A Comparison of Two Alternative Composite Leading Indicators for Detecting Japanese Business Turning Points

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Keywords: *Composite leading indicator, Japanese business turning points*

EXTENDED ABSTRACT

The Organisation for Economic Co-operation and Development (OECD) has developed a system of composite leading indicators (CLIs) for its member countries in the early 1980s. On the other hand, the Japanese government has released another CLI for detecting the Japanese business turning points. Both CLIs are widely used alternatives.

The OECD's CLI is composed of 8 component series, whereas the Japanese CLI is based on 12 component series. In addition, the component series of the indexes are different. Consequently, these two CLIs may provide different business forecasts. When different forecasts occur, how can we interpret the discrepancies? This paper tries to answer this question by clarifying their relationships.

More precisely, we identify the turning points of the two CLIs, and we try to find whether evident relationships exist. For identifying the turning points of them, we take two approaches. One is to use the frequency selective filter of Iacobucci and Noullez (2005). The other approach is to use the Bry and Boschan (1971) methodology. We additionally examine the properties of the two indexes for detecting the Japanese business turning points. We also evaluate the degree of comovements of the two cycles by the methods proposed by Harding and Pagan (2002, 2006).

Our empirical findings, based on the data from April 1973 to January 2007, are:

1. The locations of the turning points of the two indexes are almost the same (even though their component series are different).
2. With a few exceptions, the OECD's index provides earlier signals for the next turning point than does the Japanese government's index. The averages of the differences are 0.5 and 1.6 months, depending on filtering methods.
3. The empirical results concerning the degree of synchronization indicate that the OECD's index provides about one month earlier signals for the next turning point than does the Japanese government's index.
4. The average leading months of the two indexes are roughly the same, about one and one half years.

Finally, two remarks are in order. First, in this paper, we did not investigate what produces the discrepancies of the properties of the two alternative CLIs. As stated earlier, the component series for the two CLIs are different. Further investigations are necessary to identify which components play an important role in producing them. Secondly, Harding and Pagan (2006) proposed the testing procedure of synchronization. It is of interest to statistically test whether or not the OECD's index provides about one month earlier signals for the next turning point than does the Japanese government's index.

1 INTRODUCTION

Forecasting the business climate is important for not only decision making by individuals and private firms but also policy making by the government and the central bank. To meet such needs, the Organisation for Economic Co-operation and Development (OECD) has developed a system of composite leading indicators (CLIs) for its member countries in the early 1980s. The OECD has started to release CLIs for the major six OECD nonmember economies such as China and Brazil [see OECD (2006)].

On the other hand, the Japanese government has been releasing another CLI (we refer to it as the index J hereafter) for detecting the Japanese business turning points. Both CLIs are widely used alternatives, but they are quite different. As shown in Tables 1 and 2, the OECD's CLI (we refer to it as the index O hereafter) is composed of 8 component series, whereas the Japanese CLI is based on 12 component series. In addition, the component series of the indexes are different. For example, "the ratio imports to exports" is included in the index O, but not included in the index J. Consequently, these two CLIs, the indexes O and J, may provide different business forecasting. When different forecasts occur, how can we interpret the discrepancies? This paper tries to answer this question by clarifying their relationships.

More precisely, we identify the turning points of the two CLIs, and we try to find whether evident relationships exist. For identifying the turning points of the CLIs, we take two approaches. One is to use the frequency selective filter of Iacobucci and Noullez (2005). The other approach is to use the methodology of Bry and Boschan (1971). We additionally examine the properties of the two indexes for detecting the Japanese business turning points. (Table 3 tabulates the business turning points identified by the Japanese government.) We also evaluate the degree of comovements of the two cycles by the methods proposed by Harding and Pagan (2002, 2006).

This paper is organized as follows. In Section 2, we explain the data. In Sections 3 and 4, we identify the locations of the turning points of the two CLIs. In Section 5, we report the results concerning the degree of synchronization. Section 6 concludes the paper.

2 DATA

The OECD considers that the annualized six-month rate of changes of the OECD's CLI (we refer to it as the index O^* hereafter) is useful for detecting the possible business turning points. Following their idea, we compare the alternative CLIs in the form of the annualized six-month rate of change. Since the annualized six-month rate of changes of the Japanese CLI (we refer to it as the index J^* hereafter) is not released by the Japanese government, we calculate them as

Table 1. Component series of the OECD's CLI

Component series
(1) Inventories to shipments ratio (mining and manufacturing)
(2) Ratio of imports to exports
(3) Ratio of loans to deposits
(4) Monthly overtime hours (manufacturing)
(5) Construction: dwellings started
(6) Share price index (TOPIX)
(7) Spread of interest rates
(8) Small business survey: sales tendency

(Source: The OECD's web site)

Table 2. Component series of the Japanese CLI

Component series
(1) Index of Producer's inventory ratio of finished goods (final demand goods)
(2) Index of producer's inventory ratio of finished goods (producer goods for mining and manufacturing)
(3) New job offers (excluding new school graduates)
(4) New orders for machinery at constant prices (excluding volatile orders)
(5) Total floor area of new housing construction started
(6) Index of producer's shipment of durable consumer goods
(7) Consumer confidence index
(8) Nikkei commodity price index (42items)
(9) Interest rate spread
(10) Stock prices (TOPIX)
(11) Index of investment climate (manufacturing)
(12) Sales forecast D.I. of small businesses

(Source: The Japanese Cabinet Office's web site)

$$J_t^* = \left\{ \left(\frac{J_t \times 12}{\sum_{i=1}^{12} J_{t-i}} \right)^{12/6.5} - 1 \right\} \times 100 \qquad t = 1, 2, \ldots, T, \quad (1)$$

where J_t and T represent the value of index J at time t and the sample size, respectively. We obtained these series from the THOMSON DataStream Database. The data codes of the indexes O^* and J are respectively `JPOL0963R` and `JPCMLEAD`. The sample period is from April 1973 to January 2007.

Figures 1 and 2 respectively show that the indexes

Table 3. Business turning points identified by the Japanese government

	Tuning points
A	1977.01
B	1977.10
C	1980.02
D	1983.02
E	1985.06
F	1986.11
G	1991.02
H	1993.10
I	1997.05
J	1999.01
K	2000.11
L	2002.01

(Source: The Japanese Cabinet Office's web site)

O^* and J^* lead the Japanese business turning points. The shaded areas in the figures indicate the periods of recession officially determined by the Japanese government. In the following sections, in order to identify the turning points of the indexes O^* and J^*, we take the two approaches as stated above.

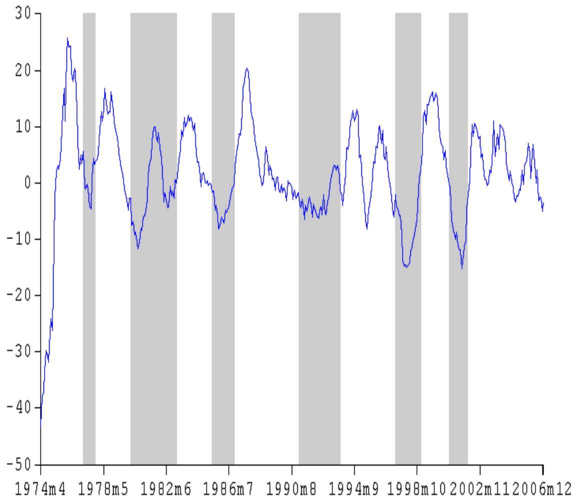

Figure 1. The index J^* and the Japanese business cycle

3 IDENTIFICATION OF THE TURNING POINTS OF THE INDEXES (1)

3.1 The HW approach

We firstly try to identify the turning points of the indexes, J^* and O^*, by extracting the business cycle fluctuations using a band-pass filter. (We refer to the extracted fluctuations as "business cycle part" of the original series hereafter.) As shown later, because the extracted business cycle part do not include noise (high-frequency components) and trend (low-frequency component) any more, the business turning points, defined as local minima or maxima, can be easily detected.

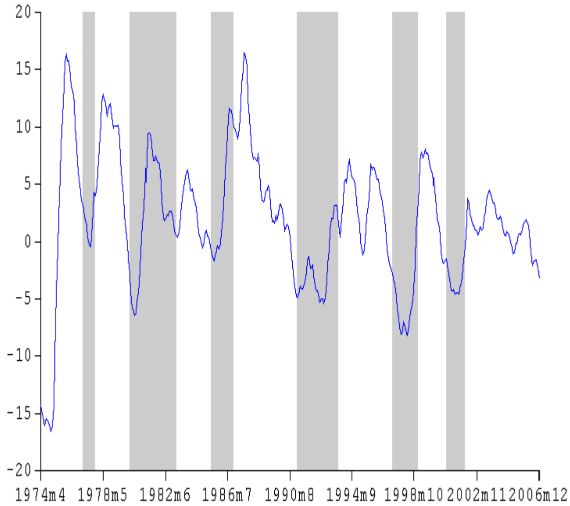

Figure 2. The index O^* and the Japanese business cycle

Although the band-pass filter of Baxter and King (1999) is widely used to extract the business cycle oscillations, Iacobucci and Noullez (2005) recently proposed another frequency-selective filter of which finite sample performance is superior to that of the Baxter and King (1999) filter. [We refer to the Iacobucci and Noullez's (2005) filter as the HW filter hereafter.] This is the reason why we select the HW filter to extract the business cycle components from the indexes. [In applied econometric works, the filters by Hodrick and Prescott (1997) and Christiano and Fitzgerald (2003) are also popular. But we do not choose them because both filters introduce phase shifts when filtering. For further information, see Iacobucci and Noullez (2005).] With the HW filter, the oscillations, y_t ($t = 0, 1, \ldots, T-1$), of which the frequency band is $[v_l, v_h]$, can be retrieved from the original time series, x_t ($t = 0, 1, \ldots, T-1$), as follows.

For $k = 0, 1, \ldots, K$, define X_k and Y_k as

$$X_k = \sum_{t=0}^{T-1} x_t \exp\left(\frac{-i2\pi tk}{T}\right) \tag{2}$$

and

$$Y_k = \left\{ \frac{(1-a)}{2} H_{k-1} + aH_k + \frac{(1-a)}{2} H_{k+1} \right\} X_k. \tag{3}$$

With X_k and Y_k, y_t ($t = 0, 1, \ldots, T-1$) is calculated as

$$y_t = \frac{1}{T}\left[Y_0 + \sum_{k=1}^{K}\left\{Y_k \exp\left(\frac{i2\pi tk}{T}\right) + Y_k^* \exp\left(\frac{-i2\pi tk}{T}\right)\right\}\right], \quad (4)$$

where i, Y_k^*, and K represent the imaginary unit, the complex conjugate of Y_k, and the integral part of $T/2$, respectively. And

$$H_k = \begin{cases} 1 & (\text{if } v_l T \le |k| \le v_h T) \\ 0 & (\text{otherwise}) \end{cases} \quad (5)$$

To extract the business cycle part of the indexes, it is required to set the frequency band $[v_l, v_h]$ and the value of a. Yamada, Honda and Tokutsu (2007), who studied the properties of Japanese leading indicators, argued that an appropriate frequency band for Japanese business cycle may be

$$[v_l, v_h] = [1/128, 1/32].$$

Following them, we have chosen the values above. As for the value of a, Iacobucci and Noullez (2005) recommend the value 0.54 for macroeconomic time series, and so we set $a = 0.54$.

3.2 Empirical results with the HW approach

Figures 3 and 4 present the business cycle parts of the indexes J^* and O^*, respectively. The shaded areas in the figures again indicate the periods of recession. Points A–L in the figures indicate the turning points of the indexes, identified visually. The alphabetical letters correspond to the official Japanese business turning points in Table 3. From these figures, it is observable that, generally speaking, the approach seems to work well. But it should be noted here that in Figure 3 we have selected Point I rather than Point (I). We considered that Point I is more reasonable because Point (I) is located just after the recession period. It should also be noted that in Figure 4, we have selected Point E rather than Point (E). Because Point E is in the expansion phase, whereas Point (E) is in the recession phase, we considered that Point E is more suitable.

Figure 5 depicts the business cycle parts of the two indexes. From this figure, we can observe that the locations of the turning points are almost the same. This is rather surprising because their component series are different.

Table 4 presents the empirical results with the HW approach. The third and fourth columns show the leading months of the indexes O^* and J^* to the Japanese business turning points, respectively. The last column shows the differences of the CLIs' corresponding turning points. A positive number in this column indicates the index O^* provides earlier signals for the next turning point than does the index J^*. The last two rows tabulate means and standard deviations of the leading months and their differences, respectively.

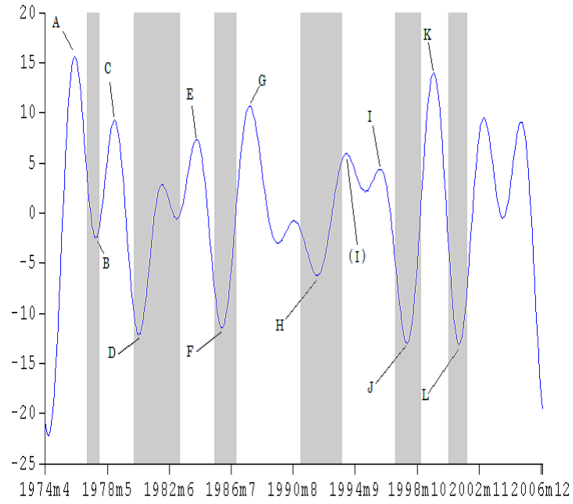

Figure 3. Business cycle part of the index J^* and its turning points (the HW approach)

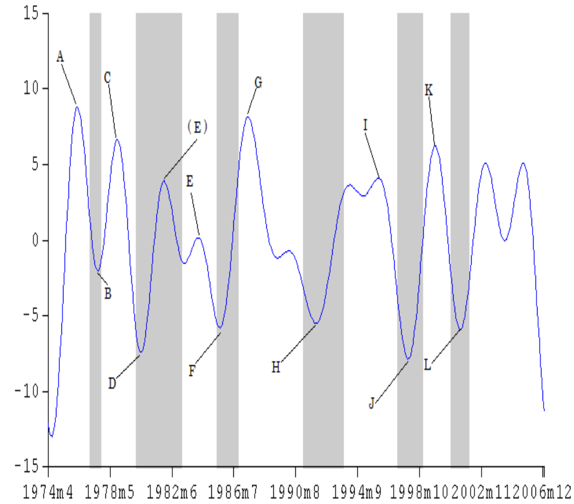

Figure 4. Business cycle part of the index O^* and its turning points (the HW approach)

From Table 4, we can confirm that the locations of the corresponding turning points of the indexes are almost the same as seen in Figure 5. We also find a clear relationship between the two indexes. The differences of turning points are nonnegative, which indicate that the index O^* provides earlier signals for the next turning point than does the index J^*. The average and the standard deviation of the differences

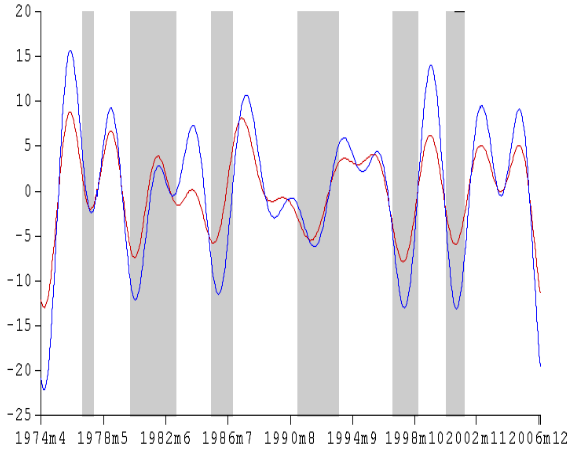

Figure 5. Business cycle parts of the indexes O^* and J^*

(Note: The red line and blue line indicate the business cycle parts of the indexes O^* and J^*, respectively.)

are 1.6 and 0.7, respectively. Assuming that the differences may be regarded as random samples from the normal population N(μ, σ^2), t-value (p-value) for the hypothesis

$$H_0 : \mu = 0 \qquad H_1 : \mu > 0 \tag{6}$$

is 2.23 (0.02), and the null hypothesis is rejected at the 5% level of significance.

4 IDENTIFICATION OF THE TURNING POINTS OF THE INDEXES (2)

4.1 The BB approach

Following the empirical analysis in the previous section, we secondly try to identify the turning points of the indexes, J^* and O^*, by the popular methodology proposed in Bry and Boschan (1971). (We refer to this as the BB approach hereafter). The BB approach is composed of rather complicated steps. A brief explanation of the approach can be found in Harding and Pagan (2002). [For a more detailed explanation, see King and Plosser (1994).]

We used the "brybos" function of the econometrics toolbox named "Grocer", which works in Scilab. To apply the BB approach, it is required to set some values of the parameters. We selected the default values of the function except for one parameter, the minimum duration of peak-to-peak and trough-to-trough. Its default value is 15 months, but we have chosen 32 months, because we set the parameter value of the high cutoff frequency, υ_h, as $1/32$ when we apply the HW approach.

Table 4. Leading months of the indexes and their differences (the HW approach)

Turning points		O^*	J^*	Differences
A	1977.01	10	10	0
B	1977.10	3	2	1
C	1980.02	15	15	0
D	1983.02	33	32	1
E	1985.06	15	14	1
F	1986.11	15	11	4
G	1991.02	44	40	4
H	1993.10	22	19	3
I	1997.05	15	13	2
J	1999.01	12	11	1
K	2000.11	13	12	1
L	2002.01	7	6	1
	mean	17	15.4	1.6
	s.d.	11.3	10.7	0.7

4.2 Empirical results with the BB approach

Figures 6 and 7 depict the indexes J^* and O^*, respectively. Points A–L in the figures indicate the turning points of the indexes identified by the BB approach. The alphabetical letters correspond to the Japanese business turning points in Table 3. Note that Points (B) and (C) in the figures are not identified by the BB approach (this is partly because the value of the minimum duration is too large) but identified visually. In addition, it should be noted that, although in Figure 7 Point (E) is identified by the BB approach, we selected Point E rather than Point (E). We considered that Point E is more reasonable for the next Japanese business turning points because Point E is in the expansion phase, whereas Point (E) is in the recession phase.

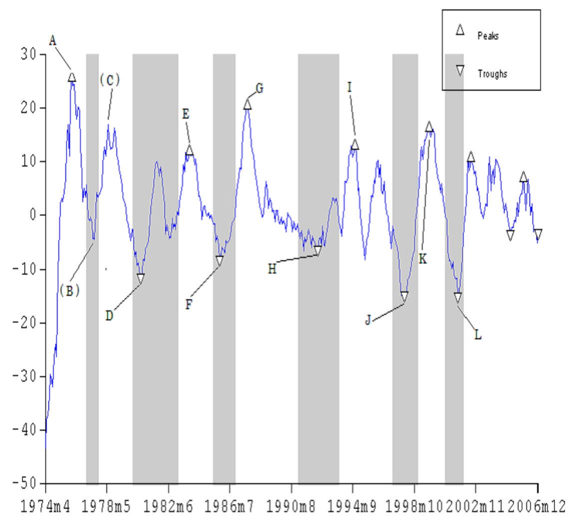

Figure 6. The index J^* and its turning points (the BB approach)

Table 5. Leading months of the indexes and their differences (the BB approach)

Tuning points		O^*	J^*	Differences
A	1977.01	13	12	1
B	1977.10	3	3	0
C	1980.02	21	20	1
D	1983.02	32	30	2
E	1985.06	19	19	0
F	1986.11	15	12	3
G	1991.02	42	41	1
H	1993.10	11	17	-6
I	1997.05	34	30	4
J	1999.01	8	11	-3
K	2000.11	16	13	3
L	2002.01	4	4	0
mean		18.17	17.67	0.5
s.d.		12.23	11.24	1

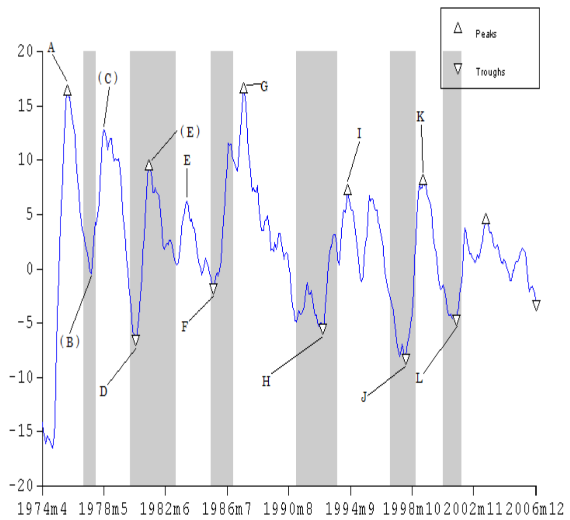

Figure 7. The index O^* and its turning points (the BB approach)

Table 5 tabulates the empirical results with the BB approach. From this table, we find similar results to those in the HW approach shown in Table 4. The locations of the corresponding turning points of the indexes are almost the same. The index O^* tends to provide earlier signals for the next turning point than does the index J^*. In addition, the leading months of the two indexes are roughly the same, one and one half years, on average. The average of the differences is 0.5 month. t-value and p-value for the hypotheses (6) are 0.5 and 0.31, respectively, and the null hypothesis cannot be rejected with the conventional levels of significance.

5 DEGREE OF SYNCHRONIZATION OF THE INDEXES

In the previous two sections, we observed that (a) the index O^* tends to provide earlier signals for the next turning point than does the index J^*, and (b) the averages of the differences are 1.6 and 0.5 in the cases of the HW and the BB approaches, respectively. These results suggests that O_t^* and J_{t+h}^* might be the most synchronized when h is around 1. In this section, we investigate whether this is valid or not.

Define $S_{i,t}$ $(i = J^*, O^*)$ as

$$S_{i,t} = \begin{cases} 0 & \text{(peak-to-trough)} \\ 1 & \text{(trough-to-peak)} \end{cases} \qquad (7)$$

With $S_{i,t}$, Harding and Pagan (2002, 2006) proposed the following index to measure the degree of comovement (the concordance index). [This index has become popular. For example, Hall and McDermott (2005) used it to analyze the regional business cycle of New Zealand.]

$$CI = \frac{1}{T}\left\{\sum_{t=1}^{T} S_{O^*,t} \cdot S_{J^*,t} + \sum_{t=1}^{T}(1 - S_{O^*,t})(1 - S_{J^*,t})\right\}. \qquad (8)$$

The closer to 1 (0) the value of CI is, the more procyclical (countercyclical) the two cycles are. For our purposes, we calculate the following $CI(h)$ $(h = 0, 1, 2, 3)$

$$CI(h) = \frac{1}{T-h}\left\{\sum_{t=1}^{T-h} S_{O^*,t} \cdot S_{J^*,t+h} + \sum_{t=1}^{T-h}(1 - S_{O^*,t})(1 - S_{J^*,t+h})\right\}. \qquad (9)$$

Table 6 reports the results. The second and third columns of Table 6 tabulate the values of the concordance indexes. From this table, we can observe that $CI(1)$ is the highest in both approaches, which indicates that the OECD's index provides about one month earlier signals for the next turning point than does the Japanese government's index. These results are consistent with those shown in the previous two sections.

Harding and Pagan (2006) also proposed using the sample correlation coefficient to measure the degree of the comovement, and we additionally calculated the sample correlation coefficients of $S_{O^*,t}$ and $S_{J^*,t+h}$ (i.e., the cross-correlations between them) for $h = 0, 1, 2, 3$. The third and fourth columns of Table 6 show the results. As shown in this table, the results are qualitatively the same as in the case of the concordance index.

Table 6. The degrees of synchronization of the indexes

	Concordance index		Cross-correlation	
h	HW	BB	HW	BB
0	0.952	0.878	0.898	0.748
1	0.975	0.883	0.941	0.753
2	0.967	0.872	0.919	0.725
3	0.954	0.857	0.886	0.687

6 SUMMARY AND SOME CONCLUDING REMARKS

In this paper, we empirically examined the relationship of the two alternative composite leading indicators (CLIs) for detecting the Japanese business turning points. One is the OECD's CLI and the other is the Japanese government's CLI. To identify the turning points of the indexes, we applied the frequency selective filter of Iacobucci and Noullez (2005) and the procedure of Bry and Boschan (1971). We also examined the degree of comovements of the two cycles, using the procedures proposed in Harding and Pagan (2002, 2006).

Our empirical findings, based on the data from April 1973 to January 2007, are:

1. The locations of the turning points of the indexes are almost the same (even though their component series are different).
2. With a few exceptions, the OECD's index provides earlier signals for the next turning point than does the Japanese government's index.
3. The averages of the differences are 1.6 and 0.5 in the cases of the HW and the BB approaches, respectively.
4. The empirical results concerning the degree of synchronization indicate that the OECD's index provides about one month earlier signals for the next turning point than does the Japanese government's index.
5. The average leading months of the two indexes are around one and one half years.

Finally, two remarks are in order. First, in this paper, we did not investigate what produces the discrepancies of the properties of the two alternative CLIs. As shown in Tables 1 and 2, the component series for the two CLIs are different. Further investigations are necessary to identify which components play an important role in producing the discrepancies. Secondly, Harding and Pagan (2006) proposed the testing procedure of synchronization. It is of interest to statistically test whether or not the OECD's index provides about one month earlier signals for the next turning point than does the Japanese government's index.

7 ACKNOWLEDGEMENT

This work was partly supported by KAKENHI (19530241).

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