238	4391	2711
$P_t D_t^W$	328	419	349	423	532	560	241	292	170	101
$P_t \Delta Z_t^W$	1025	-2499	-6125	-9797	-7794	-7721	-5641	-7194	-5112	-1524
$P_t X_t$	7935	9858	8100	9788	12275	12877	5585	6945	4220	2610
$P_t Y_t$	6910	12357	14224	19585	20069	20598	11226	14140	9332	4134
(11) Broadleaf trees (Koyoju)										
Z_t^W	2102443	2192713	2070137	1744172	1395564	1145833	895856	638631	487998	432409
G_t	91963	94995	89635	76678	61442	51171	41127	30424	23562	21109
D_t^W	5640	5942	5654	4836	3851	3181	2515	1802	1346	1182
ΔZ_t^W	36511	-2119	-32165	-76009	-48334	-52574	-60056	-49055	-16260	-7692
X_t	86323	89053	83981	71842	57591	47990	38612	28622	22217	19926
Y_t	49812	91172	116146	147851	105925	100564	98668	77678	38476	27619
$P_t Z_t^W$	525485	694415	639886	857389	1147132	1349754	1164507	906136	615071	432409
$P_t G_t$	22985	30084	27707	37693	50504	60278	53461	43168	29698	21109
$P_t D_t^W$	1410	1882	1748	2377	3165	3747	3269	2557	1696	1182
$P_t \Delta Z_t^W$	9126	-671	-9942	-37364	-39730	-61931	-78066	-69603	-20494	-7692
$P_t X_t$	21576	28202	25959	35316	47339	56531	50191	40611	28002	19926
$P_t Y_t$	12450	28874	35901	72680	87069	118461	128257	110215	48495	27619
(12) Yellowtails (Buri Yui)										
Z_t^W	0	2697	19405	70980	113552	161648	161274	170674	155470	167829
G_t	0	2402	21430	74855	126661	184821	186066	195844	186260	186713
D_t^W	0	237	3108	10480	18847	28648	28517	30644	29825	28022
ΔZ_t^W	0	2164	2872	19053	11214	-58	-467	-3399	-21605	15596
X_t	0	2164	18322	64374	107814	156172	157549	165201	156435	158692
Y_t	0	0	15450	45321	96600	156230	158016	168600	178040	143096
$P_t Z_t^W$	0	396	4574	31479	95610	139045	145606	129561	103673	167829
$P_t G_t$	0	352	5052	33197	106648	158977	167989	148667	124204	186713
$P_t D_t^W$	0	35	733	4648	15869	24642	25747	23262	19888	28022
$P_t \Delta Z_t^W$	0	318	677	8450	9442	-50	-422	-2581	-14407	15596
$P_t X_t$	0	318	4319	28549	90778	134334	142242	125405	104316	158692
$P_t Y_t$	0	0	3642	20099	81336	134384	142664	127986	118723	143096

Unit: million yen (Z_t^W, G_t, D_t^W, ΔZ_t^W, X_t, and Y_t are evaluated at 2000 constant prices)

Z_t^W is the end-of-period WiP inventory stock.

Table. 8 RIM Estimates (continued)

	1955	1960	1965	1970	1975	1980	1985	1990	1995	2000
(13) Breams (Madai)										
Z_t^W	0	0	0	976	6425	17178	31911	56055	70674	65025
G_t	0	0	0	907	6222	17214	32160	56721	72888	70571
D_t^W	0	0	0	112	840	2444	4592	8173	10739	10820
ΔZ_t^W	0	0	0	430	1795	2730	4515	6868	4105	-6333
X_t	0	0	0	795	5383	14770	27568	48548	62150	59751
Y_t	0	0	0	365	3588	12040	23053	41680	58045	66084
$P_tZ_t^W$	0	0	0	1690	12362	41088	67574	92947	91930	65025
P_tG_t	0	0	0	1571	11973	41171	68101	94051	94810	70571
$P_tD_t^W$	0	0	0	194	1615	5845	9725	13552	13968	10820
$P_t\Delta Z_t^W$	0	0	0	745	3453	6529	9560	11388	5340	-6333
P_tX_t	0	0	0	1377	10357	35326	58376	80499	80842	59751
P_tY_t	0	0	0	632	6904	28797	48816	69111	75502	66084
(14) Scallops (Hotate Gai)										
Z_t^W	0	0	0	894	5029	4587	10578	14304	19751	17962
G_t	0	0	0	1784	15358	10708	26816	42567	53563	49219
D_t^W	0	0	0	349	3019	2125	5330	8404	10646	9737
ΔZ_t^W	0	0	0	426	-179	1390	2168	-29	2359	1971
X_t	0	0	0	1436	12339	8583	21487	34163	42917	39482
Y_t	0	0	0	1010	12518	7193	19319	34192	40559	37511
$P_tZ_t^W$	0	0	0	436	5495	7388	16306	17186	18523	17962
P_tG_t	0	0	0	869	16781	17246	41338	51146	50234	49219
$P_tD_t^W$	0	0	0	170	3299	3423	8216	10097	9984	9737
$P_t\Delta Z_t^W$	0	0	0	207	-196	2239	3342	-35	2212	1971
P_tX_t	0	0	0	699	13483	13824	33123	41048	40250	39482
P_tY_t	0	0	0	492	13678	11585	29781	41083	38038	37511
(15) Oysters (Kaki Rui)										
Z_t^W	5931	8932	11358	9989	11564	12090	12909	12272	11409	11839
G_t	22151	37395	44366	39832	43238	52661	52165	51047	46877	46504
D_t^W	4245	7157	8510	7633	8308	10081	10002	9783	8989	8926
ΔZ_t^W	623	-411	541	204	1196	-1240	33	-455	-230	477
X_t	17906	30238	35856	32199	34930	42580	42164	41264	37889	37578
Y_t	17283	30649	35315	31994	33734	43820	42131	41719	38118	37101
$P_tZ_t^W$	348	736	1467	2429	6304	7460	9318	10231	12228	11839
P_tG_t	1301	3081	5731	9688	23572	32494	37654	42555	50243	46504
$P_tD_t^W$	249	590	1099	1856	4529	6220	7219	8155	9634	8926
$P_t\Delta Z_t^W$	37	-34	70	50	652	-765	24	-379	-246	477
P_tX_t	1051	2491	4631	7831	19043	26274	30435	34400	40609	37578
P_tY_t	1015	2525	4561	7782	18391	27039	30411	34779	40855	37101
(16) Pearls (shinju)										
Z_t^W	13650	41647	63807	25135	18817	25558	35838	36636	28903	18348
G_t	25760	66438	117936	75409	35321	48797	70286	76048	64725	34854
D_t^W	2889	7693	13372	8110	3988	5484	7894	8475	7200	3939
ΔZ_t^W	1443	11993	8138	-15491	2112	2405	2004	-608	-3837	1696
X_t	22871	58745	104564	67299	31332	43313	62392	67572	57525	30916
Y_t	21428	46752	96426	82790	29220	40908	60388	68180	61362	29220
$P_tZ_t^W$	2419	7828	18437	6406	13392	28778	34322	47565	32314	18348
P_tG_t	4565	12488	34078	19218	25138	54945	67312	98734	72363	34854
$P_tD_t^W$	512	1446	3864	2067	2839	6175	7560	11004	8050	3939
$P_t\Delta Z_t^W$	256	2254	2351	-3948	1503	2708	1919	-789	-4290	1696
P_tX_t	4053	11042	30214	17151	22299	48770	59752	87730	64313	30916
P_tY_t	3797	8788	27862	21099	20796	46062	57833	88519	68603	29220

Unit: million yen (Z_t^W, G_t, D_t^W, ΔZ_t^W, X_t, and Y_t are evaluated at 2000 constant prices)
Z_t^W is the end-of-period WiP inventory stock.

Table. 8 RIM Estimates (continued)

	1955	1960	1965	1970	1975	1980	1985	1990	1995	2000
(17) Laver (Itanori)										
Z_t^W	4076	9137	7969	15175	18037	21084	24963	25057	23107	23145
G_t	16885	31333	38876	66083	79200	99657	102411	110214	112483	109189
D_t^W	705	1311	1622	2759	3307	4159	4279	4602	4693	4556
ΔZ_t^W	467	2897	-751	824	794	-1081	3143	1049	-2111	-1127
X_t	16181	30022	37254	63324	75893	95497	98132	105613	107790	104634
Y_t	15714	27125	38006	62499	75099	96578	94989	104563	109901	105761
$P_tZ_t^W$	3312	6722	7407	17384	16969	30217	31712	24127	20647	23145
P_tG_t	13721	23053	36130	75704	74510	142827	130101	106123	100507	109189
$P_tD_t^W$	573	964	1507	3161	3111	5961	5436	4431	4193	4556
$P_t\Delta Z_t^W$	379	2131	-698	944	747	-1549	3993	1010	-1886	-1127
P_tX_t	13148	22088	34623	72543	71399	136865	124665	101692	96314	104634
P_tY_t	12769	19957	35322	71599	70652	138414	120672	100682	98200	105761

Unit: million yen (Z_t^W, G_t, D_t^W, ΔZ_t^W, X_t, and Y_t are evaluated at 2000 constant prices)
Z_t^W is the end-of-period WiP inventory stock.

Appendix A Current Production Account

Table 9 shows the comparison of the original 1990 Benchmark IO Table ("IO" in the Table 9) and the 1990-1995-2000 Linked IO Table ("LIO"). Here, we compare figures for WiP inventory change and gross domestic output (DO) for six commodities and value added (VA), operating surplus (OS), and intermediate inputs (II) for the sectors producing these commodities. In the case of 0116021.Seeds and seedlings, the WiP inventory change in 1990 is zero in the original IO table and it is revised to 47 in the LIO table. The output also increases by 47 (the increase of intermediate inputs, which is 661, minus the decrease of value added, which is 614). As shown in the last row, the revised value of total WiP inventories in CAWiP is 361.5 billion yen for 1990 and 603.1 billion yen for 1995.

All the estimates of WiP inventory changes are positive in the LIO, as shown in Table 9. In the current estimates of WiP inventory changes in CAWiP, only the estimated value of natural growth in CAWiP may be described as an increase in WiP inventories. The methods describing WiP inventories in CAWiP are classified into two groups labeled rev-I and rev-T, as shown in the right column of Table 9.[*25] In the rev-I, gross domestic output is increased due to the increase in WiP inventories in CAWiP. In the rev-T, the increase in WiP inventories is caused by the transfer from finished-products inventories, so gross domestic output is unchanged. The method of rev-T is applied only for 0121051.Beef cattle. Basically, the current production account applies the rev-I to revise WiP inventories in CAWiP.

Since some of six commodity categories may include both CAWiP and some non-CAWiP assets at a more detailed commodity classification level and since other revisions may have been implemented in the LIO, it is not evident how the cost structures are to be revised. In the case of the rev-I, however, the balancing cost factor may be operating surplus. In 0211101.Silviculture and 0311041.Marine culture, the increases in operating surpluses offset 95.8% and 91.5% of the increases in the WiP inventories,

[*25] Only for 0211101.Silviculture (Ikurin), the estimate for WiP inventory change in 1995 is also revised in the Linked IO Table.

Table. 9 Revised WiP inventories on CAWiP in Benchmark Input-Output Table

			WiP	DO	VA	(OS)	II	revise
0116021	1990	LIO	47	166154	103549	59926	62605	
Seeds and seedlings		IO	0	166107	104163	60991	61944	
(Shubyo)		dif.	47	47	-614	-1065	661	rev-I
	1995	LIO	163	118744	68766	38890	49978	
	2000	LIO	812	106715	52617	22867	54098	
0116031	1990	LIO	3086	534322	362379	278558	171943	
Flowers and plants		IO	0	531236	361994	278760	169242	
(Kaki Kaboku Rui)		dif.	3086	3086	385	-202	2701	rev-I
	1995	LIO	2877	559911	364089	228565	195822	
	2000	LIO	-4271	547440	351486	148922	195954	
0121051	1990	LIO	46536	915109	223997	133704	691112	
Beef cattle		IO	0	915109	227743	137123	687366	
(Nikuyou Gyu)		dif.	46536	0	-3746	-3419	3746	rev-T
	1995	LIO	5969	701208	106932	76913	594276	
	2000	LIO	6205	648675	60145	29882	588530	
0121099	1990	LIO	39716	221521	136010	99202	85511	
Other livestock		IO	0	104154	61134	39985	43020	
(Sonota no Chikusan)		dif.	39716	117367	74876	59217	42491	rev-I'
	1995	LIO	27776	126450	71177	54471	55273	
	2000	LIO	32358	113440	60384	48946	53056	
0211101	1990	LIO	248187	733382	628416	311114	104966	
Silviculture		IO	57704	542899	444861	128713	98038	
(Ikurin)		dif.	190483	190483	183555	182401	6928	rev-I
	1995	LIO	535032	841184	716480	362493	124704	
		IO	336107	642259	517555	163568	124704	
		dif.	198925	198925	198925	198925	0	rev-I
	2000	LIO	679017	849760	787157	614543	62603	
0311041	1990	LIO	23913	632924	309093	173028	323831	
Marine culture		IO	0	609011	286452	151146	322559	
(Kaimen Youshoku Gyo)		dif.	23913	23913	22641	21882	1272	rev-I
	1995	LIO	31260	605201	285581	122461	319620	
	2000	LIO	36998	564228	277348	131597	286880	
Sum	1990	LIO	361485	3203412	1763444	1055532	1439968	
		IO	57704	2868516	1486347	796718	1382169	
		dif.	303781	334896	277097	258814	57799	
	1995	LIO	603077	2952698	1613025	883793	1339673	
		IO	404152	2732596	1407756	673354	1324840	
		dif.	198925	220102	205269	210439	14833	
	2000	LIO	751119	2830258	1589137	996757	1241121	

Unit: million yen. LIO=1990-1995-2000 Linked IO Table, IO=1990 or 1995 Benchmark IO Tables.
WiP: WiP inventories, DO: gross domestic output, VA: value added, OS: operating surplus, II: intermediate inputs.
rev-I: gross domestic output increases, only due to the increase of revised WiP inventories
rev-I': gross domestic output increases, due to the increases of revised WiP inventories and others
rev-T: transference from finished-goods inventories to WiP inventories

respectively. Thus, as a basic strategy for defining WiP inventory in CAWiP for Japan's production accounts, the increase in WiP inventory is viewed as reflecting the increases in output and operating surplus to be sustained in the input-output balance.