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The Financial Cycle Indexes for Early Warning Exercise

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THE FINANCIAL CYCLE INDEXES FOR EARLY WARNING EXERCISE*

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Abstract

This paper introduces financial cycle indexes and uses them in an early warning exercise. The indexes are based on the traditional theory of business cycles. Juglar cycles are deduced from a number of financial indicators, categorized as leading and lagging indicators, and aggregated into leading and lagging indexes. We constructed Japanese financial cycle indexes and found that they warn of the current global financial crisis about a year in advance. However, the result should be interpreted with caution, since the indexes fail to take into consideration the uncertainty surrounding real-time problems and the potential delays that may be caused by policy judgment. As a solution, we propose a scheme to forecast financial cycle indexes. According to the test results based on the Japanese data, our scheme gives advance warning of the ongoing global financial crisis.

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I. Introduction

The current global financial crisis began in the summer of 2007 with the malfunctioning of the most advanced financial system developed in the United States. Since then, it has exerted a major influence on the world economy. Supervisory agencies, central banks, and ministries of finance have been working to strengthen banking regulations and financial safety nets to prevent the recurrence of sever financial turmoil. However, as became clear when Lehman Brothers Holdings Inc. went bankrupt, the current global financial crisis is a consequence of the massive financial imbalance that occurred outside the present financial regulatory framework, which focuses on the soundness of individual banks. Thus, extensions of the present regulatory framework may not save us from the recurrence of financial crises.

The concept of macro-prudence, which has recently attracted much attention, has emerged from an understanding of the limit of the micro-prudential regulatory framework. The focus of macro-prudent policy is not on the soundness of individual banks, but on the resilience of the financial system as a whole. In general, macro-prudential policy is decomposed into four functions: monitoring financial systems, designing policy tools, implementing policy measures, and coordinating policymakers. An early warming indicator is one of the tools that facilitate monitoring and, if effective, could facilitate preemptive action to prevent the recurrence of financial crises, or at least to reduce subsequent economic damage.

Strenuous efforts have been made to develop early warning indicators since the publication of a seminal paper by Kaminsky and Reinhart (1999), who outline a simple early warning scheme. According to their proposal, when a selected imbalance indicator goes beyond a threshold value, the scheme signals a high probability that a financial crisis is looming. To estimate the threshold value for each country, a long time series is required. From a statistical perspective, however, the relevant time series is often too short for estimation purposes. Kaminsky and Reinhart's solution to this problem is to collect data from multiple countries, and pool them for the purpose of estimation. By so doing, they assume that the sample countries have similar economic structures, or at least are characterized by similar dynamic properties. But, without verifying the validity of their assumptions, the Kaminsky-Reinhart scheme can hardly be used in policymaking.

This paper introduces financial cycle indexes (FCIXs) based on the traditional theory of business cycles, and uses them for early warning.[1] Note that these indexes are designed in the same spirit as are the indexes of business conditions (issued by Japan's Cabinet Office), the leading index of which is derived as follows. First, we select multiple economic indicators that are believed to precede a general business cycle; then we calculate the percentage of increasing indicators. Usually, we take it as a sign of a future recession when the percentage is below 50. To construct a leading FCIX, which will indicate the likelihood of future financial crises, we pick financial indicators that are observed to precede financial crises. Then, the index is constructed by subtracting the percentage of decreasing indicators from that of increasing indicators. It should be noted that our signaling procedure differs from that of Kaminsky and Reinhart.

The FCIXs focus on the direction in which financial indicators change, so that there is no need to estimate threshold values for warning signals as Kaminsky and Reinhart do. This allows us to construct an early warning indicator that applies exclusively to Japan and requires no data related to other countries. In addition, signaling performance can be improved by incorporating data rarely compiled in other countries, such as the *tankan*. That said, this method produces a difficulty that Kaminsky and Reinhart have not yet needed to confront: how to measure the suitability of data selection. Since we have no

[1] In this paper, we abbreviate the financial cycle indexes as FCIX to distinguish them from the financial conditions indexes (FCI).

means judging which method—ours or Kaminsky and Reinhart's—is better, we suggest that both methods be used to enhance the performance of early warning exercise as a whole.

Another point that should be taken into account in connections with FCIXs is the role of the Juglar cycle in the economy. Since C. Juglar found ten-year cycles in a number of financial data in 1862, many academics, including Galbraith (1990), have pointed out that there has been a financial crisis every ten years. This paper is based on these historical observations as well as on a wide range of business cycle theory.

We do not insist that financial crises are unavoidable. As Spiethoff (1925) suggests, we believe that financial crises are avoidable and urge policymakers to devise measures to prevent them. In this context, we recall the argument put forward by Hayek (1935) that the process of recession, once it starts, is too complicated to be controlled by policymakers. The same can be said for financial crises. Although detecting an impending crisis and designing appropriate countervailing measures are difficult, were policymakers able to detect signs of future financial crises, they would have a certain amount of time to take preemptive action.

The remainder of this paper comprises six parts. Section II explains the framework of FCIXs; Section III calculates the Japanese FCIXs and evaluates their performance; Section IV points out real-time problems and presents our suggested method for coping with them; Section V discusses the necessity for maintenance so that FCIXs can continue to perform; and Section VI concludes by summarizing the main results and discussing the limitations of FCIXs.

II. THE FRAMEWORK OF FINANCIAL CYCLE INDEXES

(1) Business cycle theory and the treatment of financial activity

Before the World War II, the field of business cycle theory attracted many competing schools of thought, including proponents of pure money theory (e.g., Hawtrey), over-investment theory (e.g., Spiethoff and Hayek), under-consumption theory (e.g., Lederer), psychology theory (e.g., Pigou), and harvest (sunspot) theory (e.g., Jevons). Yet, they all agreed that financial activity is key to understanding business cycles. For instance, according to pure money theory, an economic contraction begins when credit expansion is checked by law, social practice, and other artificial restrictions.[2] Meanwhile, according to over-investment theory, credit is a key factor in determining the timing and magnitude of crises.[3]

In contrast, after World War II, financial activity has an extremely small role in business cycle theory. A typical example is real business cycle theory (e.g., Kydland and Prescott [1982]), which describes the behavior of the real economy as optimal responses to productivity shocks. The current global financial crisis, however, has forced economists and practitioners to realize that credit information as well as real variables are indispensible if one is to understand the process involved in financial crises.[4] In particular, a broad consensus has

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[2] For instance, Hawtrey (1927), one of the most famous advocates of pure money theory, argues that a change in financial activity is a necessary and sufficient condition to generate business cycles.

[3] Over-investment theory is usually split into two schools: the monetary over-investment school, which asserts that money is an indispensible factor in generating business cycles (Hayek, 1933, 1935); and the non-money over-investment school, which argues that business cycles are characterized by real factors and the role of money is only supplemental (Spiethoff, 1925). Spiethoff, however, does not minimize the role of monetary factors in generating business cycles. As Haberler (1958) mentions, the two schools differ in their emphasis on monetary and real factors.

[4] Brunnermeier, *et. al* (2009) present a comprehensive discussion of the background to the current global financial crisis from the viewpoint of the reconstruction of financial regulation. Discussing the vulnerability of modern financial systems in a speech, Yellen (2009) re-evaluates Minsky's (1982) financial instability hypothesis.

formed in support of the idea that a financial system often malfunctions around the beginning of an economic recession. It may take a long time, however, to build a mathematical model incorporating all relevant financial activities.

Given the current situation and the suggestion made by Röpke (1936), we take a comprehensive approach in this paper, not relying on any particular economic theory. Like many schools of thought that support business cycle theory, we believe that, no matter what exogenous shocks assail the economy, there exist fixed patterns in its endogenous reactions to them. We assume no specific patterns, but instead examine a large amount of data and evaluate its potential to predict the occurrence of financial crises.

(2) Calculating financial cycle indexes

To calculate FCIXs, we take a number of financial indicators and extract cycles of approximately 10 years' duration. These cycles are then compared with past financial crises—we define the term financial crisis below in (4) of this section—categorized as leading and lagging indicators, and aggregated into leading and lagging indexes. To this end, we:

(i) Collected original series: multiple financial time series;

(ii) Selected target durations: financial cycles of between 7 and 11 years;

(iii) Extracted reference series: cycles of the target duration from original series using the HP filter (Hodrick and Prescott [1997]);

(iv) Selected reference events: past financial crises;

(v) Categorized indicators as leading and lagging: peaks of reference series compared with reference events; and

(vi) Aggregated indicators into leading and lagging: reference series plugged in index formulae.

Below is a detailed discussion of issues related to each of the above steps.

(3) Collection of original series

We have used only financial data to forecast financial crises, and include some data reflecting real activity as a proxy of financial activity. For instance, the current profits of firms are used as a proxy for their free cash flow. Our argument is based on the assumption that financial data reflect financial activity and thus play an important role in forecasting the approach of financial crises. However, it is debatable whether data on real activity signals forthcoming financial crises.[5] Below, we discuss relationships between real and financial activities from two perspectives: causality and lead-lag relationships between the two types of activities.

The first issue is whether a stagnant real economy is a cause, or a result, of a financial crisis. While views vary, from a historical perspective it can be said that all stagnant real economies do not lead to financial crises, just as all financial crises do not lead to stagnation of the real economy. The former point hardly bears mentioning, given the events of the business cycles. Meanwhile, the latter point is well illustrated by the bursting of the bubble generated by the Netherlands' tulip craze in the 17th century. Although the effects spread to London and Paris, remaining related documentation makes no mention of any subsequent vast or long-lasting economic stagnation.[6] Further, the controversy regarding the cause of the Great Depression in the 1930s shows how difficult it is to identify what links a financial crisis and stagnant real activity.

The second issue is whether financial crises lead to, or lag behind, stagnant real activity. W. C. Mitchell, a master of the business cycle theory, reviewed the

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[5] Financial data are an acceptable part of any discussion of business cycles because the cycles refer not only to the boom-and-bust episodes of real activity, but also to activities related to financial transactions. The indexes of business conditions comprise financial indicators, such as M_2, as well as those reflecting real activity.

[6] Galbraith (1990) gives a vivid description of the Netherlands' tulip mania. Spiethoff (1925) discusses the craze from the perspective of business cycle theory.

history of financial crises and pointed out that shrinking financial activity often precedes stagnation of real activity. Interestingly, he also hypothesized that the reverse—stagnation of real activity preceding a contraction of financial activity (Mitchell [1941])—would be a principle scenario in the future. His hypothesis is verified by Wolfson (1994) in the analysis of the postwar U.S. experiences of financial crises. Nevertheless, in the context of the bursting of the Japanese asset-price bubble in the early 1990s, the lead-lag relationship between financial and real activities is not clear.

The above arguments suggest that, while financial activity is not totally independent of real activity, they are not one phenomenon viewed from two different perspectives. Financial activity and real activity are two different phenomena correlated loosely with each other. Thus, while we need not be overly pessimistic—and believe that all information concerning real activity is of no value in forecasting financial crises—neither should we be too optimistic about the value of real-activity data. If we find real economic data useful for forecasting a financial crisis, we incorporate it in the indexes in the future. But, since this is our first attempt to construct FCIXs, we begin with a relatively small set of financial data.

(4) Selection of target durations

Business cycles can be constructed on the basis of either single- or multiple-cycle theory. Burns and Mitchell (1946) base their hypothesis on single-cycle theory; they analyze a large amount of historical data and argue that the duration of business cycles is flexible, expanding and shrinking in the range of between 1 to 12 years. Schumpeter (1939) advocates multiple-cycle theory, which hypothesis has business cycles composed of multiple cycles of different durations. Although this paper is based on multiple-cycle theory, we have no clear evidence to support our hypothesis and so must check its validity each time we forecast financial crises.

There are four well-known cycles, each characterized by a different duration

(Chart 1): the Kitchin cycle that lasts 3 to 4 years; the Juglar cycle, 6 to 12 years; the Kuznets cycle, 14 to 30 years; and the Kondratieff cycle, 48 to 60 years.[7] The Juglar cycle, sometimes called the main cycle, is so important in economic analysis that when we refer to business cycles, we mean the Juglar cycle, unless otherwise indicated. Although the magnitude of the financial crisis to which we refer has been reduced by various policy measures and institutional settings,[8] we have seen signs of, or experienced, a financial crisis every 10 years, indicating that the Juglar cycle continues to play an important role.

Chart 2 shows the number of years between two consecutive banking crises in countries that have experienced at least two such crises between 1970 and 2009, based on data compiled by Laeven and Valencia (2010). Intervals of 8 and 10 years (corresponding to the Juglar cycle[9]) are frequent, as are those of 16 years (corresponding to the Kuznets cycle). Thus, one direction that research might take is to merge the Juglar and Kuznets cycles and examine cycles of between 6 and 30 years. Another is to analyze both the cycles separately. Note, however, that identification of long cycles is much more difficult than that of short cycles. The HP filter employed for the purpose of this paper also faces the problem of trend extraction, for which reason we here focus on the Juglar cycle

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[7] See Shimanaka (2006). The duration of each cycle differs a little, depending on the author. For instance, Hansen (1941) defines the Juglar cycle as one that lasts at least 6 years, 12 years at most, and usually 7 to 11 years. There is also a cycle that lasts 1 year and is called a seasonality (Röpke [1936]).

[8] The Bagehot rule, concerned with the role of central banks as lender of last resort (Bagehot [1873]), has helped minimize the extent of financial crises. Yet, financial crises cannot be consigned to the annals of history. Thus, although Minsky (1982), in his financial instability hypothesis, warns that financial crises are avoided by instituting policy measures, modern financial systems are becoming increasingly vulnerable. The current global financial crises show the validity of his argument.

[9] Shinohara (2009) also discusses the importance of the Juglar cycle in relation to the current global financial crisis.

and leave analysis of the Kuznets cycle for a future time.

We have targeted cycles lasting 7 to 11 years, not 6 to 12 years as suggested in Chart 1. The reason is that the HP filter is not ideal, because when targeting cycles lasting 6 to 12 years, one is likely to extract some part of the longer and shorter cycles together with the target cycles. Our solution to this is to narrow the range of target durations, thereby reducing the adverse effects due to the incompleteness of the HP filter. At the same time, however, it is also necessary to keep the target range of durations reasonably broad, because the length of time between financial crises may depend on the source of an imbalance, the existing economic infrastructure, and the current stage of an economy's development. Analyzing the data compiled by Laeven and Valencia (2010), we find that the time between financial crises tends to be shorter for emerging than for advanced countries. Further, even in the same country, a time between financial crises is likely to change over time, as has been observed in the United Kingdom. Recently, most researchers have come to accept that there is a degree of flexibility in the length of business cycles, with only very few insisting that the duration is rigid, as discussed by Jevons (1878), the founder of the harvest (sunspot) theory.

(5) Extraction of reference series

We have used the HP filter to extract cycles that last for the target durations from an original time series.[10] The HP filter is popular in empirical research to decompose an original time series into trend and cyclical series. Denote an original time series as y and its trend as $\bar{y}$. Then the trend ($\bar{y}$) is obtained as the series that minimizes the value of the following function.

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[10] Several filters, besides the HP filter, achieve the same purpose. The OECD (2008) compares the phase-average trend, the HP filter, and the CF filter (Christiano and Fitzgerald [1999]) to construct its short-term leading indicator of business conditions, called the composite leading indicator system.

$$\sum_{t=1}^{T}(y_t - \bar{y}_t)^2 + \lambda \sum_{t=2}^{T-1}(\Delta\bar{y}_{t+1} - \Delta\bar{y}_t)^2, \tag{2.1}$$

where λ is called the smoothness parameter. The larger the parameter, the smoother the extracted trend.

We use the HP filter twice to extract the cycles lasting 7 to 11 years. This filter is called the band pass filter in the literature. Suppose that time series y consists of three cycles: cycle a that lasts less than 7 years; cycle b, 7 to 11 years; cycle c, more than 11 years. That is,

$$y_t = a_t + b_t + c_t. \tag{2.2}$$

Our goal is to extract cycle b. To do so, we first set the smoothness parameter at a low level ($\underline{\lambda}$) and apply the HP filter to the original time series (y) to obtain $b + c$. Next, we set the smoothness parameter at a high level ($\bar{\lambda}$) and apply the HP filter to the original time series (y) to obtain c. Last, we take a difference between the two extracted series to obtain b, which is the series we seek.

The problem is how to set values for the smoothness parameter, i.e., $\underline{\lambda}$ and $\bar{\lambda}$. The following formulae are used for that purpose.

$$\underline{\lambda} = \left\{2sin\left(\frac{\pi}{7f}\right)\right\}^{-4}; \tag{2.3}$$

$$\bar{\lambda} = \left\{2sin\left(\frac{\pi}{11f}\right)\right\}^{-4}, \tag{2.4}$$

where f is the parameter to adjust the formulae for the frequency of an original time series: f is 12 for monthly data, 4 for quarterly data, 2 for semi-annual data, and 1 for annual data. Chart 3 shows the values used in this paper.

The HP filter is not an ideal filter. In Chart 4, the horizontal axis indicates the duration of cycles, while the vertical axis shows the gain or pass-through rate of the HP filter. The equation (2.3) provides the smoothness parameter that allows 50% of the 7-year cycles to pass through the HP filter (the solid line).[11] As the

[11] The choice of gain in this case is arbitrary. We followed the OECD (2008) and set it at 50%.

duration of cycles decreases, so does the gain of the HP filter, although very slowly, implying that the HP filter incompletely removes cycles lasting less than 7 years. Further, as the duration of cycles increases, so does the gain of the HP filter but, once again, very slowly, suggesting that the HP filter keeps only some of the cycles that last more than 7 years. It is also shown that it becomes increasingly incomplete as the target duration of a cycle increases. These technical limitations of the HP filter should be borne in mind when interpreting FCIX-based results.

(6) Selection of reference events

In order to avoid confusion in the following discussion, we need to define the term "financial crisis." Starting with the word "crisis," as a technical term it means that economic expansion stops and contraction begins. It does not necessarily mean something like an economic panic, as often used in a non-technical way (Haberler [1958]).

Similarly, the technical term "financial crisis" means that financial activity has ceased expanding and is contracting, while it means extreme financial stress or sequential bank-runs as a non-technical term. Below, unless otherwise specified, we use the term "financial crisis" as a technical term. Thus, a financial crisis may occur, even when not accompanied by serious financial turmoil.

Certainly, the reliability of FCIXs is enhanced if there are a large number of reference events. However, due to the limited time span covered by the available data, we have used only two reference events, both of which represent financial crises in a technical meaning.

(a) The triple sell-off in the yen, equity, and bond markets (January 1990); and[12]

(b) Sanyo Securities' filing for protection with the Tokyo District Court

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[12] We follow Muramatsu and Okuno (2002) and define the January 1990 triple sell-off as the beginning of the bursting of the asset-price bubble.

under the Corporate Rehabilitation Law (November 1997).

Some remarks are in order here. First, both events signaled that the Japanese financial cycle had started to contract, marking (a) the beginning of the bursting of the asset-price bubble, and (b) the start of the bankruptcy of financial institutions, which events fit our definition of a financial crisis.

Second, financial crises can take different forms. Financial crises may follow a collapse of asset prices as in event (a), but is not always accompanied by bankruptcy of financial institutions as in event (b), as often believed.

Further, the fact that there were about 8 years between the two reference events above, although not required, fits in with our assumption that a financial crisis comes every 7 to 11 years.

(7) Leading and lagging indexes

FCIXs comprise leading and lagging indexes. We pick multiple indicators, from which we extract cycles that last about 10 years. We here define a financial series as either a leading indicator, if its extracted series turns down before the reference events, or a lagging indicator if the series turns down after the reference events. Note, however, that our definition does not depend on when the indicators begin to rise. Thus, a financial indicator that turns down posterior to the reference events is defined as a lagging indicator, even if it starts rising prior to the reference events. The leading indicators are aggregated into a leading index, while the lagging indicators are into a lagging index.

The purpose of FCIXs is to detect signs of a financial crisis so that a policy reaction may be supported, which makes the role of a leading index unquestionable. But that is not so in the case of a lagging index. In order to understand the importance of a lagging FCIX, it is informative to see how the lagging index of the indexes of business conditions is used in practice. A temporary break, or economic lull, is often encountered in the course of economic expansion or contraction. But it is hard to distinguish in real time this lull from a turning point in the economy, which is where the lagging index is useful. For instance, it is likely that the economy is experiencing an economic lull if the lagging index shows the economy being in a contraction phase, even when the leading index indicates that the economy is moving from an expansion to a contraction phase. The lagging FCIX can serve the same purpose.

It is important to distinguish a temporary lull from a financial crisis, since the former is not likely to produce financial turmoil. Supposing that a lull is encountered in a contraction phase, it is safe to assume that an accumulated financial imbalance has been removed and that we do not suffer from financial turmoil. This means that, by identifying a lull in financial cycles, policymakers can avoid signaling, incorrectly, that there will be financial turmoil.

We have no coincident FCIX, since the timing of financial crises is relatively easy to spot. In contrast, the coincident index is the most important component of the indexes of business conditions, because the timing of peaks and troughs of business conditions is often hard to detect in economic assessments.

(8) Aggregating into various indexes

The type-D index, that most frequently referred to below, is derived by taking a reference series, such as that obtained in (5) above, and assigning +1 when it increases and -1 when it decreases. We take the same steps for all reference series, and aggregate the results in each group of leading and lagging indicators. That is to say,

$$D_t = \frac{1}{N}\sum_{i=1}^{N} I\left(\Delta b_{i,t}\right). \tag{2.5}$$

In the case of a type-D leading index, b denotes a reference series for one of the leading indicators; Δb its first difference; N the number of leading indicators; $I(X)$ the index function, which takes on +1 if X is positive and -1 if it is negative. The lagging index is obtained in a similar fashion.

The type-D index provides no information concerning the magnitude of a future financial crisis, since it is designed to focus on the timing of the crisis. Another drawback of the type-D index is its stepwise movement, which prevents one from identifying the direction its changes will take. In contrast, the type-C index contains quantitative information and moves more smoothly.[13]

$$C_t = \frac{1}{N}\sum_{i=1}^{N}\frac{\Delta b_{i,t}}{\sigma_i}, \qquad (2.6)$$

where σ_i denotes the standard deviation of $\Delta b_{i,t}$.

The type-B index, defined below, indicates the level of a financial cycle, while type-C and type-D indexes indicate the direction of a cycle.

$$B_t = \sum_{s=0}^{t} C_s. \qquad (2.7)$$

Although type-C and type-B indexes measure the severity of financial crises, they do not always agree with our perception, which is influenced by all cycles, including those that are short, medium, and long. Since type-C and type-B indexes are concerned only with Juglar or medium-term cycles, they often reflect just part of our perception.

(9) Forecasting the revival of the financial system

FCIXs may not be very sensitive to the revival of a financial system, because it is designed to detect signs of financial crises. Moreover, it cannot be guaranteed, although a natural guess, that leading indicators of financial crises begin to increase earlier than lagging indicators and thus can accurately predict such a revival. It is also noteworthy that the forecasting of revival is also hampered by the fact that the timing of economic and financial recoveries is often ambiguous (Spiethoff [1925]), compared with that of financial crises.

III. THE JAPANESE FINANCIAL CYCLE INDEXES

(1) Choosing leading and lagging Indicators

The candidate financial data we have used cover the date of the two reference

13 Type-C indexes are made in the same way as composite indexes (CIs) of the indexes of business conditions. See Mori (1997), which explains Japanese CIs and how they differ from NBER indexes.

events of financial crises, namely, the triple sell-off (January 1990) and the bankruptcy of Sanyo Securities (November 1997). Since our financial data can be traced back at least to the mid-1980s, candidate data must span more than 20 years, implying that a 7-to-11 year cycle is observed three or four times during the sample period. This allows us to run a minimum check on the performance of our indexes. This paper is based on data available on January 19, 2011. Annual data are excluded to allow for the quick calculation of estimates; and only monthly, quarterly, and semi-annual data are included in the indexes. As can be seen in Chart 5, 19 items of financial data have been used: 8 leading and 11 lagging indicators.

Chart 6 presents the reference series (cycles lasting 7 to 11 years) extracted from original financial data. The solid lines represent the reference series, and the broken lines the first difference series (both normalized by their standard deviations). The dates of the three peaks are indicated on the solid lines. The financial data is categorized as a leading indicator if its first two peaks precede the reference events, and as a lagging indicator if they follow these events. Any financial data is excluded if either of the first two peaks precedes a reference event while the other lags behind the other reference event. The leading indicators are given in Chart 6 (1) to (8); the lagging in Chart 6 (9) to (19).

The reference series used are examined to construct Chart 7, where the horizontal axis indicates when the peaks occurred around the triple sell-off in January 1990, while the vertical axis indicates the timing of those peaks that occurred around the time of the Sanyo Securities bankruptcy in November 1997. Financial data are categorized as leading indicators if the corresponding label is located in the bottom left quadrant to the intersection of the two broken lines; it is a lagging indicator if the label is in the upper right quadrant. A series is ignored if the corresponding label is in the upper left or bottom right quadrants. The all-industries Tokyo stock price index (TOPIX) is not used, since the corresponding label is in the upper left quadrant, i.e., preceding the triple sell-off and following the Sanyo Securities bankruptcy.

The following eight series are adopted as leading indicators: stock prices of the banking, real estate, and construction sectors; the lending attitude of financial institutions; the financial positions of firms; current profit levels of firms; housing loans; and commodity prices. Stock- and commodity-price data, that often reflect the speculative flow of funds, are categorized as leading indicators. Spiethoff (1925) points out that stock prices are likely to turn down prior to a financial crisis. But not all stock prices classified by industry are leading indicators. Chart 8 shows the stock price peaks for 33 industries at around the time of the two reference events. Of these, only 22 industries qualify as leading indicators, while the stock prices of the remainder do not, preceding the triple sell-off and following the bankruptcy of Sanyo Securities. The stock prices of any of the 22 industries can be leading indicators, or the aggregated stock prices of the 22 industries can be used as a leading indicator. But here we have focused on the stock prices of the banking, real estate, and construction industries, since they are considered particularly relevant to the formation of bubble economies.

The pure money and monetary over-investment theories argue that, prior to a financial crisis, financial institutions are less willing to lend and the financial position of firms deteriorate. Mitchell (1941) suggests that declines in corporate profits be used as a leading indicator. Spiethoff (1925) points out that the flow of housing loans increases earlier than other indicators. This is because housing construction begins to increase at the troughs of business cycles, when the cost of building materials, wages, and interest rates bottom out. However, as Röpke (1936) warns, there is a controversy among economists about whether the construction sector is the first to revive; and thus care should be taken with generalizations. Finally, declines in commodity prices can be interpreted as either decreases in the prices of production goods, or the calming-down of speculative investments.[14]

[14] Spiethoff refers to goods used in the manufacture of production tools and

The following 11 time series are considered lagging indicators: corporate debt; household debt; lending interest rates; changes in interest rates on loans; the two monetary aggregates, M_2 and M_3; deposits; land prices nationwide and in large urban areas; as well as 3- and 9-year government bond yields. It can be said that a financial crisis is likely to occur before non-financial firms' debts stop expanding and begin shrinking; monetary stocks shrink, parallel with credit; and land prices and lending interest rates decline after a recession starts. Categorized as lagging indicators—even though they are observed typically with the expansion of bubbles—government bond yields lag behind the occurrence of financial crises, as Spiethoff (1925) points out. He also says, however, that government bond yields display abnormal variation over time, since they are subject to factors exogenous to business cycles, such as the fiscal position of nations. Thus, one should consider carefully whether to incorporate government bond yields into the index, and closely watch their developments.

One of the issues closely related to the current global financial crisis is whether and how the FCIXs react to overseas shocks. The Japanese economy is immune to neither the influence of the global economy nor expectations of such influence.[15] The leading FCIX detects global influences on the Japanese economy through various data. In addition to domestic variables, the leading index includes data that is greatly affected by the global economy. For instance, the CRB index is included among the leading indicators, while stock prices (also

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equipment—such as iron, coal, bricks, cement, and lumber—as indirect consumption goods, which he sees as key to understanding the development of business cycles. The CRB index—although it excludes iron, which was one of the major indirect consumption goods in the first half of the 20th century—still is considered useful for detecting signs of financial crises, since it includes such modern economic consumption goods as energy source material, two of which are crude oil and non-ferrous metals. Interestingly, the CRB index includes food and live cattle.

[15] Röpke (1944) reviews briefly the international linkage of business cycles from a historical perspective.

leading indicators) increasingly are becoming interlinked with overseas financial markets as globalization spreads. While the structure of the leading index enables us to identify financial shocks that originate in overseas economies, in contrast, the lagging index comprises mainly balance-sheet information on the domestic economy and has a lower correlation with overseas economies.

(2) Aggregation into the type-D index

The FCIXs are constructed on the basis of the series in Chart 6, where Δb is indicated by a broken line. The type-D leading index is obtained by inserting eight leading indicators (N = 8) into equation (2.5); similarly, the type-D lagging index is obtained by aggregating the 11 lagging indicators (N = 11). Chart 9 (1) shows the development of the type-D leading index in Japan. When the index falls to zero, half the eight leading indicators turn down. Since zero is the threshold in this paper, when the leading index falls to this point, there is a warning signal. In July 1988, the leading index fell to zero, 18 months ahead of the triple sell-off in January 1990. It next fell to zero in July 1996, 16 months ahead of the Sanyo Securities bankruptcy in November 1997.

The leading index precedes the two reference events by definition. To check the performance of the leading index, or to see whether it predicts the occurrence of the current global financial crisis, we have to have a back-test. Here, the BNP Paribas shock in August 2007 is chosen as another reference event. In Chart 9 (1), it is in July 2006 that the type-D leading index falls to zero (13 months ahead of the BNP Paribas shock), thereby predicting that financial crisis. However, we should be careful in interpreting this result, since the back-test was conducted after a certain amount of data had been accumulated following the BNP Paribas shock. Hence, one cannot be certain that the leading index could predict the current global financial crisis in real time prior to the BNP Paribas shock. In Section 4, we discuss the evaluation of the real-time performance of the FCIXs, and propose a way in which it might be configured to better assist in crisis prediction.

There is yet another way of checking the performance of the FCIXs. Assuming that a financial crisis occurred prior to the triple sell-off in January 1990, one can check whether a leading index predicted the crisis. Since at the time the financial sector was sheltered by the so-called convey system, there was no financial panic observed, even though the potential was there. Since our choice of a reference event must be arbitrary, we have chosen an event in relation to which the number of indicators that break the lead-lag relationships in Chart 5 is minimal. The optimal choice is a reference event between October 1979 and May 1980, during which a number of major economic events occurred: the FRB's monetary tightening in October 1979; the subsequent turmoil in the securities and foreign exchange markets; the announcement, by Libya and Iran, of a significant oil price hike; and the plunge in the silver futures market in the United States at the end of March 1980. In Chart 10, the peaks of reference series are plotted under the assumption that a reference event occurred in October 1979. As can be seen from the figure, only the CRB index and the M_3 aggregate violate the lead-lag relationships.

(3) Aggregation into type-C and type-B indexes

Type-C indexes are obtained from equation (2.6), as presented in Chart 11. The graphs change little by little, since semi-annual and quarterly data do not change every month. First, the leading index falls to zero in January 1989 (the type-D index, July 1988), one year ahead of the triple sell-off. Next, the index falls to zero in September 1996 (type-D index, July 1996), 14 months ahead of the bankruptcy of Sanyo Securities. Finally, the index falls to zero in September 2006 (type-D index, July 2006), 11 months ahead of the BNP Paribas shock. In addition to its high-performance, the type-C leading index has the advantage of enabling one to relatively easily infer its direction, since it moves more smoothly than type-D indexes, which it tends to lag. These two types of indexes are used complementarily for better early warning.

As in equation (2.7), the type-B indexes are obtained by accumulating the value of type-C indexes. The results are presented in Chart 12, which shows financial activity close to bottoming out on January 19, 2011. However, in order to satisfactorily assess the current financial environment, we need to know the extent to which real-time problems quantitatively influence FCIXs. The next section discusses this issue.

IV. REAL-TIME FINANCIAL CYCLE INDEXES

(1) Real-time problems

Generally, it is hard to extract a trend from a time series in real time (Orphanides and Norden [2002]). The first difficulty concerns the revision of data; the second, which has a significant effect on trend estimations, is related to trend changes resulting from the accumulation of data (the end-of-sample problem); and the third concerns lagged issuance (Chart 13), due to the time needed to collect and publish data.

FCIXs have inherited these drawbacks in connection with real-time estimates. Here we look at end-of-sample and lagged-issuance problems, ignoring the issue of data-revision, which has a relatively little impact. Chart 14 presents real-time estimates for FCIXs, obtained as follows. First, we calculate the type-D index with the end-of-sample set for January 1985 (where the sample begins depends on the series) and set aside the estimates. Next, we expand the data series by one month, calculate the type-D index, and pick up the February 1985 estimates. We repeat this process up to and including January 2011 to obtain a real-time index. Note that quarterly and semi-annual data are not published monthly, and that even monthly data cannot be observed in real time, due to lagged issuance. Missing estimates are complemented by the latest available values in real time. Here we call the series thus obtained the real-time index which, in the figure, is represented by the broken line. For comparison, we use all the available data for January 2011, and present the calculations for the period from 1985 to 2010, referred to in this paper as the final index.

The real-time index lags behind the final index. Prior to the triple sell-off, the final leading index falls to zero in July 1988, while the real-time leading index does so in October 1988 (three months behind the final index). Before the bankruptcy of Sanyo Securities, the final leading index falls to zero in July 1996, while the real-time leading index does in July 1997 (one year behind the final index). This lag is so large that the real-time leading index falls to zero only four months ahead of the bankruptcy of the firm. Finally, prior to the BNP Paribas shock, the final leading index falls to zero in July 2006, while the real-time leading index does so in March 2007 (eight months behind the final index).

The same tendency is also observed in type-C indexes, with real-time indexes lagging behind final indexes. This tendency may be crucial, given that type-C indexes tend to lag behind type-D indexes, as mentioned earlier. Chart 15 shows real-time type-C indexes, where the real-time leading index falls to zero in December 1997, thereby failing to indicate the bankruptcy of Sanyo Securities.

(2) Solution to real-time problems

We propose the following solution to the delay caused by real-time problems. To predict the timing of a peak, we use the date of an inflection point (where a change in a reference series stops increasing and begins decreasing). In so doing, we focus on the development of the rate of acceleration, instead of the rate of change. This represents the application of the rule of thumb that a rate of change in data tends to precede the level of the data (Mori [1997]).

An inflection point is obtained by calculating a change from the previous period in the change from the previous period. The simplest way to do so is to use the following second-difference values, instead of Δb, in equation (2.5).

$$\Delta^2 b_t \equiv \Delta b_t - \Delta b_{t-1} = b_t - 2b_{t-1} + b_{t-2}. \qquad (4.1)$$

Although this method experiences significant seasonal effects, the problem can be avoided by using a change from the previous year in the change from the previous year instead. That is to say,

$$\Delta_d^2 b_t \equiv \Delta_d b_t - \Delta_d b_{t-d} = b_t - 2b_{t-d} + b_{t-2d}, \qquad (4.2)$$

where d denotes the frequency of data, implying that $d = 12$ for monthly data, $d = 4$ for quarterly data, and $d = 2$ for semi-annual data.

Charts 16 and 17 present prediction results obtained by using an inflection point for type-D and type-C indexes (see broken lines). There are clear improvements, namely, the final type-D leading index falls to zero in July 1988 before the triple sell-off, as does the forecast leading index in May 1988, two months ahead of the final index. The final leading index falls to zero in July 1996, before the bankruptcy of Sanyo Securities, while the forecast leading index does so in February 1997, seven months behind the final index but five months ahead of the real-time index. Finally, in the case of the BNP Paribas shock, the final leading index falls to zero in July 2006, as does the forecast leading index.

(3) Identifying a temporary lull

A lagging index plays a role in the identification of a temporary lull. In Chart 16, the forecast leading index rises above zero in November 1999, but returns to zero in December 2001, reflecting the effects of an IT bubble. True to a typical temporary lull, this did not cause a crisis for the Japanese financial system, and shows the importance of not interpreting a temporary lull in the leading index as the sign of financial crisis.

To avoid wrong interpretation, it is useful to observe the behavior of both the lagging and the leading indexes.[16] It can be said that in December 2001, Japan was in a contraction phase of the financial cycle, since the lagging index was

[16] The effectiveness of the lagging index in detecting a temporary lull stems partly from the fact that the lagging index includes some indicators that move slowly (such as the balance-sheet information of firms and households), but does not include indicators with a high correlation to overseas economies, such as stock prices. Thus, a lagging index does not react excessively to a temporary global shock. In fact, during the current financial crisis, the fluctuation of the lagging index is smaller than that of the leading index in Chart 9 (2).

negative during the period from November 1999 to April 2004. This suggests us that the revival of the leading index that began in November 1999 is a temporary lull.

V. MAINTENANCE OF FINANCIAL CYCLE INDEXES

Although gradual, the financial and economic systems have evolved over time. There have been substantial changes in areas including policy measures, regulations and supervisory processes, and safety nets. It is likely that some financial indicators will lose slowly the ability to reflect what they now are supposed to reflect. Therefore, in order to maintain and improve the performance of FCIXs, we need to replace the financial indicators. For comparison, an examination of the components of the indexes of business conditions that have been replaced reveals that, among the seven leading indicators adopted in August 1970, only one—machinery orders—survived uninterrupted until December 2010. This suggests the need for maintenance if indicators are to keep the performance of indexes at their peak.

Yet, it is also true that indicators are replaced only infrequently, since financial crises occur only every 7 to 11 years. In addition, one cannot be sure that, should a leading indicator fail to precede a financial crisis, or a lagging indicator fail to follow a financial crisis, the indicator in question should be eliminated in order to enhance the performance of the indexes. This suggests that determining the optimal timing for the replacement of indicators is not an easy task.

The current global financial crisis has not yet come to an end; the end-of-sample problem makes it hard for us to judge in real time the directions in which financial data are moving. For this reason, we believe that it is too early to discuss the need to replace the financial data in the indexes. Nevertheless, a decision, albeit incomplete, should be reached on the reconstruction of the indexes by between 2014 and 2017, which is 7 to 11 years after the BNP Paribas shock. At the same time, there should also be discussion regarding how strictly the data replacement is to be implemented, and whether replacement is necessary when financial crises are caused by overseas shocks. In addition, we should continue to look for promising financial indicators, in order further to enhance the performance of the indexes.

VI. CONCLUSION

In this paper, based on the business cycle theory, we have constructed financial cycle indexes with a view to using it to provide an early warning of financial crises. Our FCIXs include leading and lagging indexes and, as reference events, we have used the triple sell-off in 1990 and the bankruptcy of Sanyo Securities in 1997. We tested the performance of our index and found that the leading indicator falls to zero in July 2006 and succeeded in forecasting the BNP Paribas shock (August 2007) about one year in advance. This proves that FCIXs are effective tools for detecting signs of financial crises.

However, the performance of FCIXs should be evaluated under real-time conditions where we can use data available in the examination period. Since we found that real-time indexes may be too late to serve as an early warning, we sought to forecast a change in a financial time series by a change in a change. By doing so, we succeeded in reducing significantly the delays that may be caused by policy judgments due to the real-time problem, indicating that FCIXs would, indeed, be useful in real-time policymaking.

Given that the economic environment changes over time, however, the component financial indicators of FCIXs will become increasingly ineffective, requiring that those indicators which no longer serve a purpose be removed. Such maintenance is indispensible if the indexes are to remain effective. At the same time, new financial indicators should be incorporated so that the indexes might make more accurate forecasting possible.

Finally, we wish to point out some caveats regarding the use of FCIXs. First, although these indexes make it possible to detect signs of forthcoming financial crises, they do not enable one to identify the source, type, or size of the crisis. For this to be possible, financial institutions must be carefully monitored. Second, FCIXs will not make obvious the optimal policy measures that should be undertaken; appropriate measures must be devised each time, based on current economic conditions. In short, FCIXs cannot provide optimum early warning of a financial crisis unless careful monitoring, research and analysis are conducted, and appropriate policies are put in place.

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(Chart 1)

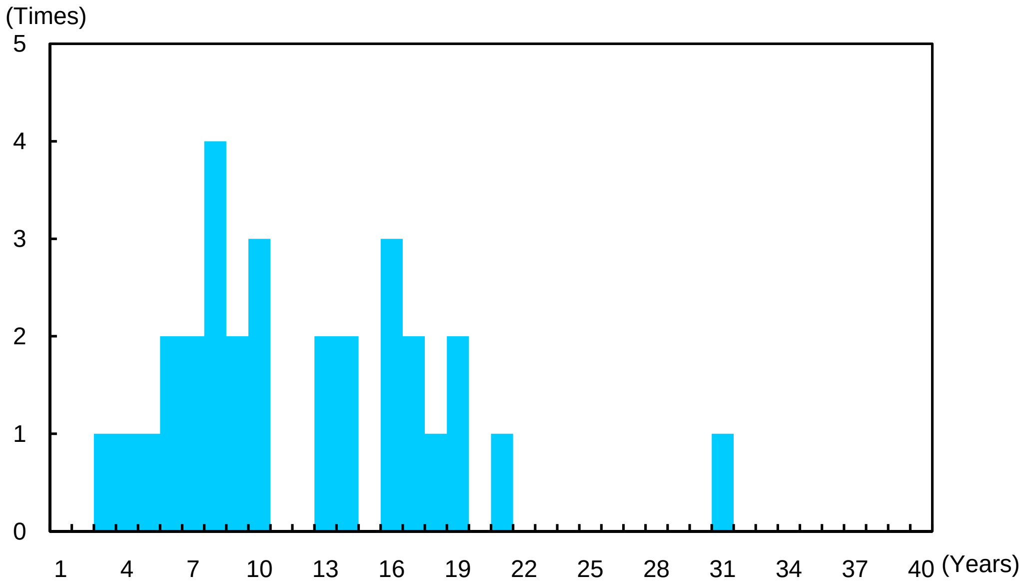
Business Cycles and Characteristics

	Name	Duration	Range	Driving Force
Super short	Seasonality	1 year	1 year	Seasons
Short	Kitchin cycle	40 months	3-4 years	Inventory
Medium	Juglar cycle	10 years	6-12 years	Fixed Investment
Long	Kuznets cycle	20 years	14-30 years	Construction, labor, urban development
Super long	Kondratieff cycle	55 years	48-60 years	Innovation, infrastructure, prices, interest rate

Note: See Hansen (1941), Röpke (1936), Shimanaka (2006), and Mori (1997). The range of duration for each cycle is the broadest one among the definitions given by the four authors.

(Chart 2)

Intervals between Consecutive Banking Crises



Source: Calculated by the authors, based on Laeven and Valencia (2010).

Note: Based on the countries that have experienced at least two banking crises between 1970 and 2009.

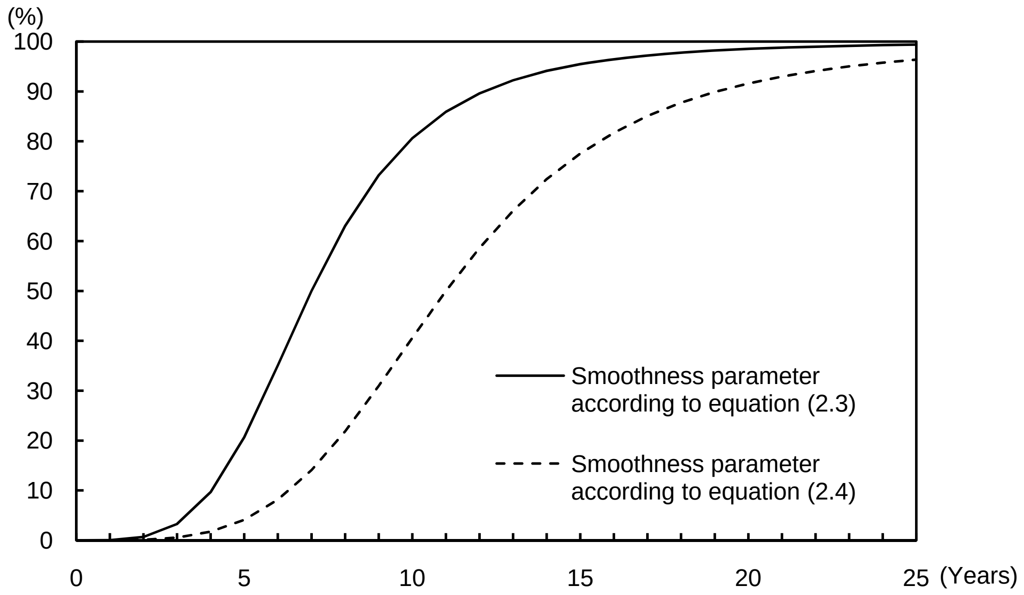
(Chart 3)

Smoothness Parameters

Data Frequency	Smoothness	
	Lower Limit (7 Years)	Upper Limit (11 Years)
Monthly	31,974	194,868
Quarterly	398	2,413
Semi-annual	25	152
Annual	2	10

(Chart 4)

Gains of the HP filter



(Chart 5)

Indicators of Financial Cycle Indexes

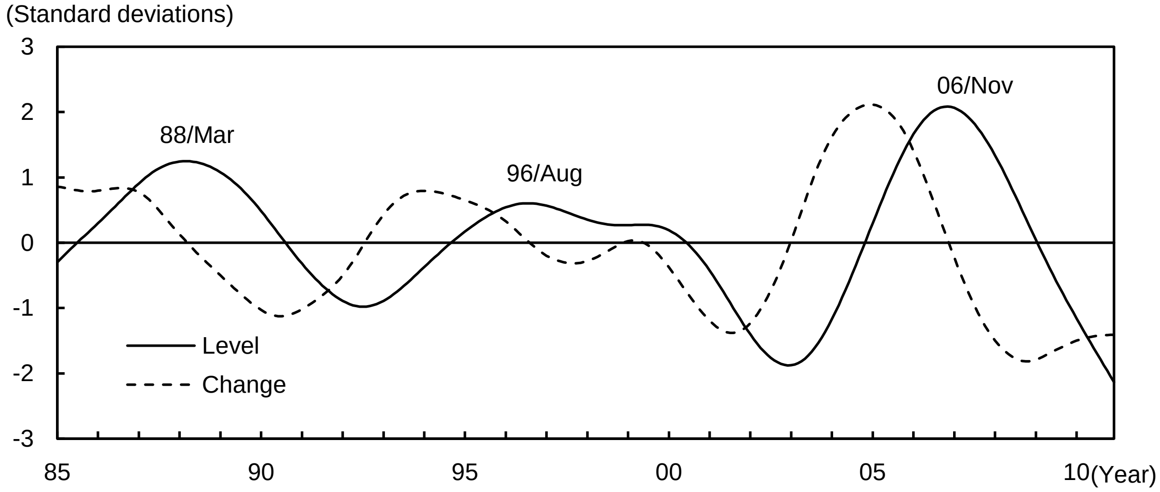
	Indicator	Frequency	Reference Series Peaks: Triple Sell-off 90/Jan	Reference Series Peaks: Sanyo Securities Bankruptcy 97/Nov	Source
Leading Indicators	Stock prices (banks)	M	88/Mar	96/Aug	TOPIX
	Stock prices (real estate)	M	88/May	97/Apr	TOPIX
	Stock prices (construction)	M	89/Mar	96/Jun	TOPIX
	Financial positions of non-financial firms	Q	89/Jun	96/Sep	*TANKAN*
	Lending attitude of financial institutions	Q	88/Mar	95/Dec	*TANKAN*
	Corporate profits	Q	89/Jun	96/Dec	Financial statements statistics of corporations by industry, quarterly
	Housing loans	Q	88/Jun	96/Jun	Loans to households
	Commodity prices	M	89/Jun	96/Jun	Reuters/Jefferies-CRB Index
Lagging Indicators	Debts of households	Q	91/Mar	00/Mar	Flow of funds accounts
	Debts of Non-financial firms	Q	90/Dec	97/Dec	Flow of funds accounts
	Lending interest rates	M	91/Aug	01/May	Average contracted interest rates on loans and discounts
	Changes in interest rates on loans	Q	90/Mar	98/Feb	*TANKAN*
	M_2	M	90/Sep	02/Jul	Money stock
	M_3	M	90/Nov	00/Apr	Money stock
	Deposits	M	90/Aug	00/Jan	Deposits by prefecture
	Land prices (all areas)	S	91/Mar	00/Sep	Urban land price index
	Land prices (large urban areas)	S	90/Sep	00/Mar	Urban land price index
	Government bond yields (3 years)	M	91/Feb	00/Jul	Japanese government bonds interest rate (Ministry of Finance Japan)
	Government bond yields (9 years)	M	91/Apr	00/Dec	Japanese government bonds interest rate (Ministry of Finance Japan)
(Reference)	Stock prices (all industries)	M	88/Nov	99/Dec	TOPIX

Note: M: monthly, Q: quarterly, S: semi-annual.

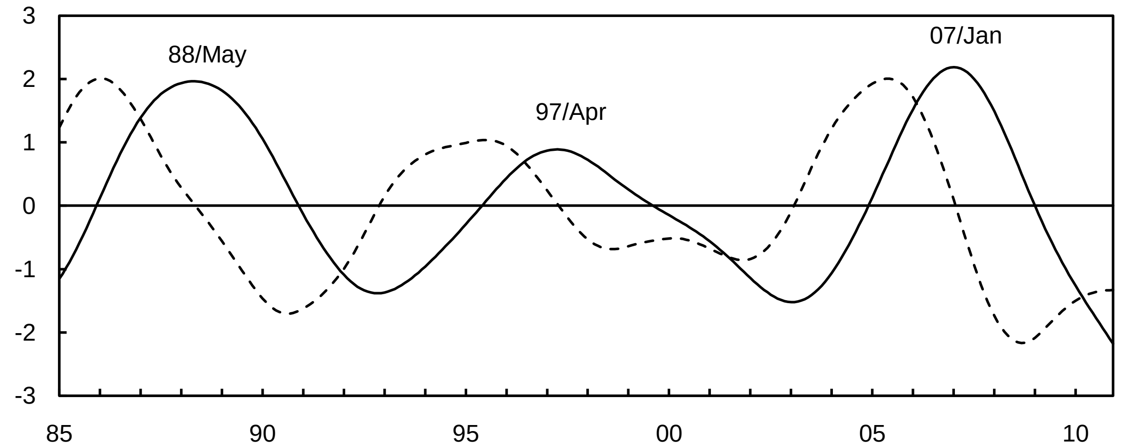
(Chart 6)

Juglar Cycles in Financial Indicators

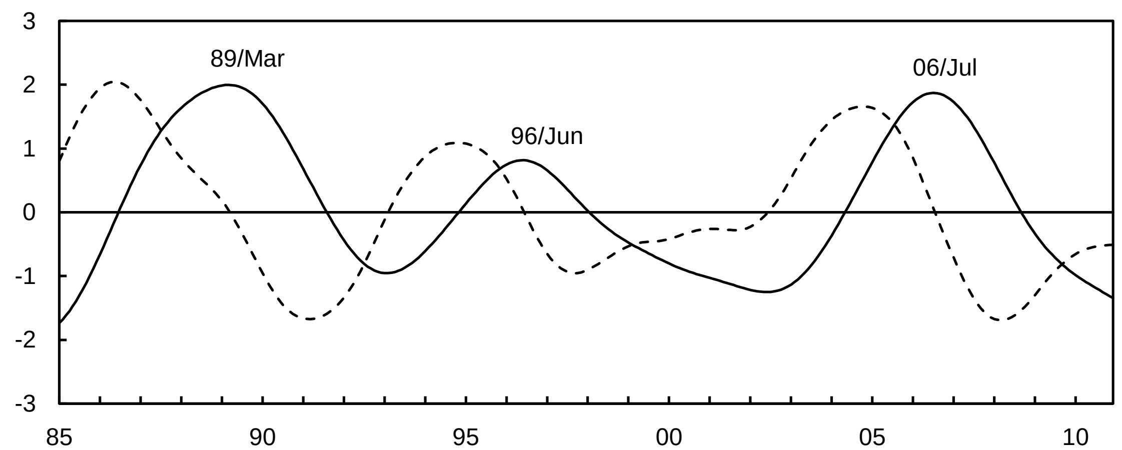
(1) Stock prices (banks)



(2) Stock prices (real estate)

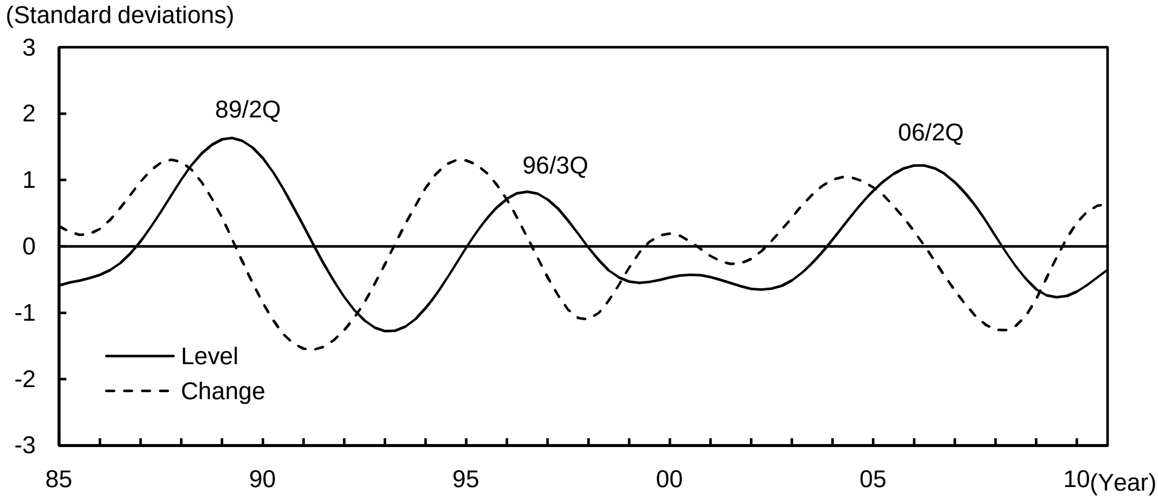


(3) Stock prices (construction)

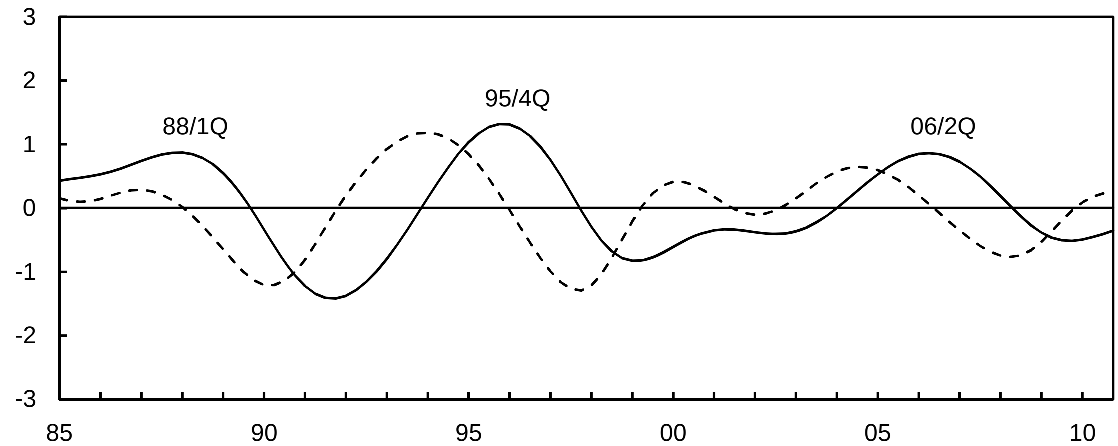


Note: Dates of peaks of the solid lines.

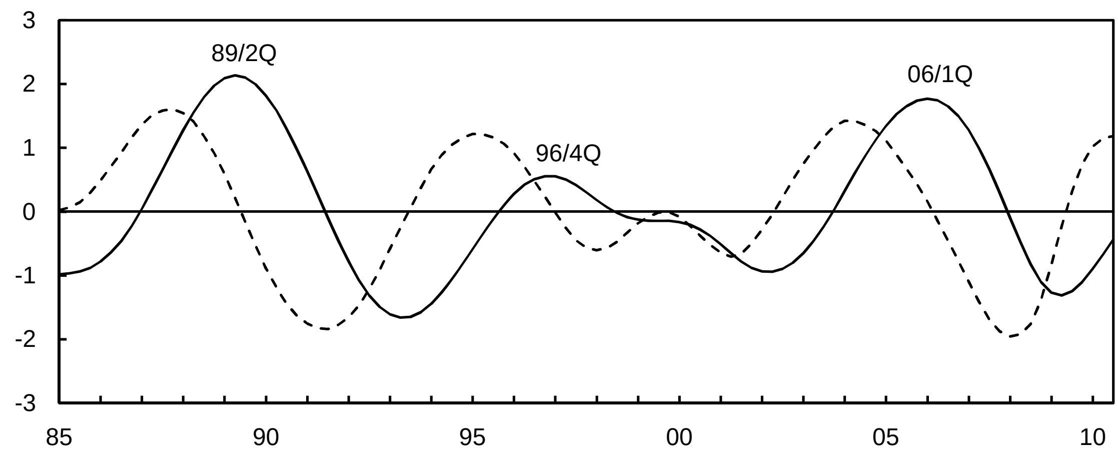
(4) Financial positions of non-financial firms



(5) Lending attitude of financial institutions



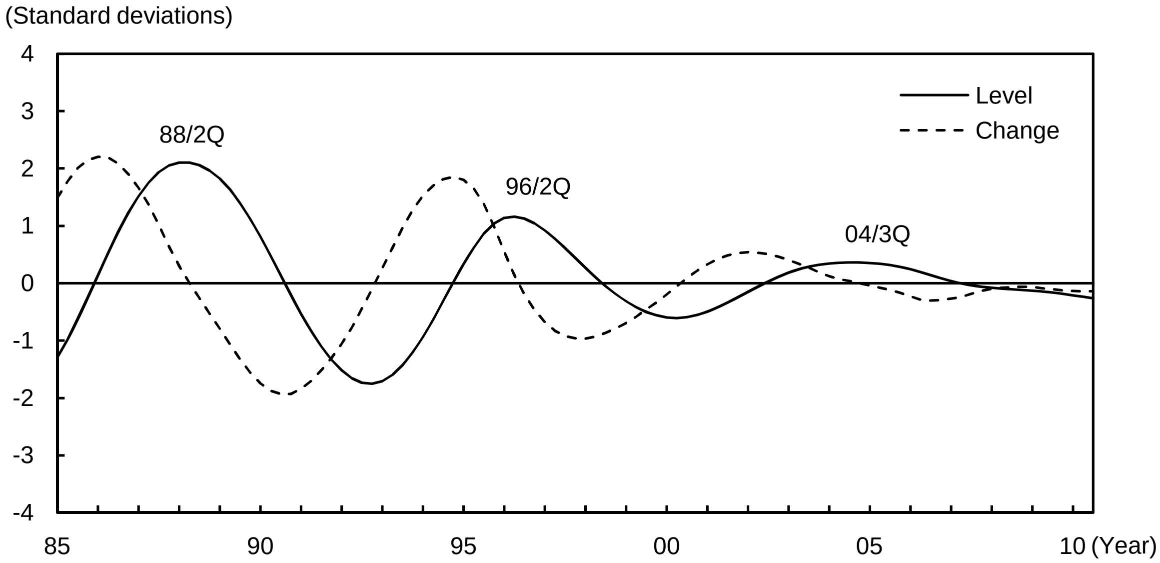
(6) Corporate profits



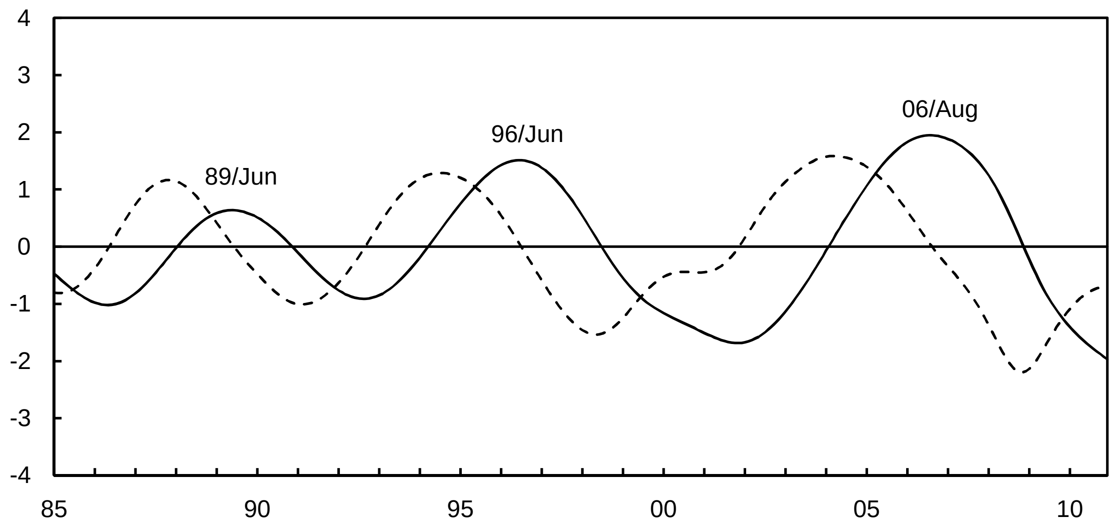
Note: Dates of peaks of the solid lines.

(Chart 6 continued)

(7) Housing loans



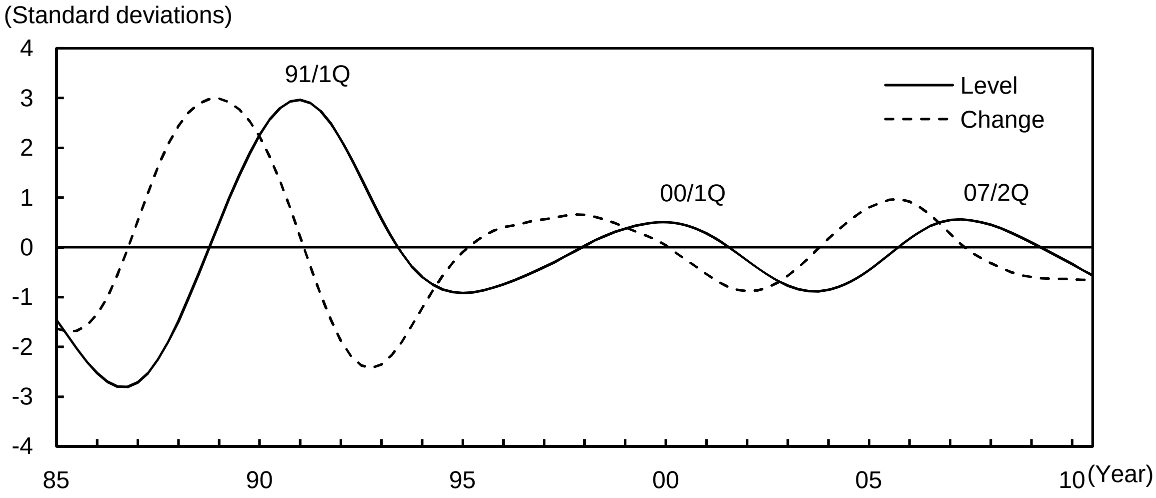
(8) Commodity prices



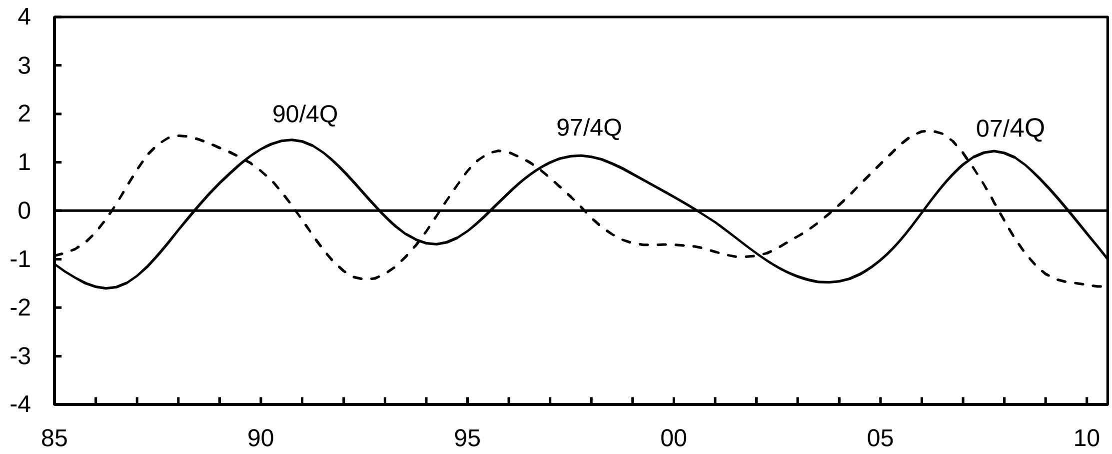
Note: Dates of peaks of the solid lines.

(Chart 6 continued)

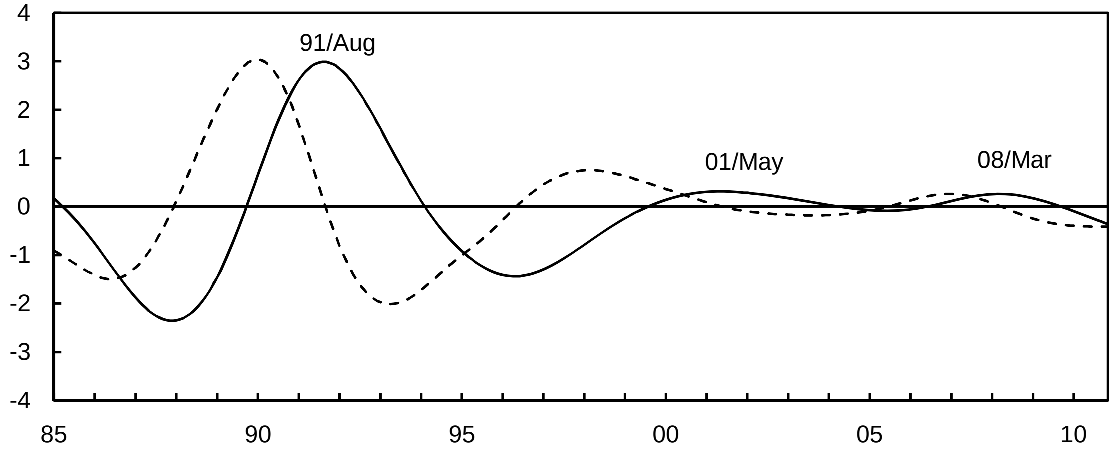
(9) Debts of Households



(10) Debts of Firms



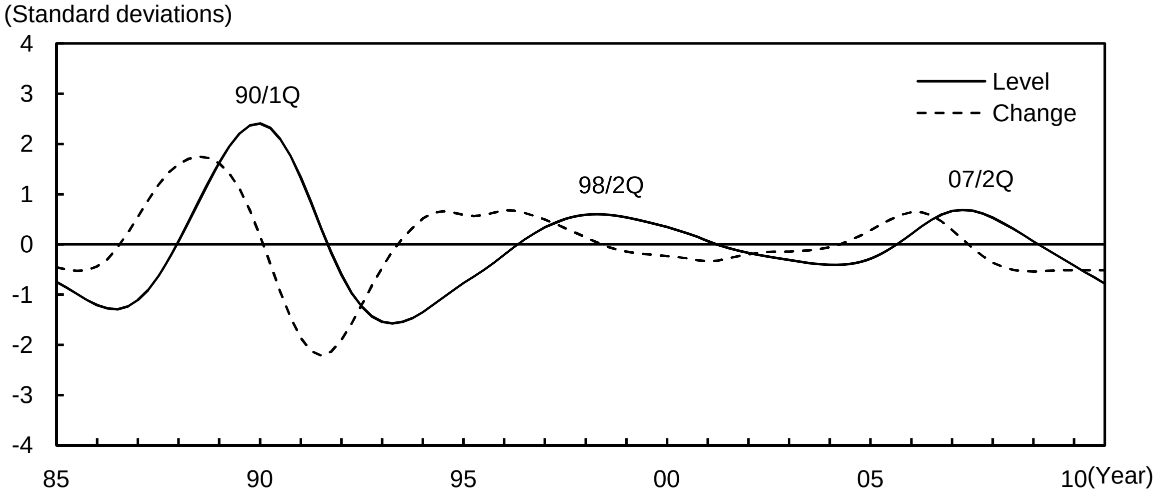
(11) Lending interest rates



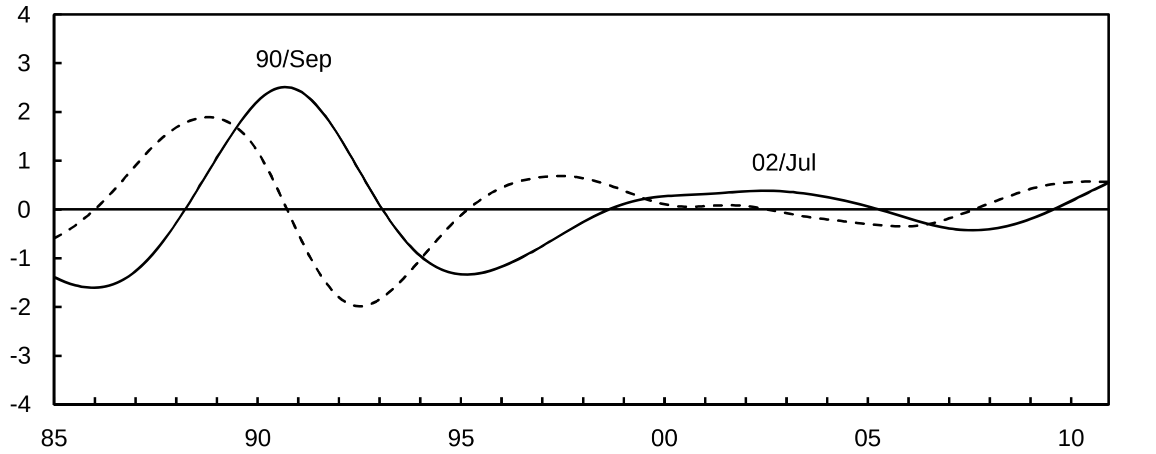
Note: Dates of peaks of the solid lines.

(Chart 6 continued)

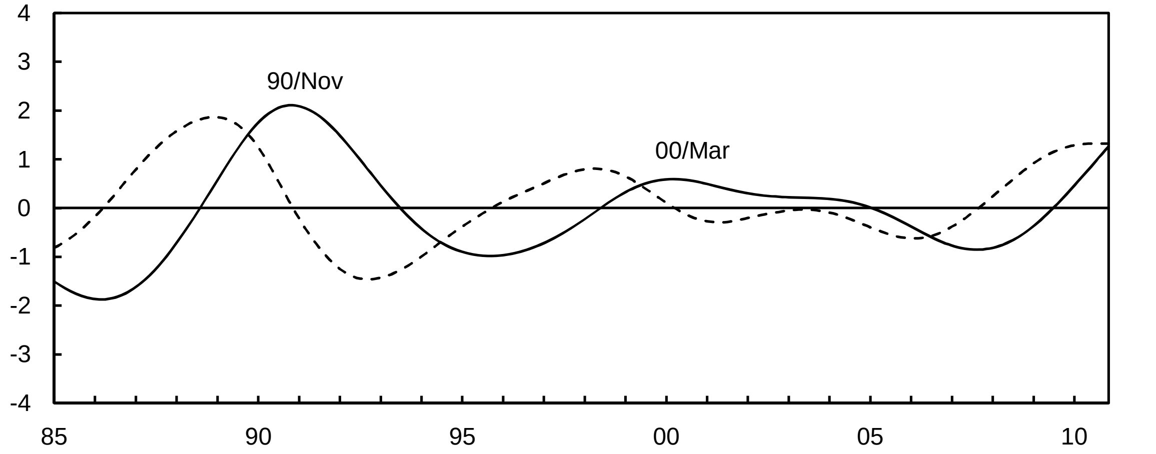
(12) Change in interest rates on loans



(13) M_2



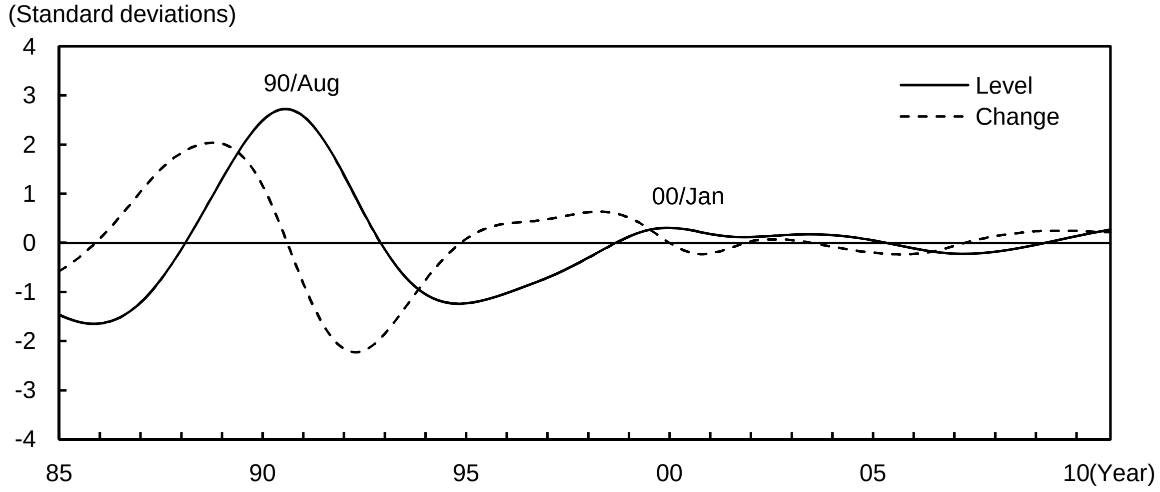
(14) M_3



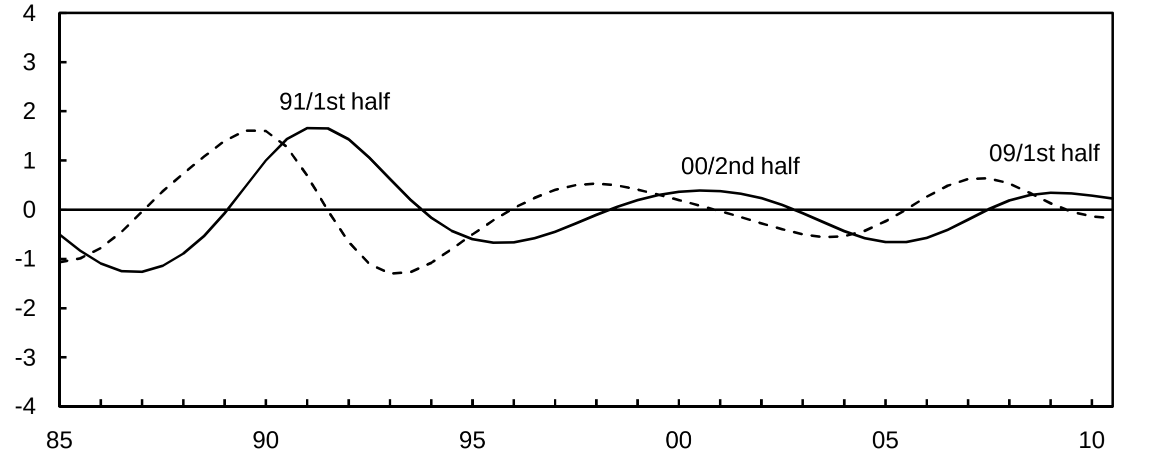
Note: Dates of peaks of the solid lines.

(Chart 6 continued)

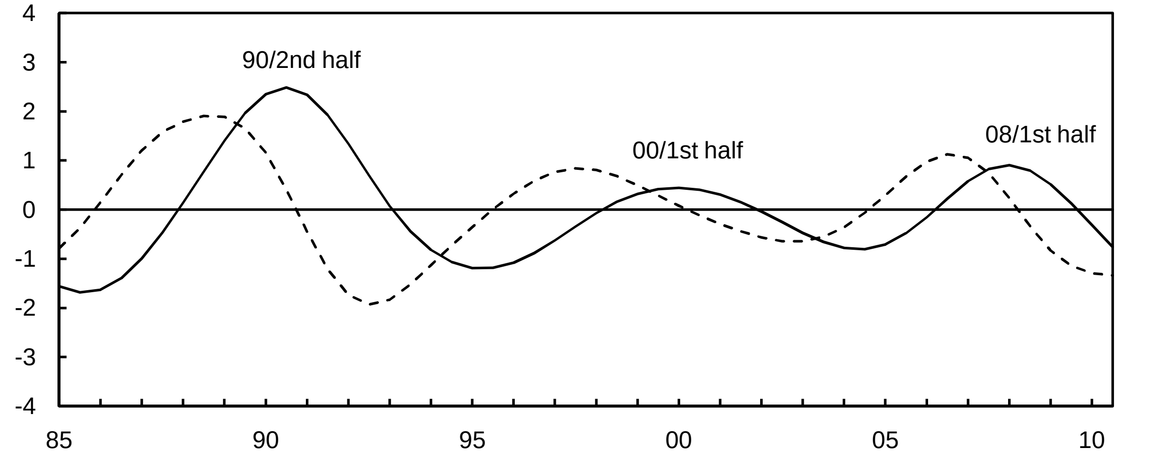
(15) Deposits



(16) Land prices (nationwide)

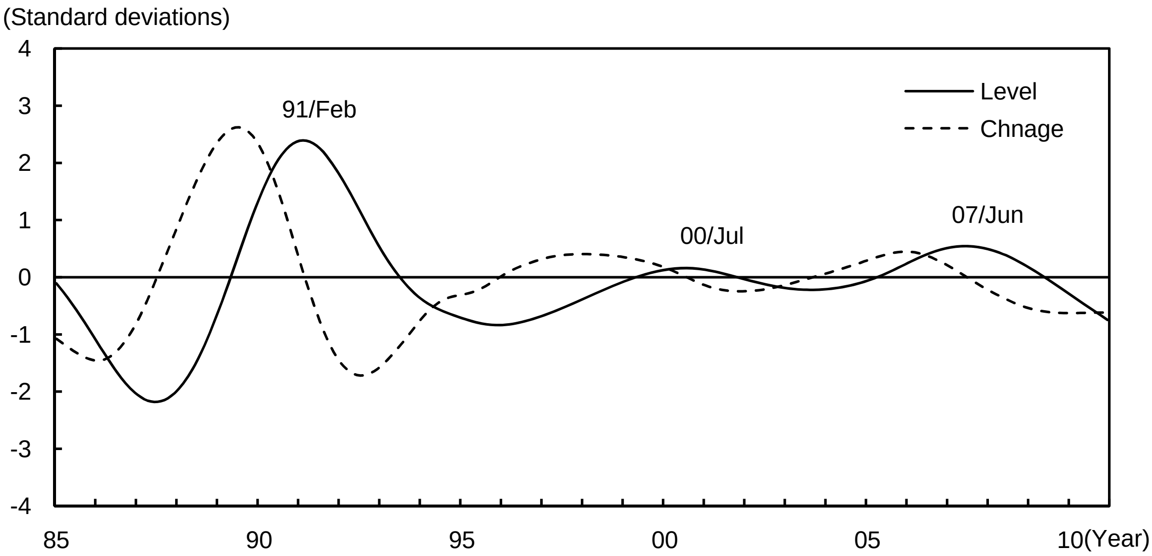


(17) Land prices (large urban areas)

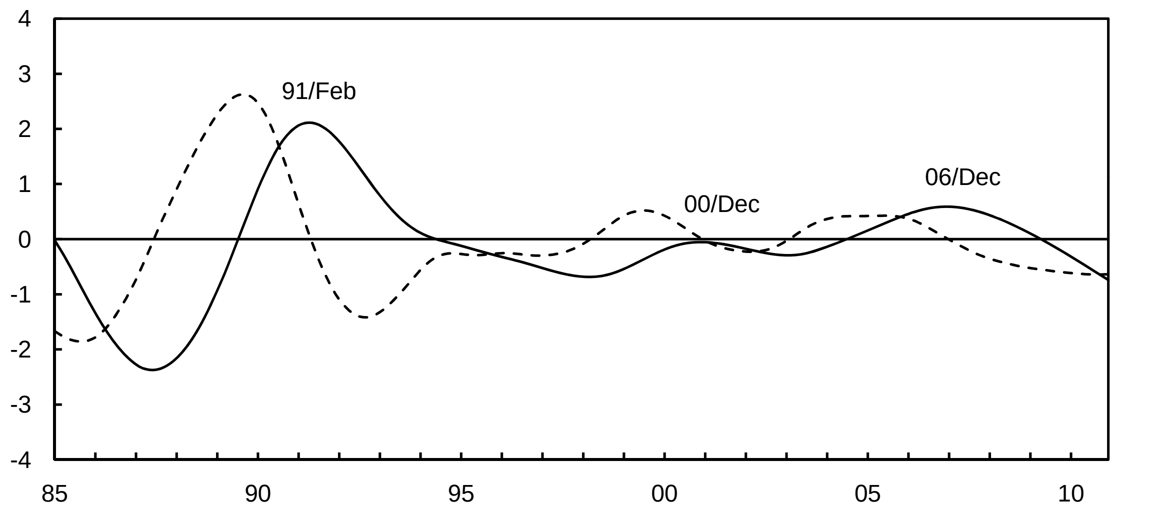


Note: Dates of peaks of the solid lines.

(18) Government bond yield (3 years)



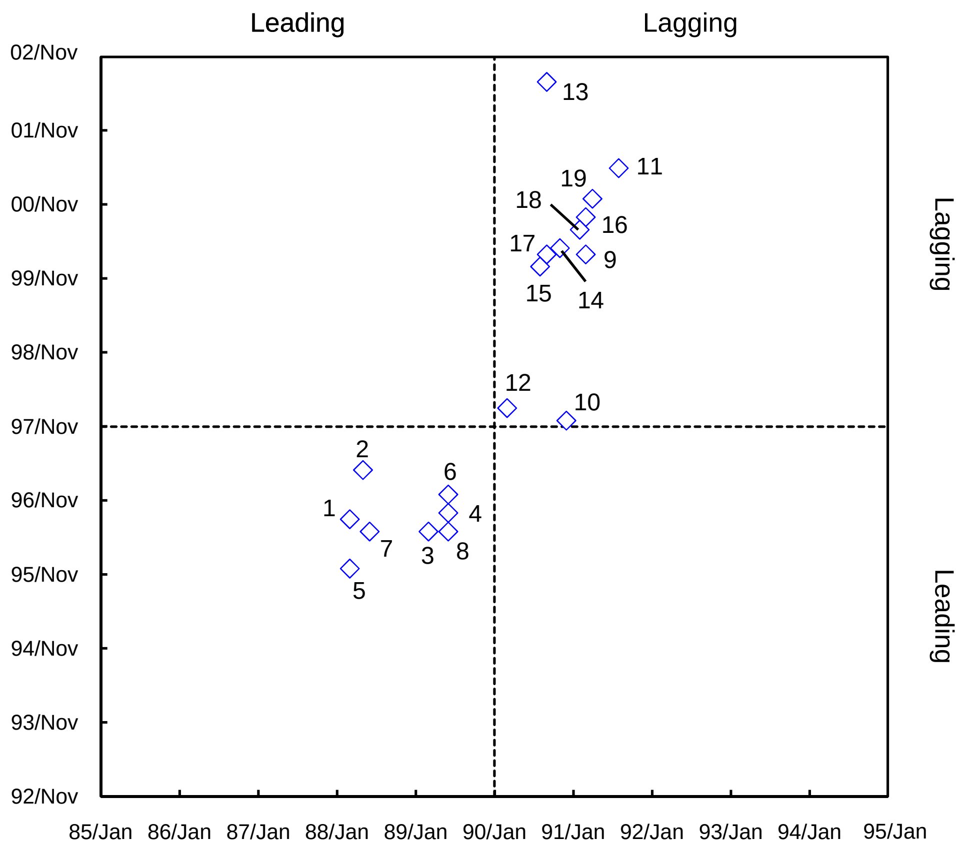
(19) Government bond yield (9 years)



Note: Dates of peaks of the solid lines.

(Chart 7)

Distribution of Peaks of Financial Indicator
Juglar Cycles (1985-2002)

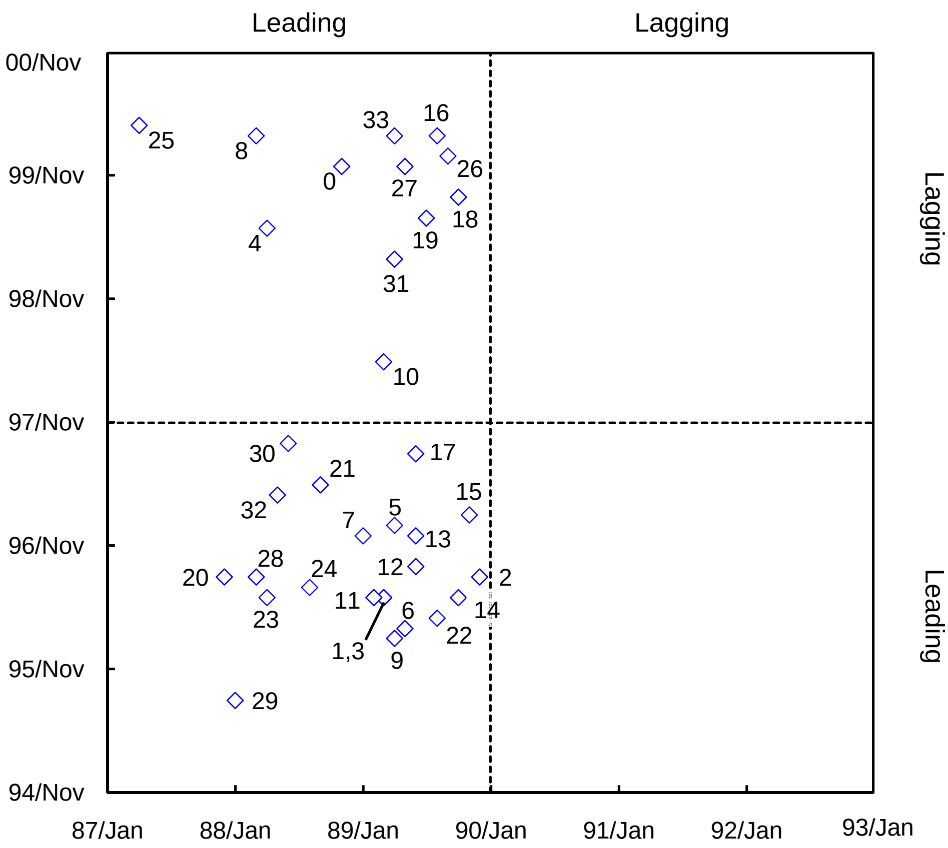


Note: The triple sell-off in the yen, stock, and securites markets occurred in 90/Jan; Sanyo Securities' bankruptcy occurred in 97/Nov.

1. Stock prices (banks)
2. Stock prices (real estate)
3. Stock prices (construction)
4. Financial positions of non-financial firms
5. Lending attitude of financial institutions
6. Corporate profits
7. Housing loans
8. Commodity prices
9. Debts of households
10. Debts of firms
11. Lending interest rates
12. Changes in interest rates on loans
13. M_2
14. M_3
15. Deposits
16. Land prices (nationwide)
17. Land prices (large urban areas)
18. Government bond yields (3 years)
19. Government bond yields (9 years)

(Chart 8)

Distribution of Peaks of Stock Price Juglar Cycles by Industry (1987-2000)

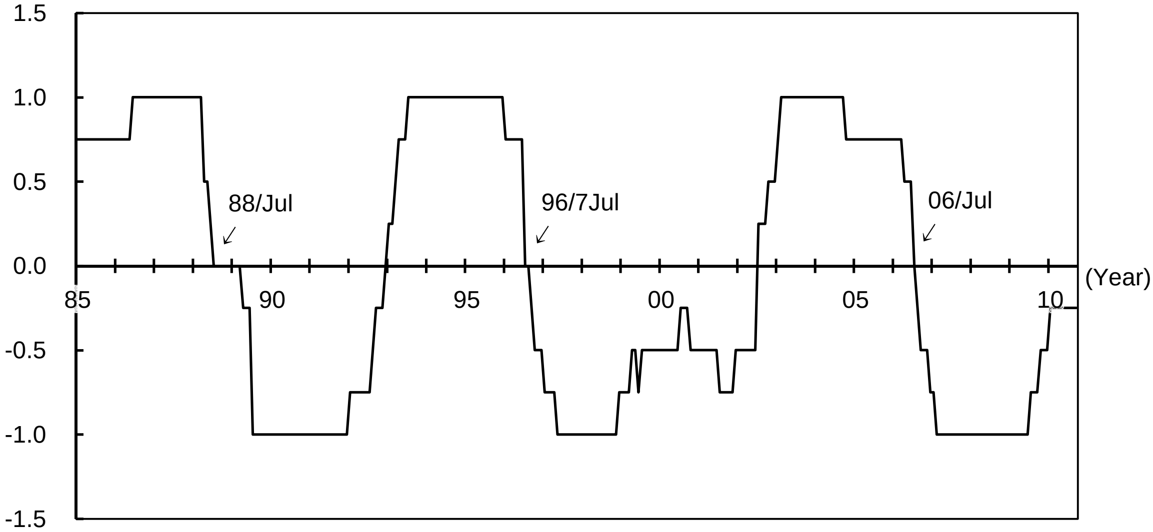


Note: The triple sell-off in the yen, stock, and securites markets occurred in 90/Jan; Sanyo Securities' bankruptcy occurred in 97/Nov.

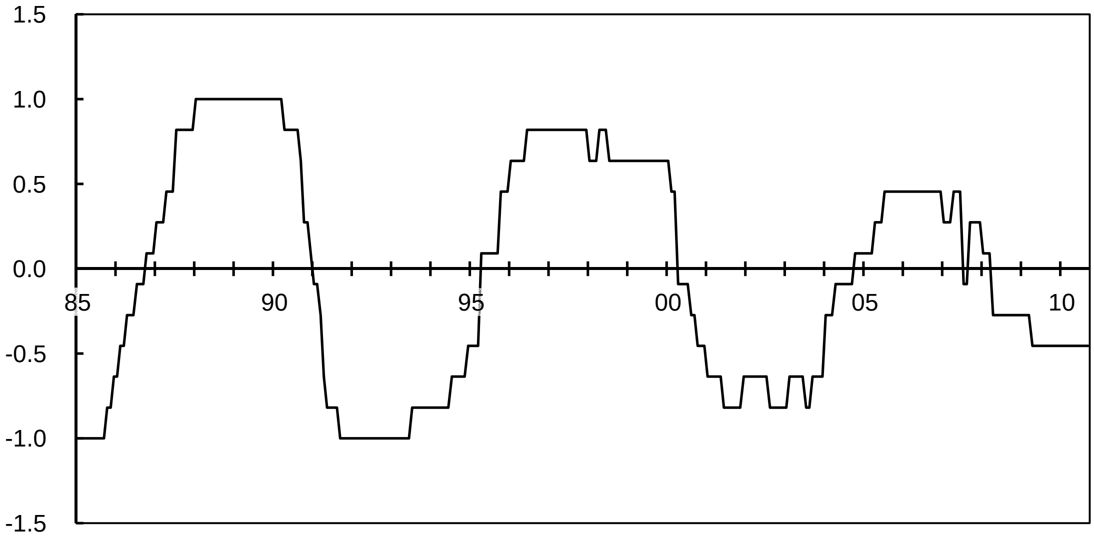
0. All industries
1. Fishery, agriculture & forestry
2. Mining
3. Construction
4. Foods
5. Textiles & apparels
6. Pulp & paper
7. Chemicals
8. Pharmaceutical
9. Oil & coal products
10. Rubber products
11. Glass & ceramics products
12. Iron & steel
13. Nonferrous metals
14. Metal products
15. Machinery
16. Electric appliance
17. Transportation equipment
18. Precision instruments
19. Other products
20. Electric power & gas
21. Land transportation
22. Marine transportation
23. Air transportation
24. Warehousing & harbor transportation services
25. Information & communication
26. Whole sale trade
27. Retail trade
28. Banks
29. Securities & commodity futures
30. Insurance
31. Other financing business
32. Real estate
33. Services

Financial Cycle Indexes for Japan (Type-D)

(1) Leading index

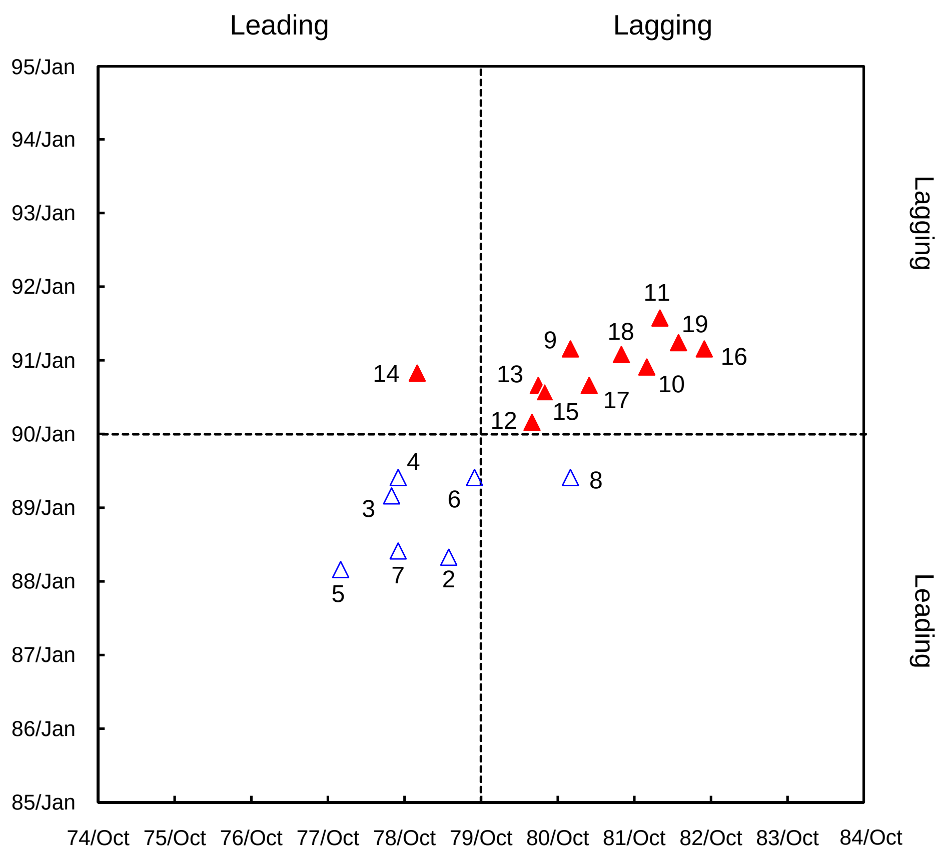


(2) Lagging index



(Chart 10)

Distribution of Peaks of Financial Indicator Juglar Cycles (1975-95)



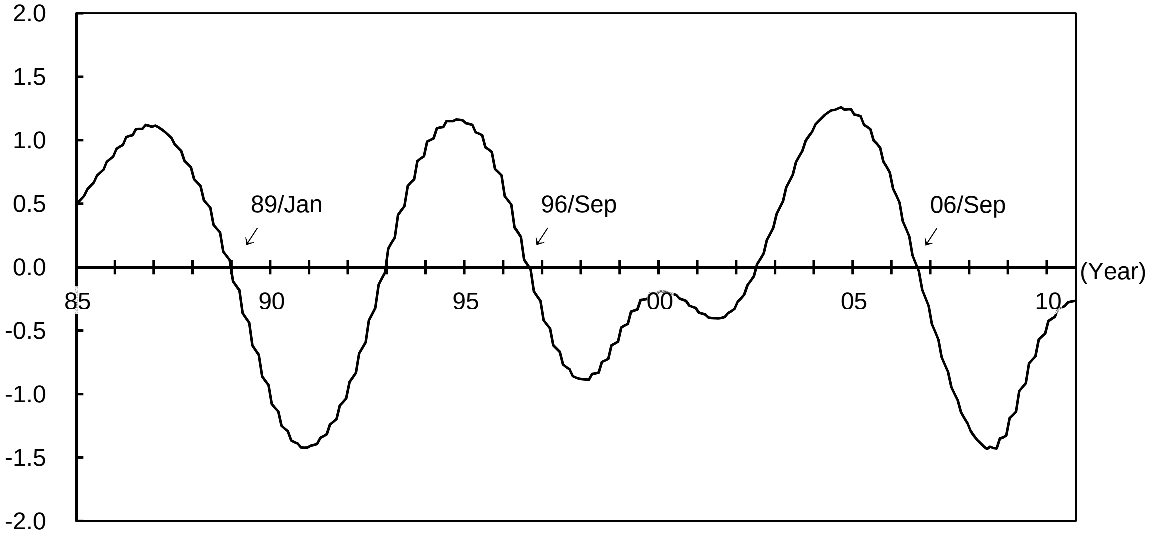
Note: Significant rises in the price of oil and other products occurred in 79/Oct; the triple sell-off in the yen, stock, and securities markets occurred in 90/Jan.
Stock prices (banks) have been excluded, because data is available only since 83/Jan.

[1. Stock prices (banks)]
2. Stock prices (real estate)
3. Stock prices (construction)
4. Financial positions of non-financial firms
5. Lending attitude of financial institutions
6. Corporate profits
7. Housing loans
8. Commodity prices
9. Debts of households
10. Debts of non-financial firms
11. Lending interest rates
12. Changes in interest rates on loans
13. M_2
14. M_3
15. Deposits
16. Land prices (nationwide)
17. Land prices (large urban areas)
18. Government bond yields (3 years)
19. Government bond yields (9 years)

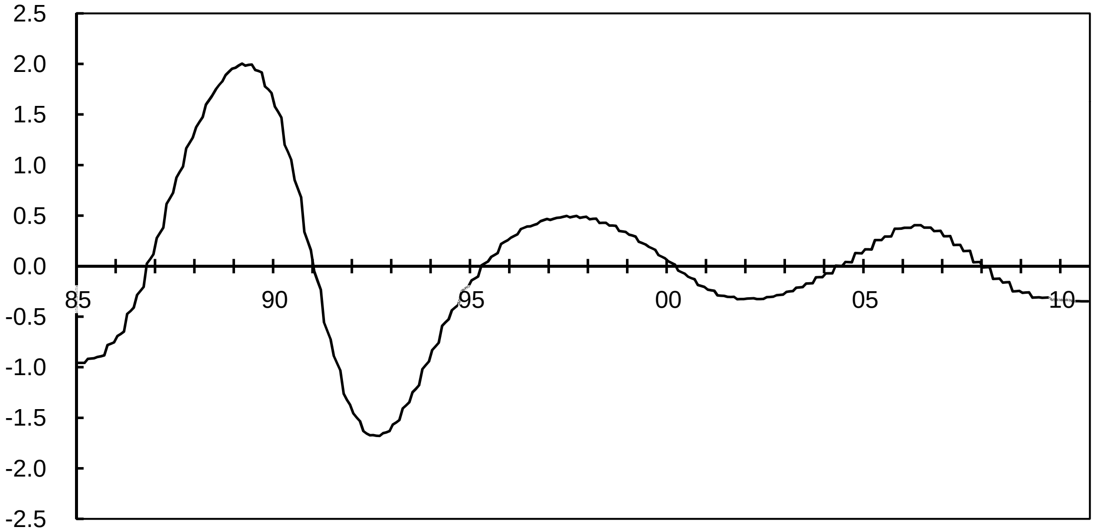
(Chart 11)

Financial Cycle Indexes for Japan (Type-C)

(1) Leading index

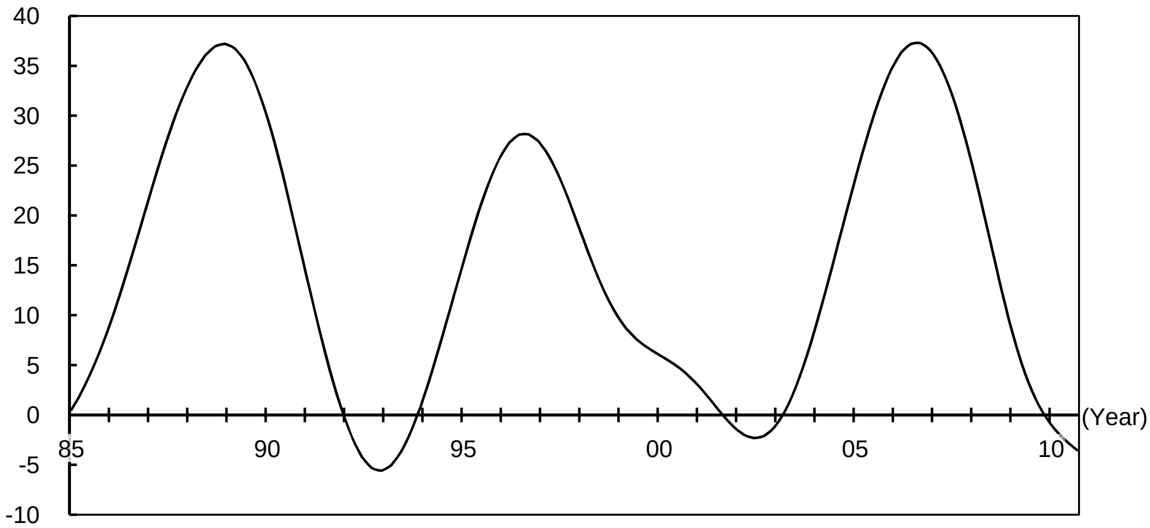


(2) Lagging index

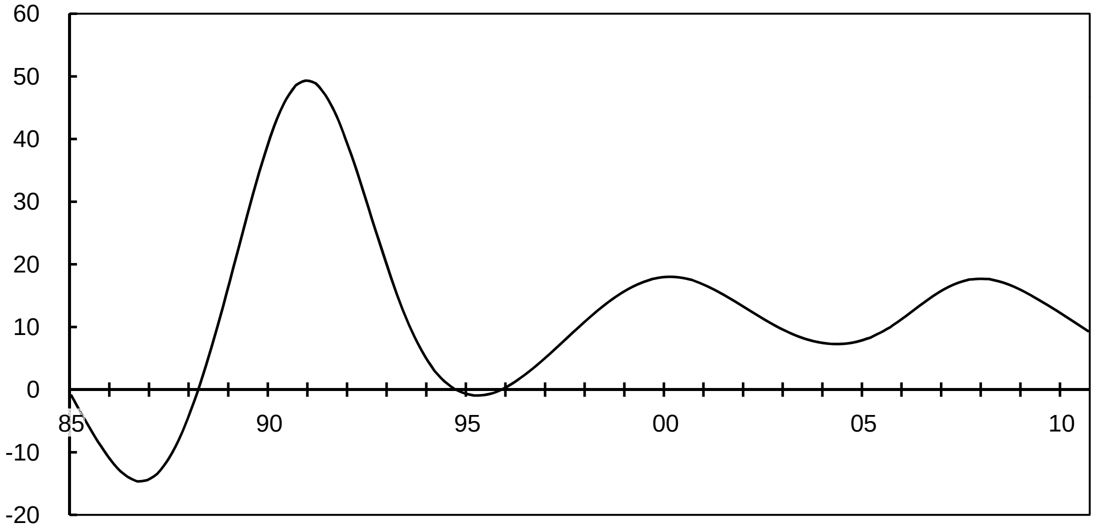


Financial Cycle Indexes for Japan (Type-B)

(1) Leading index



(2) Lagging index



Issuance Lags

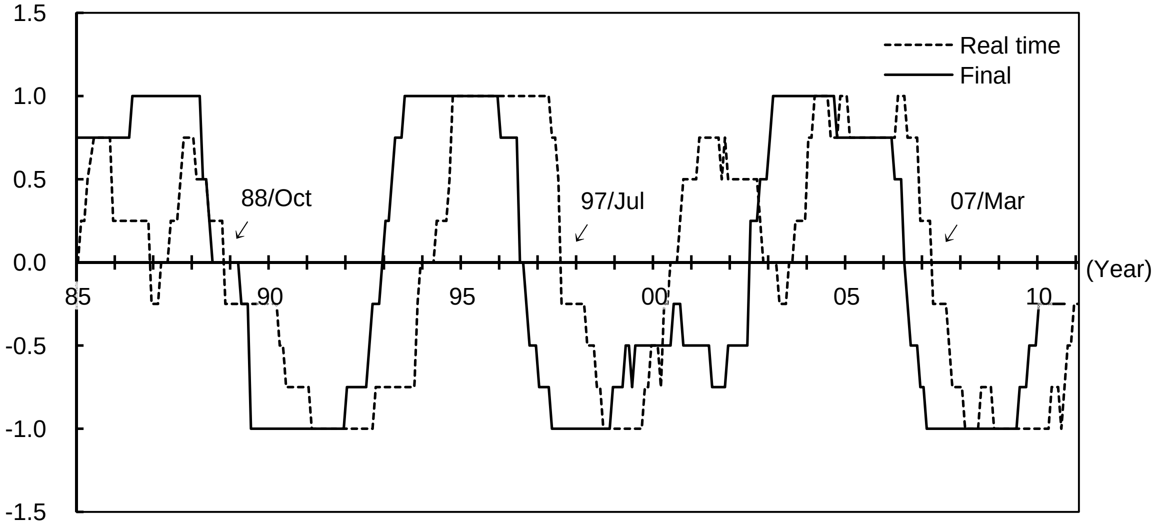
Indicator	Previous Year		Current Year									
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Stock prices (banks)	Oct	Nov	(Dec)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Stock prices (real estate)	Oct	Nov	(Dec)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Stock prices (construction)	Oct	Nov	(Dec)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Financial positions of non-financial firms		(Dec survey)				Mar survey			Jun survey			Sep survey
Lending attitude of financial institutions		(Dec survey)				Mar survey			Jun survey			Sep survey
Corporate profits		(Jul - Sep)			Oct - Dec			Jan - Mar			Apr - Jun	
Housing loans	(end of Sep)			end of Dec			end of Mar			end of Jun		
Commodity prices	Oct	Nov	(Dec)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Debts of households		(Jul - Sep)			Oct - Dec			Jan - Mar			Apr-Jun	
Debts of Non-financial firms		(Jul - Sep)			Oct - Dec			Jan - Mar			Apr-Jun	
Lending interest rates	Sep・Oct	(Nov)	Dec	Jan	Feb		Mar・Apr	May	Jun	Jul	Aug	
Changes in interest rates on loans		(Dec survey)				Mar survey			Jun survey			Sep survey
M_2	Oct	Nov	(Dec)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
M_3	Sep	Oct	(Nov)	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Deposits	Sep	Oct	(Nov)	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Land prices (all districts)	(end of Sept)						end of Mar					
Land prices (large urban areas)	(end of Sept)						end of Mar					
Government bond yields (3 years)	Oct	Nov	(Dec)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Government bond yields (9 years)	Oct	Nov	(Dec)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Stock prices (all industries)	Oct	Nov	(Dec)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep

Note: The most recent data available are for Jan 19, 2011 and are given in parentheses ().
Regular issuance months are given; issuance may be irregular.

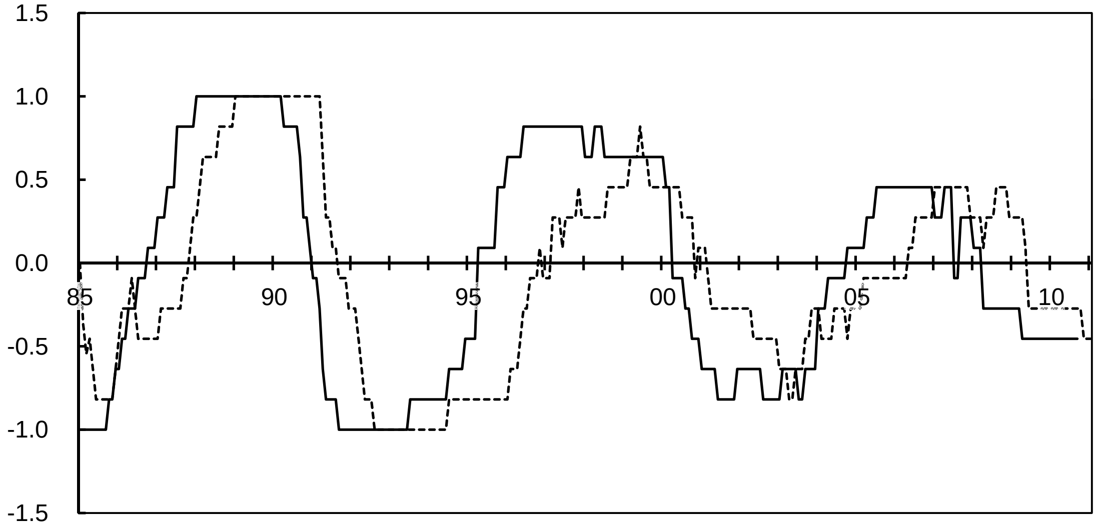
(Chart 14)

Financial Cycle Indexes in Real Time (Type-D)

(1) Leading index

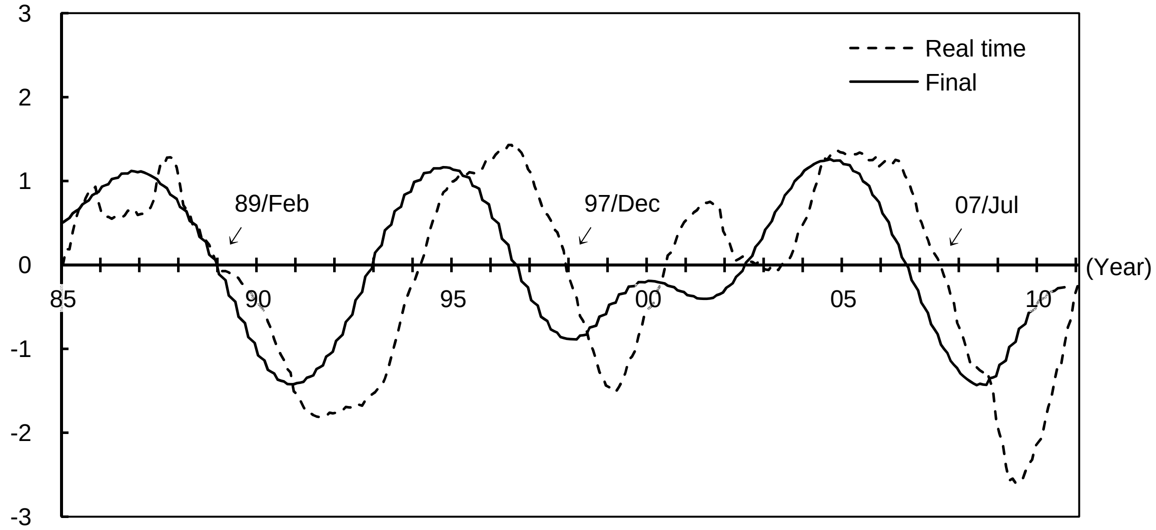


(2) Lagging index

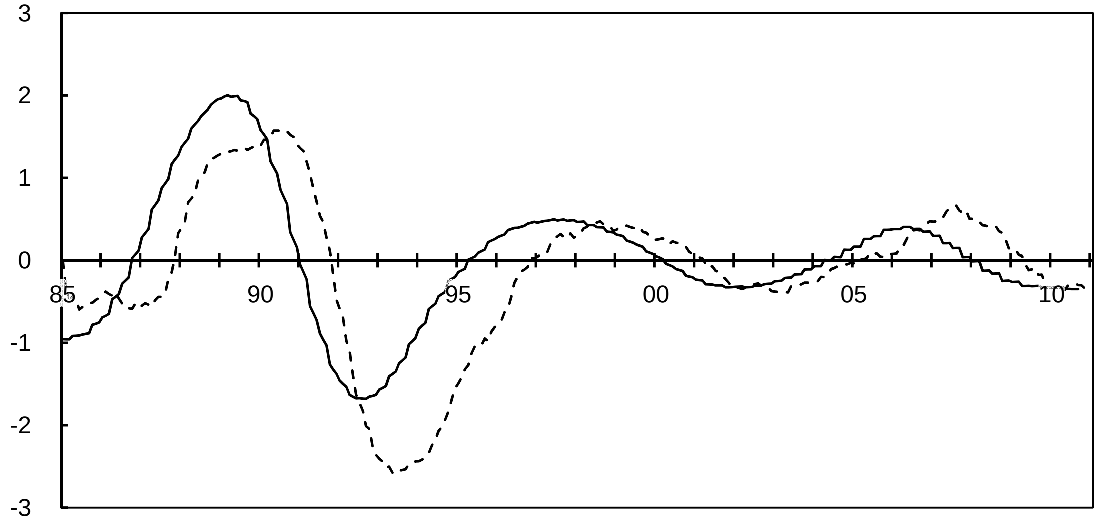


Financial Cycle Indexes in Real Time (Type-C)

(1) Leading index

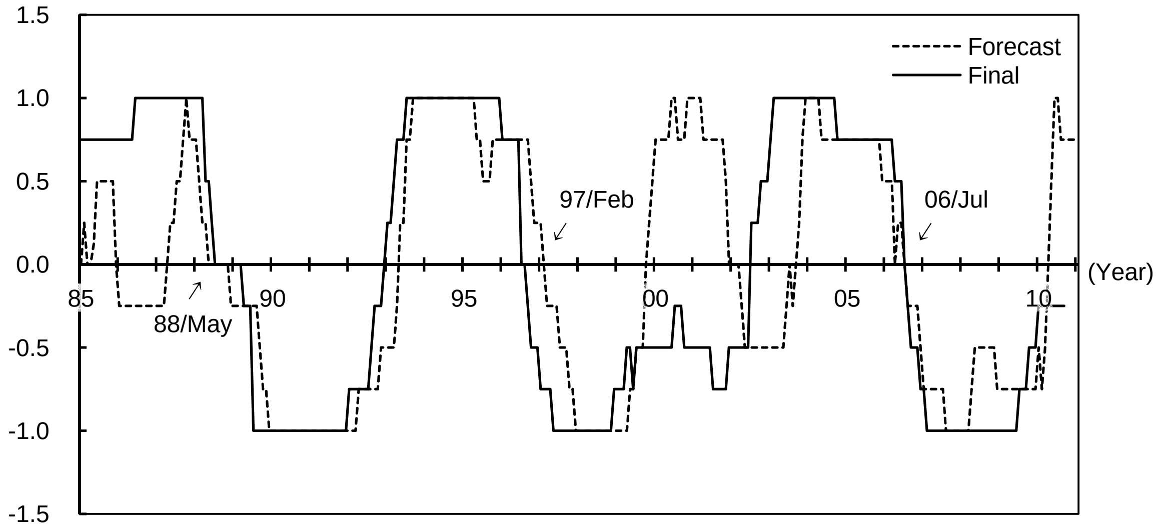


(2) Lagging index

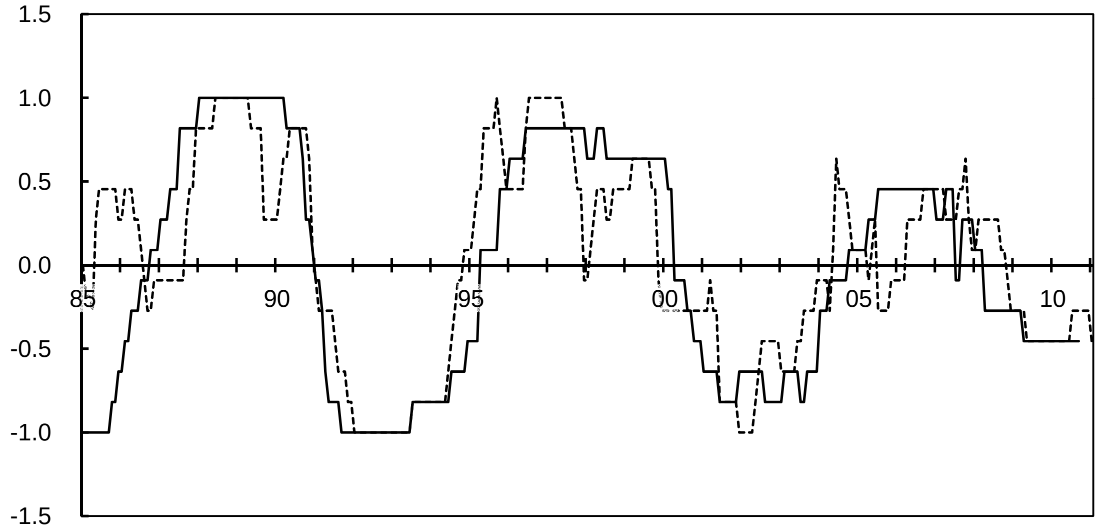


Forecast Financial Cycle Indexes in Real Time (Type-D)

(1) Leading index



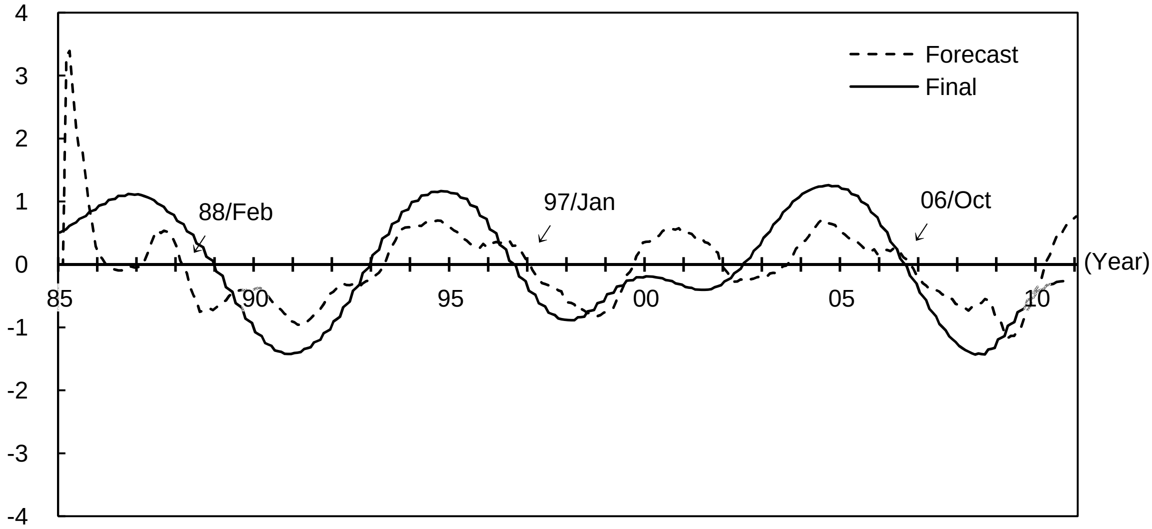
(2) Lagging index



(Chart 17)

Forecast Financial Cycle Indexes in Real Time (Type-C)

(1) Leading index



(2) Lagging index