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The Seasonal Fluctuation of the Forest Products Price (I)

—Calculation of Seasonal Index of Timber Price—

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Introduction

The price movement contains several types of fluctuation. In time-series-analysis, the original series is traditionally divided into 4 factors, that is, the trend factor, the cyclical factor, the seasonal factor and the irregular factor. The seasonal adjustment is important for a short-term forecast. In general, most of the economic indicators are announced after seasonal adjustment fixed preliminarily. In the days of rapid growth, the trend is the most important factor. Since 1973, the other three factors have been more important. This paper discusses the seasonal fluctuations of timber price mainly after 1973.

In the next paper, we are going to calculate the seasonality of the quantitative indexes related to the timber price. As a result, we shall be able to discuss the causes of structural changes of seasonality on timber price.

Data and Methods

Table 1 lists the variables used in this paper. Several characteristics of seasonality of timber price will be clarified in the next chapter. Before going into the details of the explanation on time-series-analysis, we define some valuables used in this analysis. O, T, C, S and I mean original series, trend factor, cyclical factor, seasonal factor and irregular factor, respectively. The original series is usually divided into the above 4 factors. The seasonal factor is often called seasonal index. These 4 components are often combined in a multiplicative fashion, that is, $O=T\times C\times S\times I$. In this paper the original series is often expressed as TCSI.

It is difficult to make a clear distinction between the trend factor and the cyclical factor. Several methods including the linear regression line method, have been developed till now for the mechanical definition of the trend factor. However, it is difficult to determine what type of trend function is most fitted to the data and on the research objects. As this paper discusses only the seasonal factor, it is not important how to divide the trend factor and the cyclical factor. We are going to deal with these two factors together, calling them trend-cyclical factor, expressed as TC. Therefore, the above fashion changed as follows: $O=TC\times S\times I$.

There are some methods universally used in econometrics to divide the original series into these 3 factors[5]. We can separate such methods into two types. The first type is the fixed type seasonal index. As the calculation method is simple, it is used also in the field of forestry[1,6,8,13]. However, as this seasonal index is fixed throughout the researching periods, it is applicable for the short-run economic analysis in general. This is because the seasonal fluctuations have a tendency to transform the pattern according to the structural changes of economic environment. As will be

Table 1. The list of price statistics used in this paper

Statistics name	Contents		Variable number	Period of analysis
Wholesale price index*1	All commodities*4		P11	1952–1990
	Wood, lumber and related products*4		P12	1952–1990
	Construction materials*5		P13	1973–1990
Import price index*2	Wood, lumber and related products*4		P14	1967–1990
Survey of log and lumber price*3	Log	Japanese cedar*6	P21	1973–1990
		Japanese cypress*6	P22	1973–1990
		U.S.A. Hemlock*7	P23	1973–1990
		South sea timber (Lauan)*8	P24	1973–1990
		U.S.S.R. Yezo Spruce*9	P25	1973–1990
	Lumber	Japanese cedar, squares*10	P31	1973–1990
		Japanese cypress, squares*10	P32	1973–1990
		U.S.A. Hemlock, squares*10	P33	1973–1990
		U.S.S.R. Yezo Spruce, strips*11	P34	1973–1990

*1 1934–1936 average=100
*2 1985 average=100, Yen basis
*3 Unit: Yen per m^3
*4 Indexes for groups
*5 Indexes for use
*6 Diameter 14–22 cm, length 3.65–4 m; mixed
*7 Diameter 30 cm and over, length 6 m and over; grade No. 3
*8 Diameter 60 cm and over, length 4 m and over; for plywood
*9 Diameter 20–28 cm, length 3.8 m and over; mixed
*10 Thickness 10.5 cm, width 10.5 cm, length 3 m; grade No. 1
*11 Thickness 1.3–1.5 cm, width 15 cm, length 3.65–4 m; grade No. 1

explained later in more detail, the seasonal fluctuation of lumber price is not fixed throughout the researching periods[7,11,12]. So, we have to deal the seasonal index as a sort of changeable variable. This type of seasonal index belongs to the next classification. One of these types of seasonal adjustment methods is Census-Method, started by the United States, Department of Commerce in 1961. The recent versions of Census-Method are adapted for the seasonal adjustment method of many important economic indicators. In this paper, we use EPA Method, studied by the Economic Planning Agency in Japan in 1963. EPA Method has some versions, we use the EPA Method X-4C. The details of flow chart of the calculation are shown by the Economic Planning Agency[4].

Results

1. Preice index

(1) Wood, lumber and related products price

To explain the long-run price movement, we use Prewar Base Overall Wholesale Price Index[2,3]. This index has been estimated by Research and Statistics Department, the Bank of Japan. It is calculated as 1934–36 average equal 1. As this index is long-run indicator, the contents of the survey have been changed several times. As this paper discusses only the seasonality, this weak point may be put out of consideration. The price index means nominal-term in this paper.

By the way, the seasonal factor of price index is often underestimated, because several types of seasonal fluctuation are canceled each other. This is the weak point of this index for our research objects.

Under consideration of this limitation, the result of the seasonal index is shown in Fig. 1. There are numbers from 1 to 12 in Fig. 1, these mean the number of the month at peaks or bottoms of the seasonal index (1 means January, 2 means February, etc.). However, when the index at peak or bottom is within 99–101, the number of month is not shown. This rule has been adopted to all the results. We can divide the patterns of seasonal index into the following 4 periods.

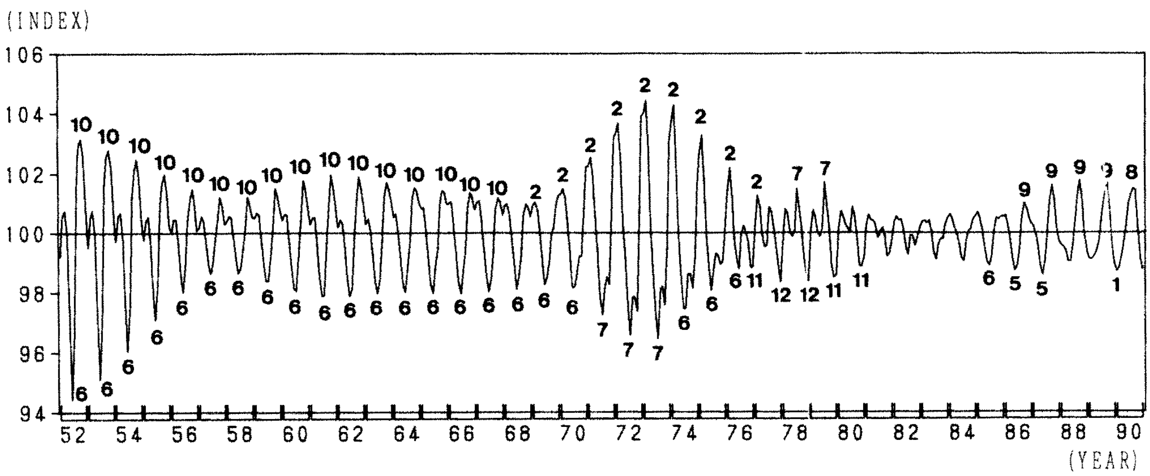

Fig. 1. Seasonal index of wood, lumber and related products price (P12).

The first period is from 1952 to 1968. In this period, the seasonal pattern is constant. The bottom months are 'June', the peak months being 'October'. This pattern is traditionally explained as the seasonal changes of timber price in Japan[1,6,13]. As June is a rainy season, they say that the housing construction is not so active. On the other hand, October and its near months are the best season for constructions. However, this typical pattern is not seen after the end of 1960's. At the mid 1950's, the amplitude is almost 4%, and since the late 1950's, it has become almost half of it, that is, 2%.

The second period is from 1969 to 1976. In this period, the bottom months are 'June' or 'July', almost the same months as in the previous period. The peak months are 'February'. This period contains the end of the high economic growth, the oil crisis and the turning point to low economic growth.

The third period is from 1977 to 1985. This period shows only the weak seasonal fluctuation. In the first half of this period (1977–1980), the peak months are 'July', and the bottom months are 'November' or 'December'. This pattern is an exceptional one both for peak and bottom. In 1979 and 1980, the timber price showed rapid rising. The second period and the first half of the first period contain the periods when the price was appreciated. In such cases, the irregular factor may influence the seasonal fluctuations[9]. Since 1983, the pattern has been similar to that of the fourth period.

The fourth period is from 1985 to 1990. The peak months are'September' or its near months. On the other hand, the bottom months are not constant. At the beginning of this period, they are

'May' or its near months. This pattern resembles the traditional one observed in the first period.

Since 1970's, the pattern of seasonal fluctuation is different from the traditional one that has been stable after the second world war. Not only the peak and the bottom months of seasonal index change, but the amplitudes are not stable.

(2) Construction materials price

The most important demand field of timber is construction activities. We compared the seasonal index of timber price with that of the construction materials price[7]. The results are shown in Fig. 2. The patterns of the peak and the bottom month of both the series are almost simultaneous ones. As a result, the changes of seasonal fluctuation are assumed to be caused by the construction movements. The amplitude of seasonality of the timber price is almost double compared with that of the construction materials price.

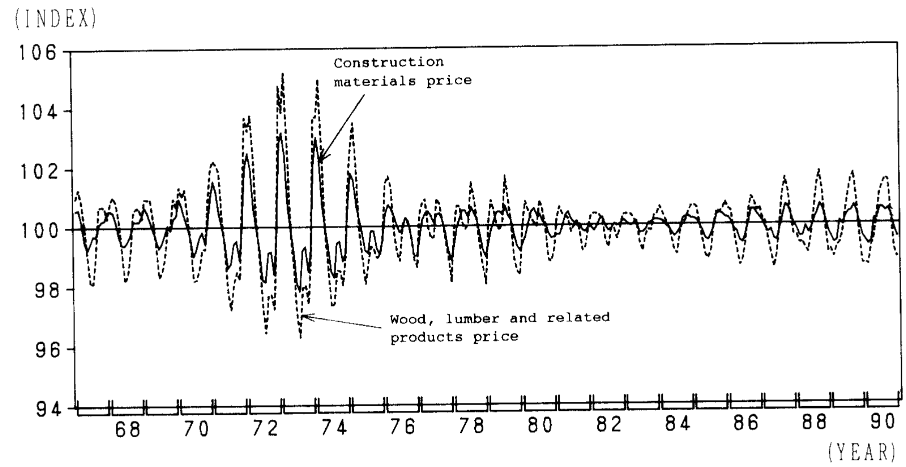

Fig. 2. Seasonal index of construction materials price (P13).

2. Survey of log and lumber price

The survey of log and lumber price is the only statistics covering all the prefectures assorted by species by commodities. This is estimated by Statistics and Information Department, Economic Affairs Bureau, Ministry of Agriculture, Forestry and Fisheries[10]. All the scales of vertical direction of figures in this paper are adjusted appropriately. It is necessary to pay attention in comparing the amplitude on the fact that the scales of all figures are different each other.

The summary of statistical analysis[4] of EPA method is shown in Table 2. The average percentage of changes of all price indicators is small. As these data were made by averaging all prefectures, the different types of seasonal fluctuation were canceled each other. As the researching periods of price index are different from those of the price survey, we can not compare all these statistical results directly. Average percentage of changes of TCSI of log is 1% line except Lauan, and that of the lumber is 2% line except U.S.S.R. Yezo Spruce. In general, as to the average percentage of TCSI, variables on lumber are bigger than those on log. This result is adopted also for S. The figures of S/TCSI are 0.5 or 0.6 except Lauan log. As the original data contain less irregular factor, I/Tc is less than 1 except Japanese cypress squares.

Next, we are going to show the details of seasonal fluctuation by log and lumber, by species.

(1) Log

First, we show the seasonality of the domestic log. The seasonal index of Japanese cedar log price (P21) is shown in Fig. 3. During the period 1973–1978, the peak months are 'August', and

Table 2. Summary of statistical analysis*1

		P11	P12	P13	P14	P21	P22	P23	P24	P25	P31	P32	P33	P34
Ave. percentage change*2	TCSI	0.5	1.3	0.6	2.4	1.4	1.6	1.8	3.1	1.8	2.0	2.7	2.3	1.8
	TCI	0.5	1.2	0.6	2.2	1.2	1.4	1.5	2.8	1.5	1.7	2.4	1.9	1.5
	I	0.2	0.6	0.3	1.3	0.7	0.9	0.8	1.0	0.7	1.1	1.6	1.2	0.9
	TC	0.4	0.9	0.5	1.6	0.8	0.9	1.2	2.5	1.3	1.2	1.4	1.3	1.1
	S	0.2	0.7	0.3	0.8	0.7	0.8	0.9	1.0	0.9	1.0	1.6	1.2	1.0
Related measures*3	I/TC*4	0.5	0.7	0.5	0.8	0.8	1.0	0.7	0.4	0.6	0.9	1.1	0.9	0.8
	I/S	1.0	0.9	0.8	1.6	1.0	1.0	0.9	1.0	0.8	1.1	1.0	1.0	0.9
	S/TC	0.5	0.8	0.6	0.5	0.8	0.9	0.8	0.4	0.7	0.9	1.2	0.9	0.9
	I/TCSI	0.4	0.5	0.4	0.6	0.5	0.6	0.5	0.3	0.4	0.6	0.6	0.5	0.5
	TC/TCSI	0.8	0.7	0.8	0.7	0.6	0.6	0.7	0.8	0.7	0.6	0.5	0.6	0.6
	S/TCSI	0.4	0.5	0.5	0.4	0.5	0.5	0.5	0.3	0.5	0.5	0.6	0.5	0.6
Ave. duration of run*5	TCI	3.6	3.6	4.4	3.3	4.2	4.1	4.6	6.0	5.8	3.3	3.7	4.2	3.4
	TC	12.3	12.0	11.4	9.9	9.8	8.3	10.3	12.0	10.8	6.8	7.2	8.3	9.0
	I	2.0	2.1	2.4	2.0	2.3	2.5	2.2	2.7	2.3	2.4	2.5	2.5	2.2

*1 The period of analysis of all variables is listed in Table 1.

*2 In case of TCSI, the month-to-month per cent change is defined as follows:

$d_i = ((TCSI)_i - (TCSI)_{i-1})/(TCSI)_{i-1} \times 100$

i: period (i=1...n), n: the number of the data period

Average of d: $(\sum_{i=2}^{n} |d_i|)/(n-1)$

By comparing the mean of TCSI and that of TCI, we can judge the effectiveness of seasonal adjustment. If the latter is bigger than the former, this series is not well adjusted by EPA method. Though only the seasonal factor is discussed in this paper, irregular factor is also important from the view point of short-term fluctuation. The mean of the month-to-month per cent change of I is a useful index to know the degree of the irregular factor.

*3 As indexes have another scales or units each other, relativized index is required.

*4 The figures of I/TC are less than 1 except variable P32. MCD span is zero except variable P32 (1 month).

*5 This index means how many months the same direction change in the series continues on the average.

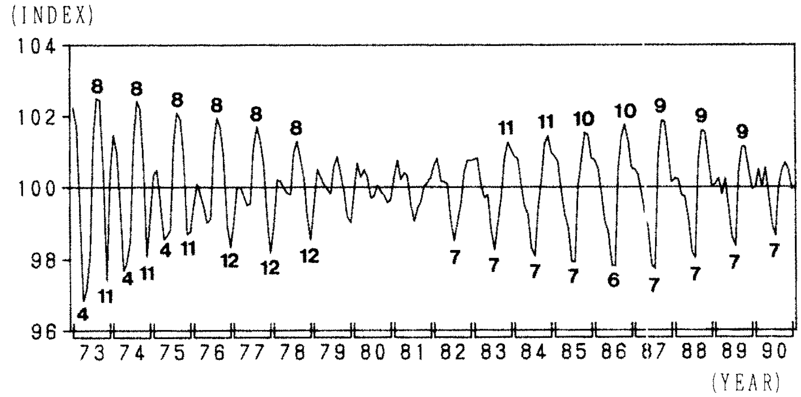

Fig. 3. Seasonal index of Japanese cedar log price (P21).

the bottom months are 'April' and 'November' or 'December'. However, since 1983, the peak months has been 'September', 'October' and 'November', the bottom moths being 'June' and 'July'. The patterns of the peak and the bottom have become almost reversed. What is the

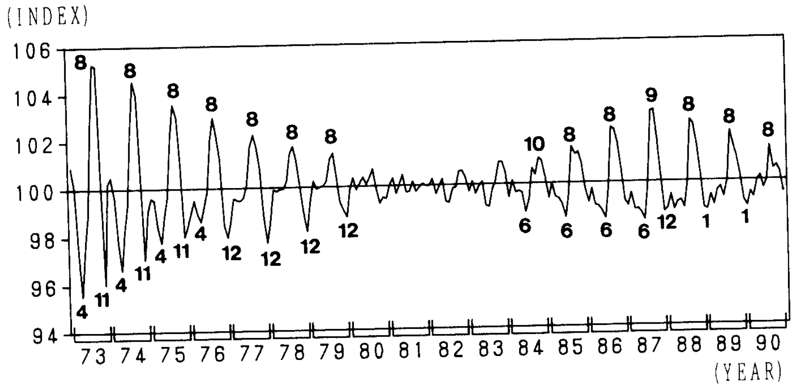

Fig. 4. Seasonal index of Japanese cypress log price (P22).

reason? The amplitude of seasonal index was almost within 2% except 1973. During the period 1979–1982, it showed within 1%. In this period, the price showed a rapid rise and down.

The result of Japanese cypress log price (P22) is shown in Fig. 4. During the period 1973–1979, the peak months are 'August', and the bottom months are 'April' and 'November' or 'December'. This pattern is almost the same as the one at the Japanese cedar log price shown in Fig. 3. Since 1984, the peak months have been 'August' and 'September'. The bottom months have been 'June' in the first half, and have been 'January' and its near months in the second half. This pattern is almost the same as the one at the Japanese cedar log price. In general, the amplitude of seasonal index is bigger than that of Japanese cedar log price. During the period 1979–1982, the amplitude has been within 1%. At this period, the price showed a rapid rise and down. This movement is also the same as that in the case of Japanese cedar.

Next, we are going to show the result of the foreign log. The seasonal index of log price of Hemlock (P23), Lauan (P24) and Yezo Spruce (P25) are shown in Fig. 5, Fig. 6 and Fig. 7, respectively. These figures have several common characteristics. The patterns of the peak and the bottom are divided into four periods. During the period 1973–1976, the peak months are 'February' or 'March'. The bottom months are months from 'June' to 'November'. During the period 1977–1981, the peak months are those from 'June' to 'September', and the bottom months are months from 'October' to 'December'. During the period 1982–1985, the seasonal pattern of Hemlock and Lauan is not so clear. However, Yezo Spruce has a seasonality clearly, that is, the peak months are 'February', and the bottom months are 'September' or 'November'. Since 1986, the peak months are almost the months from 'September' to 'November'. The bottom months are almost 'June' or 'July' in the first half, and are 'March' in the second half.

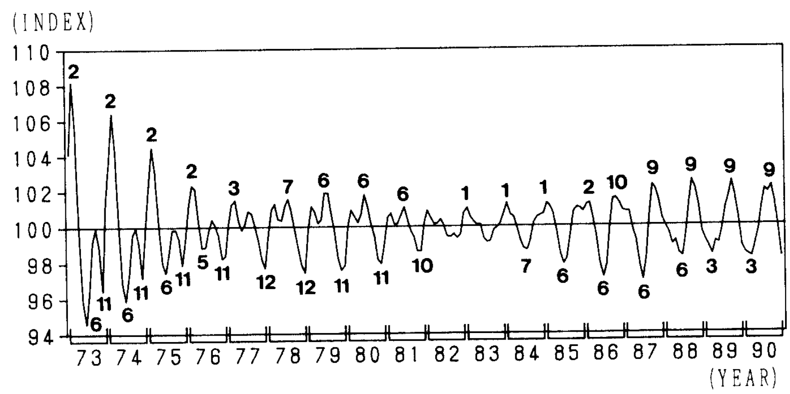

Fig. 5. Seasonal index of U.S.A. Hemlock log price (P23).

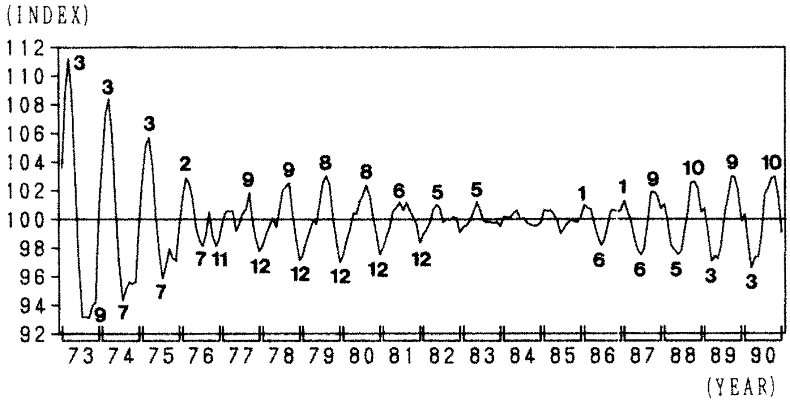

Fig. 6. Seasonal index of Lauan log price (P24)

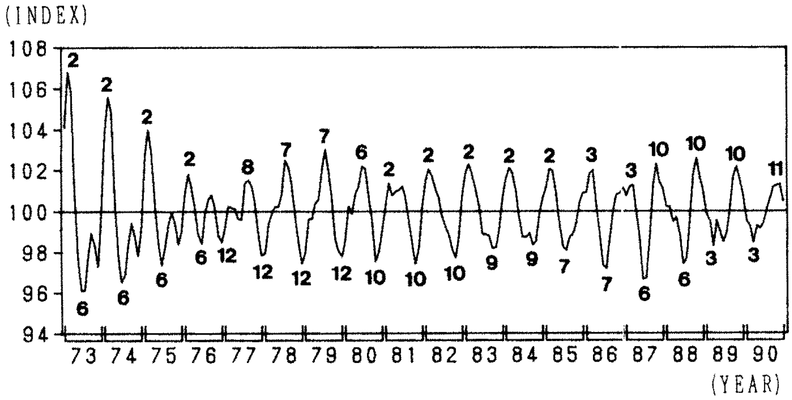

Fig. 7. Seasonal index of U.S.S.R. Yezo Spruce log price (P25).

As to the change of amplitude, the pattern of Hemlock is similar to that of Lauan. In case of Yezo Spruce, the amplitude is almost constant during the researching periods.

(2) Lumber

First, the seasonality of the lumber made of domestic log is shown. The seasonal index of Japanese cedar squares (P31) is shown in Fig. 8. During the period 1973–1980, the peak months have been almost 'August' and 'September'. The bottom months have been 'April' in the first half, and 'December' in the second half. Since 1985, the peak months have been 'August' or 'September' which is alike to the period before 1980. The bottom months have been almost 'July' in the first half, and been 'December' in the second half. The peak months have been 'August' or

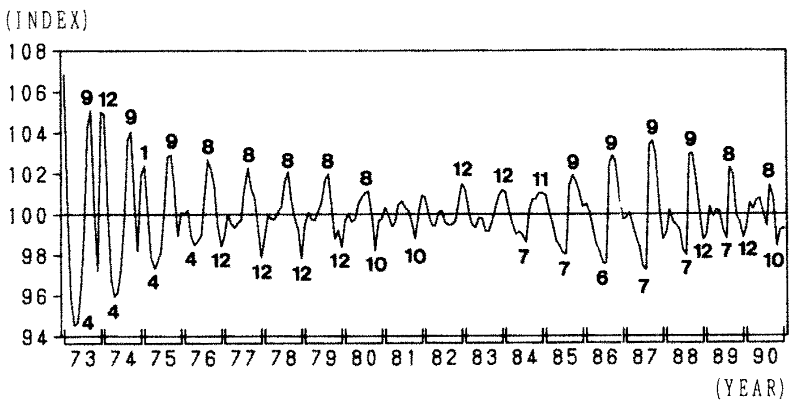

Fig. 8. Seasonal index of Japanese cedar squares price (P31).

'September', and have been almost fixed through the whole researching periods. On the other hand, the bottom months have been changeable.

The seasonal index of Japanese cypress squares price (P32) is shown in Fig. 9. the result is almost the same as that in Fig. 8. The different points are in the bottom months noted since 1980. The amplitude of Japanese cypress squares price is bigger than that of Japanese cedar one.

Next, the results on lumber made of foreign log are as follows: In case of U.S.A. Hemlock squares (P33), the result is shown in Fig. 10. The peak months have been 'January' or 'February' (1973–1984), and 'September' or 'October' (1985–1990). Next, the bottom months have been 'October' or 'November' (1973–1981), and 'June' or 'July' (1982–1988). As listed in Table 1, the standard and the grade of variable P31, variable P32 and variable P33 are common. In spite of

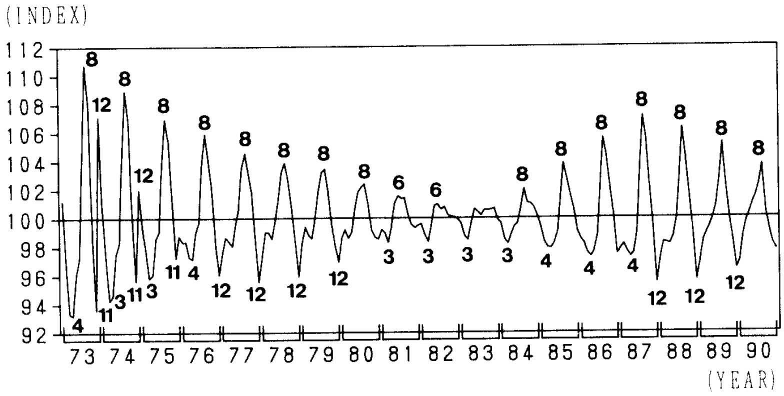

Fig. 9. Seasonal index of Japanese cypress squares price (P32).

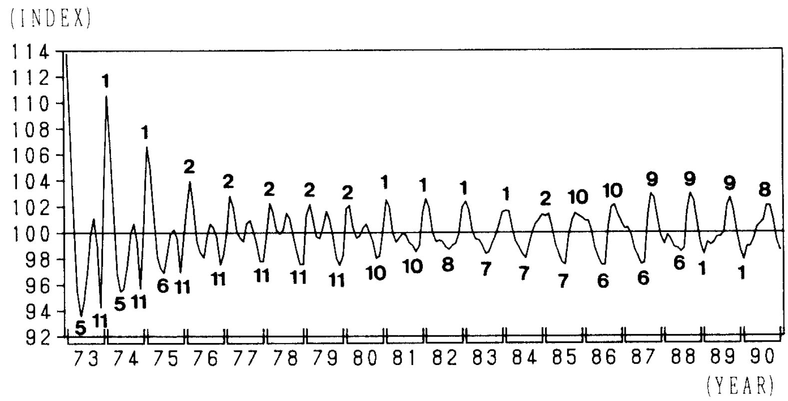

Fig. 10. Seasonal index of U.S.A. Hemlock squares price (P33).

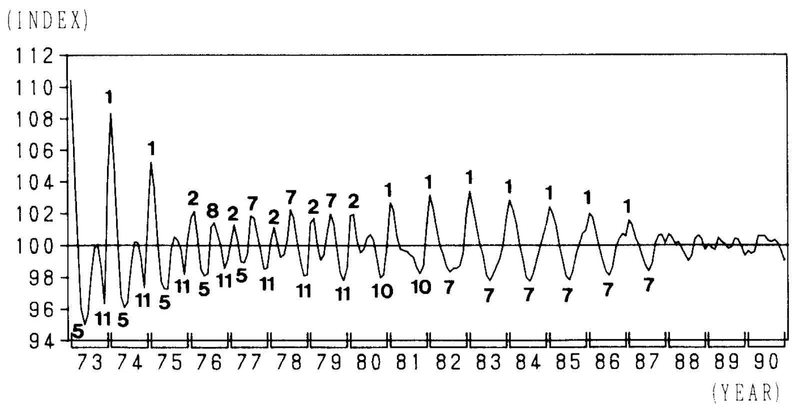

Fig. 11. Seasonal index of U.S.S.R. Yezo Spruce strips price (P34).

the same standard, the pattern of Fig. 10 is quite different from that of Fig. 8 or Fig. 9. Especially, the peak months are different. The amplitude since 1976 has been almost of the same degree, and has not been decreasing during the period 1981–1983 similarly to the lumber made of domestic log.

The seasonal index of Yezo Spruce strips (P34) is shown in Fig. 11. The peak months have been 'January' or 'February' (1973–1987), and 'July' or 'August' (1976–1979). The bottom months have been 'October' or 'November' (1976–1981), 'May' (1973–1977) and 'July' (1982–1987). Since 1988, the amplitude has been less than 1%. This is partially alike to the one in Fig. 10, but the recent movement is quite different from all the other seasonal indexes discussed till now.

Discussion

To know characteristics of seasonal pattern, we tried typing seasonal indexes of price variables. The variables used in this typing are those with variable number P13 and P21–P34 listed in Table 1. As the construction materials price is involved among the variables on timber price, we can know which indexes are most closely related to the indicator. As discussed in Fig. 2, the seasonal index of P12 has had almost the same pattern as that of P13.

In using cluster analysis, it is a important technical problem to ascertain what type of measures of similarity should be adopted. We used the square Euclidean distance. Next, what type of method has been adopted in calculating the similarity also affects the result considerably. The furthest neighbor method was adopted. Trial was made on another method, with almost the same result obtained. As discussed above, the seasonal fluctuation pattern has not been constant through the whole researching periods. Judging from the results of seasonality of price survey (Fig. 3–Fig. 11), we can divide the researching periods into halves for convenience. The results are shown as dendrogram in Fig. 12.

During the first half, all the seasonal indexes of price series under consideration are classified into two categories broadly. Three combinations that is, 1) Japanese cedar log price and Japanese cypress log price, 2) U.S.A. Hemlock log price and U.S.S.R. Yezo Spruce log price, 3) U.S.A. Hemlock squares price and U.S.S.R. Yezo Spruce strips price, are judged as most closely set groups. The first category contains variable number P21, P22, P31 and P32, that is, the variables related to the domestic timber. Within these four variables, Japanese cypress squares price (P32) has a singularity. The second category contains the seasonal index of foreign timber. Lauan log price has a singularity within this category. The construction materials price is similar to that of foreign log. Consequently, the similarity is to be determined by the question whether the variable is domestic or foreign or the question whether the variable is log or lumber.

Into the second half, the structure in the first half changes considerably. First, whether the variable is domestic indicator or foreign one is not so important to type the seasonal index. Japanese cypress squares price has a singularity in the first half among the domestic indexes, and the singularity comes to be applied more clearly to the second half. U.S.S.R. Yezo Spruce log price and strips price have also a singularity next to Japanese cypress squares price. Lauan log price is the next. The other 6 variables are judged as a sort of close combination from the view point of seasonality.

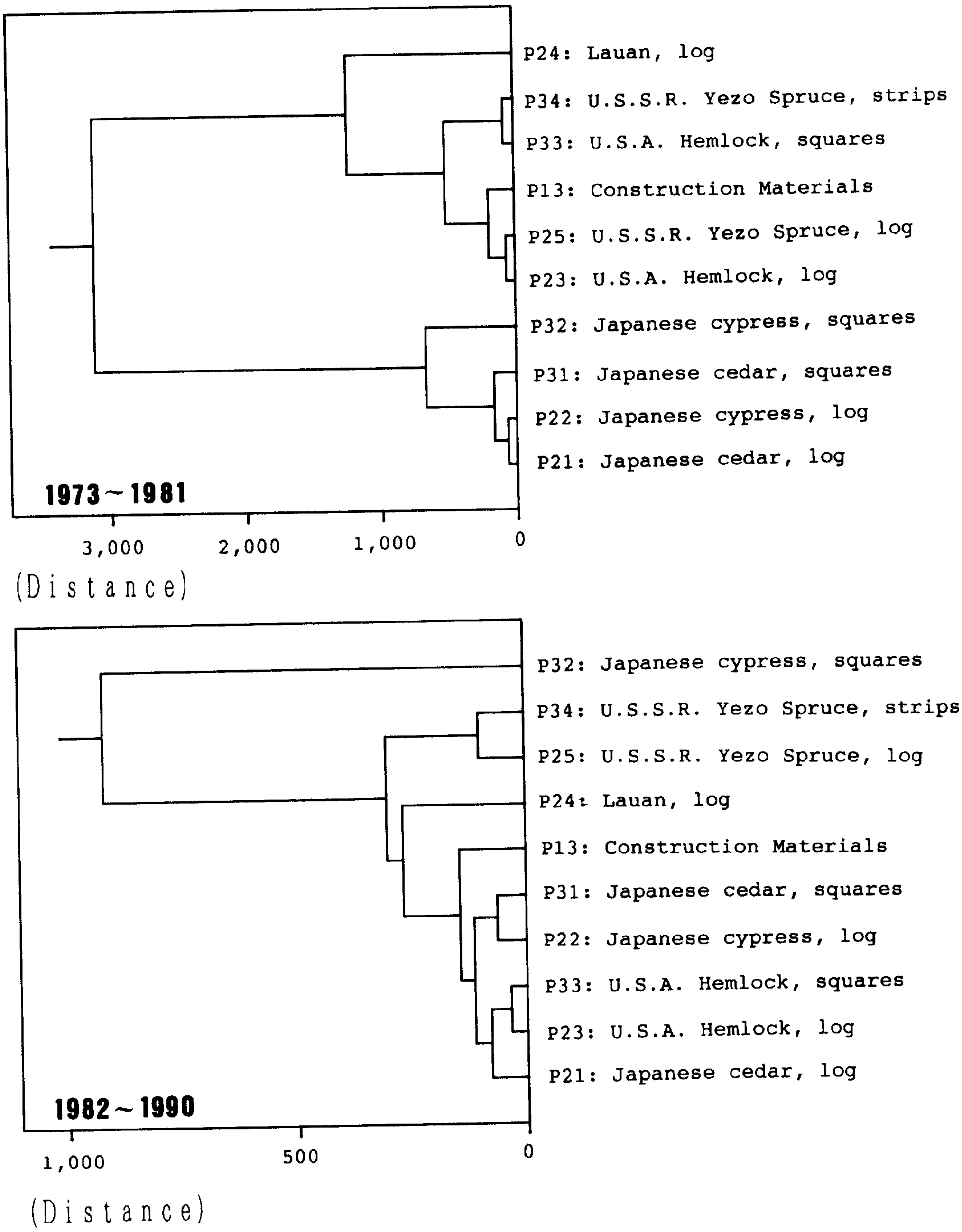

Fig. 12. Dendrogram of seasonal index of price variables.

Summary

Using time-series-analysis, calculations of the seasonality of the timber price movement were made. The results are as follows:

(1) The pattern of the seasonal fluctuation of wood, lumber and related products price has approximately been constant till late 1960's. The peak months are 'October', and the bottom months are 'June'. However, since around 1970, this fixed pattern have been changing. (Fig. 1).

(2) The peak and the bottom of the seasonal index on wood, lumber and related products price consisted well with that of construction materials price. The amplitude of the former is bigger than that of the latter. (Fig. 2)

(3) The pattern of the seasonal fluctuation of the different species is not always equal. The amplitude is not consistent throughout the researching periods. The amplitude of most of the price variables have a tendency to be decrease in early 1980's. (Fig. 3–Fig. 11)
(4) Although individual seasonality is different in details mutually, but a classification is possible using cluster analysis. This classification is not stable. Japanese cypress price and Lauan price have a tendency to show an unique seasonal fluctuation. (Fig. 12, 13)

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