LEADING INDICATORS OF ECONOMIC GROWTH IN THAILAND : 1970 - 1991

Kanlayanee Tantigate-Quah

The South East Asian Central Banks (SEACEN)
Research and Training Centre
Kuala Lumpur, Malaysia

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FOREWORD

The importance of having timely and reliable economic indicators for the purpose of monitoring and forecasting has long been recognized by the Board of Governors of the SEACEN countries. This is evident in its decision for The SEACEN Centre to conduct a study on composite economic indicators as one of the Centre's first two research projects in 1979. Since then, the interest among member central banks and monetary authorities in this subject has not diminished. Another indicator-related project was conducted in 1987 although it was confined to the external sector. In 1989, it was decided that the Centre was ready to embark on a more ambitious project - the construction of leading economic indicators for the SEACEN countries - which was a logical extension of the continuing SEACEN database project.

In view of the fact that the Centre has ten member countries and that this is the first time an indicator approach is used, it has become necessary to implement the Project in stages. In the first stage, the study will focus on just one country, Thailand, on the ground that the country has a good and comprehensive database. When this is done successfully, a similar technique will be applied to the other countries, which constitutes the second stage of the Project.

The present document reports the outcome of the study on Thailand. The coverage of the work reflects its main objective - that is to construct a composite index of leading indicators for the country. The Report is divided into two parts. The first part covers an overview of the leading indicator approach. It especially focuses on the procedure developed and used by the Centre for International Business Cycle Research (CIBCR) in dating the growth cycle chronology and selecting leading economic indicators. This procedure is later applied to the case of Thailand, the results of which are presented in the second part of the Report.

Work of this nature cannot be successfully concluded without the assistance and kind co-operation of various institutions and individuals. In this respect, The SEACEN Centre wishes to thank the CIBCR, particularly Dr. Geoffrey H. Moore, the late Dr. Charlotte Boschan and Dr. Anirvan Banerji, for their methodical and comprehensive training of Mrs. Kanaengnid T. Quah who implemented this particular Project. We are especially grateful to the Economic Research Department of the Bank of Thailand for kindly giving us access to their database and for allowing Mrs. Poonsin Chalermpong, Chief of the General Economic

Section, to participate in the Project. The discussion and comments given by Mrs. Poonsin and her able staff of the General Economic Section helped stimulate insights into the statistics and understanding of the nature of the Thai business cycles.

We would also like to recognize the contribution of Dr. Bambang S. Wahyudi, Assistant Director of the Research Division, for his useful comments and supervision; Ms. Doris Wong for her assistance on graphic presentation; and, Ms. Karen How for typing the manuscript. Lastly, it should be reminded that the views presented in the paper are those of the author and not necessarily reflect those of The SEACEN Centre or the member central banks and monetary authorities.

Dr. Vicente B. Valdepeñas, Jr.
Director
The SEACEN Centre

Kuala Lumpur, Malaysia
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CONTENTS

LIST OF TABLES

LIST OF CHARTS

LIST OF APPENDICES

PART I :
THE LEADING INDICATORS : AN OVERVIEW OF THE GROWTH CYCLE PROCEDURE

PART I

THE LEADING INDICATORS : AN OVERVIEW OF THE GROWTH CYCLE PROCEDURE

1. INTRODUCTION

In the volatile and rapidly changing world economic environment of today, the need for a tool that is capable of assessing and forecasting economic conditions in the quickest possible time cannot be overemphasized. As is evident in the debate over the state of the U.S. economy right now, whether it has recovered from the recession or flattened, policy planners must have the answer quickly so that appropriate action can ensue. To this end, again, they turn to the leading economic indicators before making their judgements. Likewise, financial and business managers as well as the general public keep track of the indicators for their own planning. In fact, these cyclical indicators, which have been published and widely watched since 1938, have proven time and again to be a useful input for assessing economic conditions as well as producing short-term forecast.

Although the main shortcomings of the leading indicator technique are its apparent lack of theoretical basis and inability to explain a transmission process, it does have a number of advantages. Unlike the macroeconomic modeling technique which requires considerable time and manpower to set up, maintain and update, the indicator technique involves much lesser effort. Provided that data of diversified economic coverage are available on a monthly or quarterly basis, the bulk of the work lies in the initial stage when the cyclical behaviour of these data series are carefully studied, analyzed and classified into leading, coincident and lagging indicators. Once this is done, the updating part requires little time and manpower. In addition, these indicators appeal to the public as being easy to understand and interpret.

Since the first published set of the most reliable indicators for cyclical revival by Wesley C. Mitchell and Arthur F. Burns of the National Bureau of Economic Research (NBER) in 1938,[1] a lot of research work have

1. Wesley C. Mitchell and Arthur F. Burns, *Statistical Indicators of Cyclical Revivals*, Bulletin 69, New York: National Bureau of Economic Research, 1938.

been devoted to improve and refine the technique as well as to keep it abreast with the changing economic environment and the improved statistical data and computer facilities. Out of these, one of the most significant contributions was made by the Center for International Business Cycle Research (CIBCR) under the direction of Geoffrey H. Moore in its work on International Economic Indicators (IEI). Recognizing the high inflationary situation since the first oil shock in 1973/1974 and the tendency for economic time series to be trend-dominated during an extended high-growth period, the CIBCR took a leading role in deflating the series in nominal values and switching emphasis from classical business cycles to growth cycles.

Still, the significant contribution of the CIBCR in the international context is its effort to apply the growth cycle technique to other countries. This is done out of the conviction that the cyclical indicator technique can be used not only in the U.S. but in any market-oriented economies. It also tries to shed some light on the way in which instability is transmitted internationally. To date, the CIBCR has successfully applied the technique to the U.S., Canada, the United Kingdom, West Germany, France, Italy, Japan, Australia, Taiwan, South Korea and New Zealand.

The main purpose of this Part is to present a brief overview of the growth cycle procedure as developed and used by the CIBCR. Since it is targeted for the audience who are new to the technique, it attempts to be comprehensive and to give some insights or rationale behind the procedure as well. It is organized into six sections: Section 1 gives a brief introduction to the subject; Section 2 summarizes an overview of the cyclical indicator technique; Section 3 touches on the difference between the growth and classical cycles as well as the merits of the former; Section 4 presents the CIBCR growth cycle procedure; Section 5 discusses briefly the use of composite index of leading indicators. It concludes with Section 6 which surveys the previous work on economic indicators in the SEACEN countries together with the possible application of the CIBCR procedure in these countries.

2. THE CYCLICAL INDICATOR TECHNIQUE

Cyclical indicators are one of the important outcomes of the studies on business cycles. In this respect, it is useful to begin this Part with a working definition of business cycles.

According to Wesley C. Mitchell and Arthur F. Burns, business cycles are a type of fluctuations found in the aggregate economic activity of nations that organize their work around business enterprises. A cycle in this sense consists of expansions occuring at about the same time in many economic activities, followed by similar general recession, contraction and revival which merge into the expansion of the next cycle. The important characteristics of business cycles are: (1) the sequence of changes is recurrent but not periodic; (2) they are not divisible into shorter cycles of similar character with amplitude approximating their own; and, (3) the duration of a cycle varies from more than one year to 10 or 12 years.[2] The duration of a cyclical phase, i.e., from the beginning to the end of an expansion or contraction period, should be at least five months.

Thus, careful studies on business cycles enable identification of dates at the highest points (peaks) in an expansion phase as well as the lowest points (troughs) in a contraction phase. These dates are often referred to as "turning point dates" as they signal the changes in the general direction of the entire economy either from expansion to recession or from recession to recovery. The whole set of these turning point dates constitutes "reference date" which is the benchmark date of the "reference cycles".

The cyclical indicator technique makes use of the fact that, statistically, an economic time series comprises four elements - the seasonal factor, the cyclical factor, the trend and the irregular component. The idea is to separate the cyclical factor, examine its behaviour and compare this behaviour with that of the reference cycles. Series which always reach the turning point dates ahead of the corresponding reference dates are grouped into "the leading indicators"; those which consistently turn at more or less the same time are grouped into "the coincident indicators" or "the roughly coincident indicators"; and lastly, the series which turn at a later date are called "the lagging indicators". Such a classification is very important. The leading indicators could be used for forecasting purposes as their movements indicate the direction of the general economic situation in the months ahead. Meanwhile, the coincident indicators are a useful summary of the state of the economic condition at the present time.

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2. Arthur F. Burns and Wesley C. Mitchell, *Measuring Business Cycles*, National Bureau of Economic Research, 1946, p. 3.

Thus, their aggregated movements should theoretically be the same as the reference cycles. The lagging indicators, which normally have the smoothest curves of the three groups of indicators, could be used to confirm the predictions made earlier by the leading indicators. In addition, they normally exhibit the imbalances or excesses in the economy. With some adjustment, they could be considered as the leading indicators in a longer time span.

2.1 The Reference Dates

Although the concept of reference dates is quite straight-forward, the actual identification of these dates is not that easy. Should the reference cycles be derived from a single economic time series or a group of series? How to ensure that these reference cycles and consequently the reference dates are correct?

Until now, there is no agreement on the answer to the first question. On one side, it is proposed that a single economic variable which measures economic activity in the most comprehensive form such as real GDP or GNP, or in its absence, the index of industrial production, is sufficient to generate the reference dates. The feasibility and validity of this approach, of course, hinge on the availability and reliability of the underlying data. Institutions that follow this approach are Statistics Canada and the OECD Secretariat which is responsible for developing reference dates for a number of OECD countries.[3]

On the other hand, it has been argued that a single series, no matter how broadly it is defined, might not be sufficient to reflect the state of the entire economy. As stated clearly in its definition, business cycles reflect a consensus of *many* economic activities, thus the reference cycles should represent an aggregated movement of several time series signifying the various economic processes such as employment, production, income, and trade. Further, data measurement error is more likely to occur when only one series is used. This is especially the case when the most recent figures are often based on preliminary data. To the extent that these errors are mutually independent among different series, their composite index would give a better signal than any one individual series alone. Some of the countries

3. These countries are Austria, Luxembourg, Iceland, Turkey and Yugoslavia.

that use this approach are the U.S. (the NBER, the U.S. Department of Commerce and the CIBCR), Japan (the Economic Planning Agency), Spain (Banco de España), and the United Kingdom (Central Statistics Office). The coincident series which are used to generate the reference dates in these countries are given in Appendix 1.

If a single series approach is adopted, the dating of the reference cycles is quite straightforward after studying the cyclical behaviour of the underlying series. The procedure is more complicated when the multiple series approach is used. Although a more detailed procedure is illustrated in Section 4, it should be mentioned here that the procedure involves an iterative process. In the first round, a preliminary set of coincident indicators is identified and later combined into a composite index. After analyzing cyclical behaviour of both the component series and the composite index, the first approximation of the reference dates is obtained.[4] These reference dates are then used to verify the component series whether they are really coincident indicators. Thus, in this iteration, some may be dropped while new series may be included. Subsequently, the series are again combined into a new composite index and the process is repeated until dates of the all the available evidences converge and are consistent with the experts' judgements.

To ensure that these reference dates are realistic, there is no statistics or procedure to substitute for a well-informed judgement. This requirement calls for intimate knowledge of the economic structure and history of a country. In fact, the ability to augment qualitative information to the statistical evidence at hand is needed throughout, from the identification of reference dates to the selection of leading, coincident and lagging indicators. Thus, it is a general practice to depend on a group of experts for the final decision on the reference dates. Another point worth mentioning here is that a country may have two sets of reference dates - one for the business cycles as defined in the conventional sense and the other for the growth cycles which are derivatives of the former. As will be explained later, these two sets of dates serve well under different circumstances and can be used as complementary evidences.

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4. If the turning point dates of the component series differ from those of the composite index, the dates of the former are normally chosen by virtue of being actual dates.

2.2 Economic Rationale behind the Leading Indicators

From their first appearance in 1937, the choice of leading economic indicators has been based on the fact that it takes time for certain economic decisions to realize their full economic impact. When a construction contract is signed, some time will have passed before the actual work begins. Once it begins, its economic impact will be spread to other sectors through increased demand for construction materials, labour, and others. Likewise, some lead time is needed for the building permits and new orders of machinery and equipment to be translated into real economic activity which will also spin off demand for input not only within the construction sector but also in other related industries. The leading indicator technique exploits this timing relationship by identifying the indicators which reflect new commitments in the sectors that have significant bearing on the entire economy and using them as advance warning for what will become of the economy in the months ahead.

Some indicators, however, are proven to be good leaders despite the apparent lack of such obvious timing relationships. One classic example is the average length of work-week (in man-hours) in the manufacturing sector which has an excellent record of forecasting the future employment situation. One plausible explanation, and probably also the justification for using it, is that when there is an upsurge of demand for its products, the company tends to increase the hours of overtime work of the existing staff rather than employing new workers. Although this alternative is relatively more costly, it gives the company not only sufficient time to ensure that the rise in demand is not of a temporary nature, but also the flexibility to reverse their decisions later, if need be. Thus, employment tends to rise only after a certain period of rapid increase in average length of work-week. This sequence of events, particularly in the manufacturing sector, has been observed and documented in the U.S. as well as other industrialized countries.

Apart from relying on the timing relationships, some leading indicators such as the stock price index and the ratio of price to unit labour cost are chosen out of their close connections with the most fundamental force behind business cycles - the profits. Since demand for stock depends on their respective price-earnings ratio and the forecast of the company's profit, movements of the broad stock price indexes have performed exceptionally well in foretelling the general economic condition in the near future. In fact, nearly all of the countries

that use the indicator technique includes this index in their list of leading indicators.

It is probably appropriate at this juncture to elaborate a little more on the reason why profits is a good leader of output in the sense that profits normally starts to decline before the peak in output. During a recovery stage, profits will rise rapidly as both production and prices are increasing while a unit cost remains low as the formerly idle workers and machines are increasingly utilized. However, as boom time continues, all the factors of production will be working at a nearly full capacity. Factors that work towards raising a unit cost of production such as higher wages, lower productivity, and higher input cost will increasingly exert themselves in relation to prices. Although prices will also rise, they will move up at a slower pace due to reasons such as previous commitments and determination to keep market shares. The end result is that profit margins will decline but this will not adversely affect the output as long as total profits continue to grow. Total output will decline only when a squeeze in profit margins offset an increase in output resulting in a fall in total profits.

Thus, the leading economic indicators are products of economic rationale as well as empirical tests.[5] These indicators have also withstood the test of time as many series of the original 1938 list (the average work-week in the manufacturing sector, construction contracts and the stock price indexes) remain in use in the U.S. list until today. As proven by the work on international economic indicators at the CIBCR, these series or their proxies have proven to be good leading indicators in other market-oriented economies as well.

2.3 Preparation of Series

As mentioned briefly earlier, the cyclical indicator technique makes use of the fact that for any time-series data, there are elements of seasonal factor, cyclical factor, trend and irregularities. Thus, an examination of the cyclical behaviour of time-series data has to be done after the series

5. Geoffrey H. Moore compiled a list of research work on the rationale and empirical test results of each of the leading indicators in the U.S. list. See Geoffrey Moore, "Why Leading Indicators Really Do Lead" in *Business Cycles, Inflation and Forecasting,* 2nd ed., NBER Studies on Business Cycles No. 24, 1983.

have been deseasonalized as and when the presence of seasonal factors is statistically significant.

Another step required to prepare the series before analyzing its cyclical behaviour is the deflating of the series reported in nominal values. In the original Mitchell-Burns method, this is not necessary because the inflation then was only minimal. Since the first oil shock in 1973/ 1974, inflation has become a major factor dominating the data series reported in nominal values. As empirical evidence points to the fact that cyclical behaviour of prices are quite distinct from the underlying series, it should be eliminated so that the actual cyclical factor could be observed more clearly.

For the trend factor, although there has been a general consensus of its existence, opinions among the experts regarding its treatment differ. Some believe that the trend factor should be eliminated from the series while others feel that it should be left alone.

To appreciate this problem, perhaps it is worthwhile to look back at how Mitchell and Burns view this problem in their original work of 1937. To them, there are two distinct types of trend inherent in any time series data. In the business cycle context, one is the trend within each cycle or "intracycle" trend which is combined with the cyclical forces to form one unit of experience. Thus, it is part of the business cycles and should be retained. The other type of trend is associated with the forces that move one cycle to a higher level than that of a previous cycle or the "intercycle" trend. This type of trend, therefore, should be treated like other exogenous factors such as the seasonal factor, that is, it should be eliminated from the series before an analysis of its cyclical behaviour could be performed.

Although this view on the distinction between "intracycle" and "intercycle" trend is widely accepted, the debate on how to operationalize this concept remains: in other words, how to estimate the "intercycle" trend and how to ensure that it is the true one. Some experts feel that since there is no best way to deal with this problem, and since an arbitrary method used to estimate trend would leave the interpretation and generalization of the results difficult, it is better to ignore the trend factor. On the other hand, some experts argued that even without an ideal trend estimating procedure, the effort to isolate this type of trend from the time series is still justifiable especially if one believes that these long-run trends are statistically independent of the

short-run fluctuations and the objective is to analyze the latter separately.[6] The idea of isolating the underlying trend from cyclical forces lies at the heart of the growth cycles concept which is discussed below.

3. CLASSICAL CYCLES VS. GROWTH CYCLES

To many observers of economic history, the 1960s signified a golden decade when unprecedented prosperity was evident in most parts of the world while inflation was negligible. During this period, many economists believed that business cycles had become obsolete as the industrial countries, most notably the U.S. and West Germany, were experiencing high growth rates for such an extended period. In addition, it was believed at that time that with the Keynesian economic fine-tuning way, a reliable tool to counteract cyclical forces had been found.

Although the recession as defined in the traditional Mitchell-Burns way resurfaced after the 1973/1974 oil shock, the experience of the 1960s brought about two important questions: (1) were business cycles really absent during the 1960s or was it because the measure used was not sensitive enough to capture the mild setbacks of the economy during that time; and, (2) when the economy is experiencing high growth for such a long period, what could be the effect of the trend? Was it possible that the trend factor offset the cyclical forces?

In response to these questions, Ilse Mintz was the first to come up with the idea of growth cycles in her study on business cycles in West Germany during 1950-1967.[7] By observing the movements of growth rates rather than absolute values as in the traditional way, she could successfully date the (growth) cycles during this period. Subsequently, this growth cycle concept was taken up by several leading proponents of business cycles, most notably Geoffrey H. Moore of the CIBCR. The OECD Secretariat also adopted this concept in their work on leading indicators in the OECD countries in the late 1970s.

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6. For more detailed discussion, see Philip A. Klein and Geoffrey H. Moore, *Monitoring Growth Cycles in Market-Oriented Economies,* NBER Studies in Business Cycles No. 26, 1985, pp. 29-39.

7. Ilse Mintz, *Dating Postwar Business Cycles: Methods and Their Application to Western Germany, 1950-1967,* New York: National Bureau of Economic Research, Occasional Paper No. 107, 1969.

At the outset, it should be stated that the growth cycle concept does not deviate drastically from the traditional business cycles. In fact, it retains most of the latter basic concepts and procedure. The major difference lies in how the expansions and contractions are measured. In the traditional sense, or the "classical cycles" as we shall subsequently call them, the measurement is based on the absolute level of aggregated economic activity. For example, an economy will not be considered as reaching a trough until there is a contraction in the absolute level of GDP. For the growth cycles, on the other hand, the highest and lowest points of the business cycles are measured against its long-term trend which generally depicts a long-term growth. In other words, the growth cycles are the upswings and downswings in the rates of growth around the long-term trend.

As the growth cycles measure fluctuations in the growth rates, they are a more sensitive tool to bring out even a mild setback of the economy. Thus, although the procedure in dating the growth cycles and the classical cycles is basically the same, the outcomes can be quite different. Firstly, within the same period of study, more growth cycles are observed than those of the classical type. This is not a surprise finding considering the fact that growth cycles can occur even when the rate of growth is not negative as in the case of the classical cycles. Secondly, the turning point dates of the growth cycles can be quite different from those of the classical cycles. Downturns of the growth cycles normally come earlier and upturns later. As a result, the duration of the upswing phases of the growth cycles are shorter while the downswing phases are longer. This also means that the growth cycle reference dates, or the growth cycle chronology, may not be the same as those generated from the classical dates.

It is well documented from the work of Mintz and the CIBCR that the growth cycle concept provides a suitable tool to measure economic instability in the countries which have been experiencing high growth for a long period. Although the debate on how best to estimate the long-term trend is still continuing, the growth cycles offer a few distinct advantages:

(1) As mentioned earlier, the sensitivity of the growth cycle analysis provides a means of identifying even mild setbacks in economic activity which do not become actual declines in the absolute level. This situation is sometimes referred to as "growth recession".

(2) Growth cycle peaks tend to precede business cycle peaks while their troughs tend to be coincident with business cycle troughs. Thus, it offers early warnings for what may become recessions in the classical sense later.

(3) The more frequent incidence of growth cycles provides more cases for observation and generalization.

(4) Studies at the NBER have shown that leading indicators and their composite index have a better record of forecasting growth cycles than of forecasting classical cycles. The reason may be that these leading indicators are extremely sensitive to any slowdowns of any kinds whether they are of recession variety or not.

4. THE CIBCR PROCEDURE

To summarize, the CIBCR procedure has the following salient features: (1) it measures growth cycles rather than classical cycles; (2) it relies on a group of coincident indicators rather than a single indicator to date the growth cycle chronology (reference dates); (3) it uses the same U.S. list of leading, coincident and lagging indicators as chosen by the NBER for all the 11 countries included in its work on International Economic Indicators; and, (4) it assigns an equal weight of one to each of the component indicator to compute a composite index.

It should be noted here that the growth cycles are measured by calculating the deviations of the monthly observations from the long-run trend. Thus, the estimation of a long-run trend that is stable and independent of the length of the series and the duration of a cycle are crucial to the CIBCR procedure. For ease of updating, the CIBCR also requires that the trend estimating technique should have the ability to be brought up to date without extensive revisions of earlier results.[8] After experimenting with several techniques, the CIBCR found that the Phase-Average Trend (PAT), which was developed by Charlotte Boschan and Walter Ebanks[9] best suited these requirements.

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8. Philip A. Klein and G.H. Moore, *Monitoring Growth Cycles in Market-Oriented Economies,* op.cit., p. 32.

9. Charlotte Boschan and Walter W. Ebanks, "The Phase-Average Trend: A New Way of Measuring Economic Growth", *Proceedings of the Business and Economics Statistics Section,* American Statistical Association, 1978.

As the name suggested, the technique estimates the trend by grouping the original deseasonalized and deflated series into expansion and contraction phases. This is done by first computing a 75-month moving averages of the series and later using them as the first approximation of the trend.[10] The deviations from this first approximated trend are then used to construct a chronology of the rough growth cycles wherein the turning point dates are identified and cyclical phases determined. Finally, a three-phases moving average of the original data is computed, interpolating monthly between the centered values of these averages. Appendix 2 gives details of the procedure as used in the program developed by Charlotte Boschan.

The detailed CIBCR procedure to construct a composite index of leading economic indicators is as follows:

4.1 Preparation of Series

To facilitate across country comparison, all the series used in the growth cycle analysis are deseasonalized. Those which are reported in nominal values are also deflated by an appropriate deflator. Occasionally, smoothing of the series is necessary so that a clearer cyclical pattern could be observed. This is normally done by a moving average technique over a maximum period of five months[11] with the values placed at the center.

4.2 Establishment of A Growth Cycle Chronology

A growth cycle chronology is normally determined by a consensus of two major evidences - the median turning point dates of all the roughly coincident series[12] and those of the composite index of coincident indicators. If all the coincident series have consistent timings, the two sets of dates should be more or less the same. However, this is not normally the case. Thus, some adjustments on the list of the coincident series may be needed and the composite index recalculated. The process is repeated until the two sets of dates converge.

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10. It is believed that a 75-month moving average will smoothen out the cyclical factor as duration of a cycle is seldom longer than 6 years (72 months).

11. Sometimes, a statistic called MCD (months of cyclical dominance) is used to determine the appropriate period for a moving average.

12. The roughly coincident series are those which display the turning point dates within three months either before or after the corresponding reference dates.

Although the CIBCR relies heavily on the Turning Point/Growth Program to identify the turning point dates of both the component series and the composite index, the final selection also depends on judgement through visual inspection. This is in recognition of the fact that even though the computer is 95 percent of the time correct, its choices are based purely on raw statistics without additional qualitative information whether any unusual events of either freak fortune or calamity had occurred. In addition, it is widely known that the Turning Point/ Growth Program, or commonly known as the Bry-Boschan program, does not take into consideration the amplitude of the cycle thus it has the tendency to include turning point dates of very small and shallow cycles. It is also not quite accurate in selecting the turning points at the beginning and towards the end of the data series.

After the individual coincident series are selected, they are combined into a composite index. At this stage, a number of statistical problems have to be overcome. For example, different series may have different units of measurement. Some also tend to display wider up- and downswings (such as data on production, exports and imports), while others exhibit smoother movements (such as most of the monetary and price variables). As such, a step-by-step procedure together with its brief explanation is presented below:

(1) For each component series, compute "weighted" month-to-month changes either in percentage form or first differences.[13]

The weighted percentage change is computed by using as a base the average of two adjacent figures. The formula is ((a2 - a1)/(a1 + a2)/2) * 100. This has the effect of equalizing the range of percentage increases and decreases (the limit is +200 or -200) so that they may be averaged without upward bias which occurs in the case of the normal unweighted formula.

These month-to-month changes are then standardized by a standardization factor to prevent a series with more volatile amplitude from dominating the composite index.

13. First difference is used when the series contain data in negative values.

The standardization factor for each series is the average month-to-month change without regard to sign over a certain time period (1948 to 1975).

(2) The first approximation of the composite index is obtained by computing an arithmetic mean of all the component series for each month of the month-to-month standardization changes. This means the weight is set to equal to unity, although the standardization factor is itself a form of weighting.

(3) The first round composite index is, again, standardized so that it will average to unity.

The index is then adjusted to make its amplitude equal to the trend-cycle component of the industrial production index of the country concerned. The purpose is to ensure consistency in the amplitude of the composite index of coincident, leading and lagging indicators of the same country.

(4) A cumulative index is derived from the standardized percentage changes obtained from step (3) with the initial month of the historical series set as 100 and subsequently rebasing to make 1980 the base year. The method of computation takes into account the formula by which the changes are calculated. That is, if p is the percentage change from month 1 to month 2 and y is the index for month 1, then the index for month 2 is y * (200 + p) / (200 - p).

This is the composite index without adjustment for trend.

(5) A final composite index is derived by adjusting the trend of the composite index in step (4) to equal the long-run real GNP growth rate during a specified period of the country concerned. This reverse-trend adjustment will ensure that all the three composite indexes of leading, coincident and lagging indicators have the same trend. The magnitude of the composite index of leading indicators could also be used to generate a short-run forecast of real GNP.

4.3 Construction of a Composite Index of Leading Indicators

Once the growth cycle chronology is dated, analysis of turning point dates and the lead profiles of the individual leading series

could be determined. The final selection of each leading indicator should be based on the following criteria:

(1) It should have the consistency in conforming to the growth cycle chronology throughout the entire period;

(2) It should have a one-to-one correspondence with the reference cycles, in other words, it should not have extra or skip cycles as compared with the reference cycles;

(3) It should be uniform in timing, that is, it should consistently lead the reference dates throughout and not lead in some occasions while lag in others;

(4) The series which has a more comprehensive measure or wider coverage of the economy is preferred to a series with narrower coverage, such as total imports should be used rather than imports of machinery goods;

(5) The series which is available promptly without frequent revisions is preferred; and,

(6) A monthly series is preferred to quarterly series.

The composite index of leading indicators is computed in the same way as that for the coincident index elaborated in 4.2. Appendix 3 gives the CIBCR's choice of leading and coincident series for the countries covered in the IEI project.

4.4 The Software Programs Used

4.4.1 The Plot and Gplot Program

The Plot program is used for preliminary visual inspection of the original data series. It is a useful tool to check whether the series is a good candidate for leading, coincident or lagging indicators. The Gplot program plots the various output of the Turning Point/Growth program, the most important of which are the deviations from trend. The programs are run on microcomputers.

4.4.2 The Troll Program

This is mainly used to prepare raw data for growth cycle analysis, namely, seasonal adjustment using the X-11 method, deflating data in

nominal values and computing moving averages. Some macro instructions are embedded to generate all the standardization factors used to compute a composite index. This program is run on the main frame.

4.4.3 The Turning Point/Growth Program

This twin-purpose program is used to determine turning points, estimate the phase-average trend and compute the deviations of original deseasonalized and deflated data from final trend. A brief write-up on the program procedure is given in Appendix 2. This program is written in FORTRAN and runs on the main frame.

4.4.4 The Composite Index Program

The program performs the task of combining all the component series into a composite index in the manner described in 4.2. The program also gives a trend-cycle component of the industrial production index which is used for adjusting the amplitude of the composite index. The composite index generated from this program is presented in various forms such as the compounded annual growth rate, 6-month and 12-month smoothed growth rates. This program is also run on the main frame.

5. HOW TO USE THE COMPOSITE INDEX OF LEADING INDICATORS

Although the main objective of this study is to construct a composite index of leading indicators, it will be useful to touch briefly on how to use this composite index, especially for the purpose of forecasting.

At the outset, it should be remembered that the usefulness of the raw composite leading index depends on the individual's interpretation and judgement. The index itself is not as useful as its derivatives in the same manner as the rate of change of Consumer Price Index (CPI) is a more well-known measure of inflation than the CPI itself. For example, the CIBCR has been publishing the composite leading index in the form of an annual rate of growth of the six-month change, six-month smoothed change and twelve-month smoothed change. Out of these, the CIBCR believes that the six-month smoothed change is the most reliable and uses it as a main basis for its forecast. In

addition to this, the CIBCR also relies on other relevant evidences before reaching a definite conclusion.

Apart from this six-month smoothed change, a few simple rules of thumb can also be applied to the composite leading index (CLI) to predict the onset of recessions or expansions. As shown by Koenig and Emery in their assessments of the CLI compiled and published by the U.S. Department of Commerce,[14] these rules perform as well as other more sophisticated measures.[15] The parameters to examine in each of the rules are as follows:

(1) The number of consecutive monthly decline or increase in the CLI;

(2) The percentage difference between the current value of the CLI and its maximum value over the preceding twelve months; and,

(3) The percentage gap between the current value of the CLI and a twelve-month moving average of past values. This gap can be converted to an annualized percentage rate of growth.

Before implementing, a critical value for each of these rules has to be specified. For example, the number of months of consecutive increase/decrease that, basing on either past performance or some other criteria, will signal a turning point correctly is needed for Rule (1).

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14. Evan F. Koenig and Kenneth M. Emery, "Misleading Indicators? Using the Composite Leading Indicators to Predict Cyclical Turning Points", *Economic Review,* Federal Reserve Bank of Dallas, July 1991, pp. 1-14.

15. In the Koenig and Emery study, a more sophisticated signaling rule which was first developed by Neftci was also used. The Neftci methodology assumes that the history of CLI can be divided into expansion and contraction phases, with the behaviour of the index during the expansion phase being fundamentally different from that of the contraction phase. It further assumes that the turning points in the CLI will precede turning poins in the overall economy. Thus, the Neftci formula for the probability of the recession is written as:
$P_t = [P_{t-1} + P_L (1-P_{t-1})] F_t^d / \{[P_{t-1} + P_L (1-P_{t-1})]F_t^d + (1-P_{t-1})(1-P_L)F_t^u \}$
where, P_t is the estimated probability that the composite index of leading indicators is in its contraction phase at time t, so a recession is imminent; P_L is a priori probability that the CLI has entered its contraction phase, given that a month earlier the CLI was in its expansion phase; and, F_t^d and F_t^u are the likelihoods that the latest observation of change in the CLI came from the contraction phase of the index and the expansion phase of the index, respectively.

It must be remembered, however, that the more stringent the critical value, the less advanced warning the given measure will provide, thus making it less useful for forecasting purpose. On the other hand, the more stringent the critical value, the fewer false signals the measure is likely to give. For example, a prediction basing on a critical value of four months in Rule (1) would be more likely to be correct than the one basing on a critical value of two months. However, if all the latest data of the component indicators become available after a four-month lag, the conclusion of the four-successive month rule can no longer be made before the recession or expansion takes place.

Of the three rules, the first one is of course the simplest and the easiest. In practice, the most appropriate critical value can also be easily determined by experimenting with a few values and observe the corresponding performances. The main drawback of this rule, however, is that it ignores the magnitude of changes of the index. In this respect, the second and third rules are preferred because they involve both the number and the magnitude of declines/increases. This is confirmed in the Koenig and Emery study.

Apart from the above rules, there are several other suggestions on how best to use the CLI. Some attempt to incorporate an element of probability into the composite index,[16] in the belief that it will help enhance the predictive power of the CLI at least in its ability to signal with a certain confidence interval whether the turn will occur. All these suggestions illustrate the fact that the value of the CLI is generally as good as the person who uses it. In this perspective, it is quite logical to have some specialization of tasks here. Institutions like the U.S. Department of Commerce or even the CIBCR focus their effort on the compiling, updating and revising part of the index, which already requires a substantial effort in itself, and leave the interpretations mainly to the users themselves.

16. This is normally done at the stage of combining the component indicators into a composite index. See, for example, James P. Lasage, "Analysis and Development of Leading Indicators Using a Bayesian Turning-Point Approach", *Journal of Business and Economic Studies*, July 1991, Vol. 4 No. 1, pp. 305-316.

6. APPLICABILITY OF THE CIBCR PROCEDURE TO THE SEACEN COUNTRIES

6.1 Previous Work on the Indicator Technique

6.1.1 The Composite Economic Indicator

The importance of having economic indicators that are available on a timely basis and can be updated easily to guide policy planners has long been recognized by the SEACEN countries. Fourteen years ago in 1978, The SEACEN Centre undertook a project on Composite Economic Indicator with the aim of constructing a set of economic indicators which would provide a means of determining the direction of economic activity.[17] This comparative study reviewed the two methods used in some of the SEACEN countries to construct economic indicators during that time. Indonesia, Malaysia, the Philippines and Thailand adopted the business cycle index (BCI) approach while Singapore used the diffusion index (DI). The study was published in 1979 but, in line with the SEACEN Centre policy at that time, its circulation was restricted to member central banks and monetary authorities.

Conceptually, the BCI was a useful tool to indicate whether the economy needed any fine-tuning as its movements reflected departures from and returns to a "normal state" of the economy. As such, the BCI represented a diversified economic coverage in the sense that the component series were drawn from all economic process groups. The procedure began with the selection of data series and adjusted each of them for seasonal and irregular components. The heart of the procedure was determining the check points for each individual series. If the rate of change for a particular period coincided with the expected value or the "norm" of the series, a zero point was assigned. If the rate was higher (lower) than the expected value, a positive (negative) number was given accordingly. Thus a highly positive number warns of overheating while a highly negative number warns of recession. These points, which were based on the opinion of the experts in that field, replaced the actual rates of changes of the individual series. Lastly, a certain weight was assigned to each component series for the purpose of combining them into a composite index. The

17. The SEACEN Centre, *Composite Economic Indicators,* Kuala Lumpur, Malaysia, 1979.

composite index was again assigned check-points as in the individual series. The study mentioned in passing tests for leads and lags but did not elaborate how this could be done.

The DI approach differed from the BCI in three aspects. First, it only took into account the direction of change. For each series, one-half (0.5) point is given if the rate of change for that month was zero (plus or minus a small allowance); plus one (+1) point if the rate of change was positive; zero (0) point if the rate of change was negative. This eliminated the necessity to determine the "norm" or expected value of the series. Second, the computation of composite index did not require a weighting scheme for each component series. Third, the DI provided classification of data series into leading, coincident and lagging indicators through the identification of reference cycles.

Overall, the study gave a useful effort in providing a step-by-step procedure to construct the BCI and DI. Unfortunately, it could not meaningfully evaluate the performance of both of the indexes due to lack of data. Some important data series such as inventory or employment were not available or were only available on an annual basis. The available monthly or quarterly series used were also too short (most series were available up to seven years) to allow a meaningful analysis of business cycles.

In addition, there were problems in the methodology itself. For the BCI, since it relied heavily on judgments of the experts in determining the "norm" value and assigning check-points and points, it brought a high level of subjectivity and arbitrariness into the index and made it hard to standardize the procedure for computerization purpose. In addition, the BCI was essentially a coincident indicator. It could produce short-term forecast only after predictions of the sub-groups of the composite index were made, some of which were quite difficult to obtain. The DI method, on the other hand, could be used readily for short-term forecast through the leading indicator group. It was also known to produce better results during the period of vast structural changes wherein the assignment of check-points in the BCI procedure was extremely difficult. However, the DI procedure itself had a few disadvantages. As mentioned earlier, it only provided the direction of changes while the magnitudes of changes were discarded. In addition, to enable a well-balanced choice of time-series, the procedure called for a large amount of data series. To date, only the Bank of Thailand continues to update and publish the BCI indicators regularly.

6.1.2 Other Work on Economic Indicators in the SEACEN Countries

Apart from the SEACEN study on Composite Economic Indicators, another project of similar nature was conducted by the Institute of Developing Economies (IDE) in Japan in collaboration with partner institutions (mostly universities) in the participating countries. This Project which was called the Short-term Economic Predictions in Asia (SEPIA) started in April 1984 and ended its development stage in March 1989. Its objective was to develop a diffusion index for the seven Asian countries (India, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand). The role of the IDE was to provide the methodology, the computer software programs and the financial support.[18]

Being a more recent study, the SEPIA Project was able to make full use of the improved computer facilities in terms of software programs and the evolving concept of business cycles. In its cyclical analysis of each data series, the Bry-Boschan Program, or the Growth/ Turning Point Program as referred to in the CIBCR procedure, was used to select the turning points. The Program was, however, slightly modified to allow users to impose their own criteria on the duration of a cycle and a cyclical phase. Recognizing that most of the Asian countries included in the study have been recording very high growth rates for a long period, a growth cycle concept was applied to most of the countries. In addition, the SEPIA Project also made use of the Phase Average Technique to detrend the series before making a final selection of turning points.

6.2 Application of the CIBCR Procedure

The results of the SEPIA project illustrated that the cyclical indicator technique could be applied to the SEACEN countries. Although availability of data continues to be a source of frustration in the SEPIA project, the databases in these countries have improved tremendously compared to the situation in 1979. Most of the countries have monthly or quarterly data as far back as mid-1970s thus at least two or more cycles could be observed. The study also succeeded in identifying

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18. The Institute of Developing Economies, *Business Cycles in Five ASEAN Countries, India and Korea (II),* ed. by Hiroshi Osada and Daisuki Hiratsuka, Tokyo, 1989.

the reference cycles based on several coincident series and using iterative method similar to that of the CIBCR. However, since the completion of its development stage, some of the participating institutions have stopped compiling and publishing these diffusion indexes due to lack of financial support.

Going by the results of the SEPIA project and the SEACEN study in 1979, the procedure suggested by the former seems to perform better, especially when the main objective is short-term forecast. This is because the IDE procedure involves minimal subjectivity and arbitrariness. It also adopts the growth cycle concept which is appropriate for the kind of data series available in the participating countries. Most importantly, their results appear to be corroborated by other evidences. However, in using a diffusion index approach, the IDE procedure discarded a very important aspect of statistical evidence - the magnitude of the changes. To compensate for this, the DI needs a lot of data series to give its composite index a well-balanced picture of the entire economy. Since this requirement was not fully met, its final list of coincident, leading and lagging indicators tends to be sectorally biased towards production and prices, most of which have very narrow coverage. This tends to make it difficult to justify economically the inclusion of some of the series in the coincident and leading composite indexes.[19] In addition, the IDE software programs required a mainframe hardware to run.

The SEPIA project chose the diffusion index over the composite index because of a few reasons. Firstly, the method of compiling a diffusion index is more standardized and simpler than that of the composite index. Secondly, it does not require a weighting scheme for the component indicators as in the case of composite index. Lastly, the dominant influence of a certain variable over others which might occur in the composite index case could be minimized.[20]

Although the above reasons are well appreciated, they warrant a few comments. First, it should be pointed out that the CIBCR procedure to combine a composite index is quite similar to that of the U.S. De-

19. For example, out of the 11 coincident indexes for Thailand, 6 are production indexes of motorcycle, commercial vehicle, beer, lignite, tin plate and gypsum.

20. The Institute of Developing Economies, *Business Cycles in Five ASEAN Countries, India and Korea (II),* op.cit., p. 297.

partment of Commerce and other major institutions with only a few minor differences such as the computation of a standardization factor which do not have significant bearing on the results. In addition, the procedure is already computerized which makes it very easy to use. Second, the CIBCR procedure has already simplified the weighting scheme by assigning an equal weight of unity (1) to all the component series. This also does not significantly affect the composite index as proven by the fact that the U.S. Department of Commerce is also switching from an elaborated weighting scheme to a similar system of an equal weight of unity. Third, the CIBCR uses a standardization factor to normalize the impact of certain series being more volatile and having bigger magnitude of changes. This takes care of the pre-dominance of movements of such series on the composite index.

On the other hand, the composite index approach has certain advantages. Since it takes into account the magnitude of changes, it offers additional dimension to the evidence at hand. The index as compiled by the CIBCR also has an added advantage of having the same long-term trend as that of the real GDP/GNP. This enables the CIBCR to experiment with the idea of finding a way to predict the rate of growth, not just a direction but also the magnitude, directly from the composite index of leading indicators.

Thus, there is a real value added to construct a composite index of leading and coincident indicators for the SEACEN countries using the general CIBCR procedure, with some modifications to suit the individual country situation. In addition, it is not uncommon for a country to publish both the composite index and the diffusion index as they can be used to help validate one another's results. The U.S. Department of Commerce routinely computes both the indexes while the CIBCR also used diffusion index to confirm the final growth cycle chronologies. In fact, for more complete information, a business survey index is another important statistic commonly available in most of the advanced countries. This index, which is based on entrepreneurs' judgements and anticipations of the outlook of business conditions, is another useful input for short-term forecast.

PART II: GROWTH CYCLE CHRONOLOGY AND COMPOSITE INDEX OF LEADING INDICATORS FOR THAILAND

PART II :

GROWTH CYCLE CHRONOLOGY AND COMPOSITE INDEX OF LEADING INDICATORS FOR THAILAND

The objective of this Part is to report on the application of the CIBCR procedure to date the growth cycle chronology and to construct a composite index of leading indicators for Thailand. It is organized into four sections. The first section covers the source of data - the availability as well as the constraint. The second section deals in detail with the most important part of the report - the dating of growth cycle chronology or the reference dates for Thailand. It also compares the results with the reference dates derived from previous work on business cycles in Thailand. The third section explains the selection of leading indicators and the construction of their composite index. The last section offers some comments and recommendations for further work on building up the indicator system for Thailand.

1. SOURCE OF DATA

As mentioned in Part I of this report, the cyclical indicator technique requires a comprehensive range of data series to establish reference dates as well as to construct a composite index of leading indicators. Ideally there should be data representing all the economic processes, namely, production, employment and wages, expenditure or trade, investment, and, income and profits. These data should be available on a monthly or at least on a quarterly basis, and should be sufficiently long to enable a meaningful analysis of business cycles. In addition, these data series should be current and reasonably accurate, with the latest figures available within three-month time lag and the magnitudes of the subsequent revision reasonably small.

At the initial stage of data selection, we benefited a great deal from the two previous efforts on business cycles in Thailand, namely the Composite Economic Indicator (CEI) by the Bank of Thailand and the SEPIA Diffusion Index Project by the Socio-Economic Policy and Forecasting Unit of Chulalongkorn University in Thailand. This enabled us to narrow down the choices of candidates for coincident and leading indicators to a total of 61 series. As will be seen later, the results of these efforts were also used as additional evidences to our final selection of the growth cycle chronology for Thailand.

All of the 61 data series used are monthly data and most of them are available as far back as 1970. Thus, the current SEACEN Project enjoys a much more improved information base than the 1979 Composite Economic Indicator Project or even the SEPIA Project as far as data availability is concerned. Categorized by economic process, data representing expenditure and investment are quite good as there are several candidates to choose from, such as Sales of Department Stores, Total Cheque Clearing, Imports of Consumer Goods, Imports of Capital Goods and Domestic Cement Sales. For income and profits, there are a few data series that can be used as a rough proxy such as Personal Income Tax and Stock Price Index.

Turning to data on production, however, the absence of monthly or quarterly data on key comprehensive measures such as real GDP and production index is greatly regretted. Although the Bank of Thailand has recently started to compile monthly data on real GDP[21] and Production Index of Manufactured Goods, these series are available only from January 1985 and January 1987 respectively. This short time span does not permit us to conduct a meaningful analysis of their cyclical patterns. Thus, we have to rely on indirect measures such as Electricity Consumption, Payments for Exports and Domestic Oil Consumption. The situation is worse for data on employment and wages as only annual data are available and suitable substitutes cannot be found at all.

2. DATING OF A GROWTH CYCLE CHRONOLOGY

As mentioned in Part I, an iterative approach, requiring in each round a comparison between the turning point dates of the coincident indicators and their composite index, is used to date the growth cycle chronology. Thus, a preliminary set of coincident indicators is needed to start off the process. When data on monthly real GDP is available, its turning point dates will be used as a first round chronology to guide

21. It should be mentioned here that there is a monthly GDP series that starts from 1970. However, its data are estimated by interpolating the annual data using a Fernandez Method. Although this series has been used for various purposes successfully in the Bank of Thailand, its use for our purpose was far from satisfactory. The series did not display any particular cyclical pattern, a result which contradicted the conclusion derived from a majority of the other data series. Its estimated phase-average trend as generated by the computer software program was also not well-behaved.

a selection of this preliminary set of coincident indicators. Unfortunately, this data series only starts from 1985 while our study period begins in 1970.

Without the GDP series, we have two options to date the first round chronology. One is to use the series which are believed to be good coincident indicators, determine their respective turning points and derive a set of reference dates from them. This will yield a reasonable result if the assumed coincident indicators are really coincident and present well-clustered turning point dates. Unfortunately, this is not the case for Thailand. Since most of the available series are merely indirect measures of the economic processes, their turning point dates are rather diverse making it difficult to arrive at a conclusive set of dates. Accordingly, we have to turn to the second option - relying on the annual real GDP data to determine the years of economic turning points.

To be consistent with the underlying growth cycle methodology, the actual annual growth rates of real GDP during the period 1971-1991 have to be trend-adjusted by some long-term growth trend. Due to limitation of data points, this long-term growth trend is assumed to be constant at a certain growth rate approximated by a geometric mean of the growth rates during the period for which data are available.[22] Thus, these trend-adjusted growth rates reflect deviations of the actual growth rates from the long-term value. To enable selection of turning point years, a cumulative index is then computed from the trend-adjusted growth rates. Table 1 presents the actual and trend-adjusted growth rates, the cumulative index as well as the selected turning point years.

2.1 Coincident Series Used

The peak and trough years derived as above form a basis for selecting the coincident indicators. This is done by examining a cyclical

22. It is cautioned here that this approximation of the long-term growth rate may not be valid towards the last part of the sample period. It is evident that the Thai economy has accelerated tremendously since 1987 achieving double digit growth rates for three consecutive years. Thus, the average growth rate for the period 1987-1991 is 10.5 percent, compared with an average of 6.3 percent during 1971-1986. This suggests a structural shift to a higher plane of the Thai economy. As a result, we have to use a different long-term growth rate for the period after 1986 to determine the last peak of 1990. As will be seen later, this is done with the help of the monthly real GDP series which begins in 1985.

Table 1

THAILAND: GROWTH CYCLES OF REAL GDP (TREND-ADJUSTED)

Year	Real GDP Growth Rates (Unadjusted)	Trend-Adjusted GDP Growth Rate 1/ (Ratio)	Cumulative Index 2/ (Per cent)	Turning Point Dates 3/
1971	4.96	0.9829	98.2864	
1972	4.08	0.9746	95.7922	T1972
1973	9.85	1.0287	98.5370	P1973
1974	4.36	0.9772	96.2948	
1975	4.85	0.9818	94.5455	T1975
1976	9.37	1.0242	96.8297	
1977	9.90	1.0291	99.6496	
1978	10.44	1.0342	103.0555	P1978
1979	5.31	0.9861	101.6273	
1980	4.78	0.9812	99.7145	
1981	6.33	0.9957	99.2849	
1982	4.06	0.9744	96.7468	T1982
1983	7.25	1.0043	97.1635	
1984	7.13	1.0032	97.4729	P1984
1985	3.51	0.9693	94.4791	
1986	4.92	0.9825	92.8246	T1986
1987	9.47	1.0251	95.1542	
1988	13.22	1.0602	100.8835	
1989	12.05	1.0493	105.8526	
1990	10.00	1.0301	109.0344	
1991	8.00	1.0127	110.4230	

1/ The geometric mean of the growth rates during 1971-1991 is 6.8 per cent. The trend-adjusted ratio is computed using a formula:

ratio t = [(growth rate t / 100) + 1.000] / 1.068

2/ Cumulative index t = ratio t * cumulative t_{-1} . The first value of the index (1970) is set to 100.

3/ P and T indicate peak and trough respectively.

timing behaviour of the deseasonalized[23] and properly deflated series.[24] Those whose cyclical turning points are consistent with the reference years are grouped as the first round coincident indicators. The composite index of these indicators is again subject to a similar cyclical timing analysis. Thus, two sets of turning-point dates emerge - the median dates of the component indicators and those of the composite coincident index. At the final stage, these two sets of dates should be more or less the same. They should also match with all the other available evidences.

Out of the process discussed in the foregoing paragraphs, a total of six series emerge as coincident indicators. As shown in Table 2, they cover nearly every aspect of the Thai economy except for income and employment. For the production side, we have two series, namely, Electricity Consumption and Payments for Exports.[25] To represent the consumption expenditure side, three series are found to have cyclical pattern conforming to the reference cycles - Total Cheque Clearing, Sales of Department Stores and Total Imports.[26] Since the Total Imports series also covers imports for raw materials and capital goods, it could be used to represent the investment sector (item C3.2 in Table 2) together with Domestic Cement Sales which indicates the activity in the construction sector. Section 2.4 gives detailed analysis of the coincident profiles of these series.

For income and profits as well as employment and wages, we cannot find any suitable indicators to represent them. In the latter case, it is due to lack of monthly or quarterly data series. For income and profits, it is due to the poor performance of the proxy series used. As mentioned earlier, in the absence of a more direct measure of income, Personal Income Tax seems to be the closest proxy avail-

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23. In this respect, we deviate a little from the CIBCR. Instead of extracting the seasonal factor from *all* the series as practised for purposes of consistency at the CIBCR, we use the F-test to decide which series should be deseasonalized along U.S. Department of Commerce approach which deseasonalizes a series only where there is significant presence of a seasonal factor. Of all the series finally selected as coincident and leading series, only the Stock Price Index does not display a strong presence of seasonal factor, thus its original values are used in combining the composite leading index.
24. For a brief discussion of the software programs used, please refer to Appendix 6.
25. Deflated by deseasonalized Export Price Index.
26. The first two series were deflated by deseasonalized CPI while the series on Total Imports was deflated by deseasonalized Import Price Index.

Table 2

THAILAND: COINCIDENT AND LEADING SERIES USED

Economic Process	Coincident Series	Leading Series
1. Production	C1.1 Electricity Consumption C1.2 Payments for Exports	L1.1 Authorized Capital of Newly Registered Companies and Partnerships
2. Consumption Expenditure	C2.1 Total Cheque Clearing * C2.2 Sales of Department Stores * C2.3 Total Imports *	L2.1 Loans for Personal Consumption (6-month smoothed growth rates) L2.2 Broad Money Supply (M2)*
3. Investment	C3.1 Domestic Cement Sales C3.2 Total Imports *	L3.1 Construction Area Permitted *
4. Income and Profits	-	L4.1 Stock Price Index
5. Employment and Wages	-	-

Note: 1. All the series, with the exception of Stock Price Index, are seasonally adjusted.
2. Series with * are deflated series.
3. Data for Construction Area Permitted are smoothed over 5 months, with the first value placed at the center.

able.[27] However, it did not perform very well as a coincident indicator. Out of the four peak dates, only once that the date coincided with the reference dates (1978), while it lagged in 1973 and 1985 and led in 1990 by more than twelve months. Likewise, among the three troughs, only once that its trough date could be considered as "roughly coincident" with the reference cycle (1986). At the other two troughs, they turned at much earlier dates than the corresponding reference dates.

Of the series that were tested but were not included in our final list of coincident indicators, a few are worth mentioning here. Since Thailand depends on oil as the major source of energy, particularly during the earlier stage of development, it was felt that Domestic Sales of Oil could be a good proxy for production[28] in spite of its data beginning only from January 1978. However, the results are quite disappointing especially during the earlier period of 1978 to early 1982 when no clear cyclical pattern could be discerned. This could be the outcome of the second oil price shock in 1979/1980 because the series seems to perform much better from the period 1982 onwards when the two trough dates (July 1982 and June 1986) and the two peak dates (February 1984 and August 1990) are quite close to the reference dates. Although we decided to drop it from our final list, we still feel that this series has a potential to be a good coincident indicator in the future when more data are available for further investigation.

We also tested the series Number of Tourists which has been used in both the SEPIA Project as well as the Thai CEI. The rationale behind the use of this series could be that tourism has been one of the country's top foreign exchange earner. We found that, in the growth cycle context, this series could perform well only up to 1978 when its cycle was prominent and conform roughly to the reference dates. For the period 1978-1986, the series displayed several small and shallow cycles whose

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27. In Thailand, personal income tax liability of the current year must be deducted directly from the monthly salary of the employees in the same year. This is in contrast with the corporate income tax liability which can be settled one year later. This time lag allows the companies to manage their cash-flows in such a way that an opportunity cost is minimized. Thus, data on corporate income tax reflect more of this policy than a cyclical pattern. This is why we opted for Personal Income Tax instead of the Corporate Income Tax although the latter forms a bigger bulk of the total income tax.

28. Refinery Production of Petroleum Products was used as a leading index in the SEPIA Project. See Components Variables of DI, p. 317 in IDE, *Business Cycles in Five ASEAN Countries, India and Korea (II)*, 1989.

turning point dates were quite far off the reference dates. The experiment with its possible substitute series - Income from Tourists - did not fare any better except for the only correct turn it took at the trough of May 1986. Its movements after 1989 resumed an erratic pattern but this might indicate more of the fact that these numbers were first-round estimates which were normally subject to large revisions later.

In terms of imports, the availability of three import series, namely Total Imports, Imports of Capital Goods and Imports of Consumer Goods, presented a problem of which series should be used. The Bank of Thailand has been using Imports of Capital Goods as a key variable for investment. It is argued that since Thailand has increasingly become industrialized, together with the fact that Thailand is just about to implement many big infrastructure projects, this type of imports should be the most direct and specific measure to capture the most current investment climate.

Our argument for using Total Imports, on the other hand, is that it is a more comprehensive measure which covers not only investment but also a consumption expenditure aspect of the imports. While it is true that capital goods and investment play a dominant role in the late 1980s, consumption formed the bulk of aggregate demand in the 1970s. At that time, imports of consumer goods were definitely a better indicator of consumption expenditure as the domestic manufacturing sector was still at its infancy stage. Accordingly, in our case of having to deal with a long period of investigation when structural change is likely to occur, a more comprehensive measure such as Total Imports is preferred. This is also probably the rationale behind the practice at the NBER as well as the CIBCR to opt for a data series with more comprehensive coverage, if alternatives are available.

Nevertheless, we tested both Total Imports and Imports of Capital Goods to determine empirically which was a better coincident indicator. We found that although the Total Imports series tended to have extra cycles, its turning points on the whole went closely together with the reference cycles.[29] Imports of Capital Goods, as expected, did not do very well during the first 16 years of our study period as its cyclical turning points were generally in the opposite direction of the reference cycles. For example, at the reference cycle peak of September

29. For detailed discussion of the coincident profile of Total Imports, please refer to Section 2.4.

1973, Imports of Capital Goods reached its trough. In November 1975, the reference cycle pointed to a trough but the series climbed to a peak in May of the same year. These countercyclical movements, to some extent, imply that imports of capital goods during the earlier period resulted more from the government efforts than the forces of the private sector.

Another series which has been included in the Thai CEI is Sales of Galvanized Iron Sheets. This series includes data from January 1978. Again, we did not succeed with this series as far as cyclical timings were concerned. The cycles were erratic although some of them conformed roughly to the reference cycles. However, considering the fact that this series represented mainly the building of houses in the rural sector, we did not feel that its exclusion from the final composite coincident index would present a serious problem. In addition, as the rural sector becomes more affluent, a perceptibly changing trend from using galvanized iron sheets to ceramic tiles has already taken place indicating that this series will become even less significant in the future.

2.2 Growth Cycle Chronology

As mentioned earlier, the final growth cycle chronology will be selected on account of the three turning point dates of: (i) the six chosen coincident indicators as well as their median dates; (ii) the composite coincident index; and, (iii) the trend-adjusted annual rates of growth of real GDP (for the period 1970-1986) and the trend-adjusted monthly rates of growth of real GDP (for the period 1987-1991).

Using the GROCYC program[30] the turning point dates of the six coincident series and their composite index were first selected by this program. They were subsequently verified by judgement before finalizing. Charts 1 to 7 display the growth cycles from which the dates of the highest and lowest points from trend of the individual indicators and their composite index are selected. In these Charts, we follow the CIBCR convention to mark a circle around the dates that are rejected because the cycles are too insignificant or when the dates are inconsistent with evidences from other sources or some other reasons. Dates

30. This is the U.S. Department of Commerce's version of Boschan's Turning Point/Growth Program. For details of all the software programs used in this study, please refer to Appendix 6.

marked in the square are those included by judgement. These dates are then presented again in Table 3 which also reports the median dates for the six coincident indicators.

As can be observed from Table 3, the peak and trough dates of the six coincident indicators are rather diverse, especially for the peaks of the earlier period up until 1980. However, clustering of turning point dates is seen in practically all of the trough dates (1975, 1982 and 1986) and the peak of 1984. Another noteworthy observation from this Table is that some series seem to have extra-cycles while others miss them. Measuring from peak to peak, the Payments for Exports series has seven cycles while those for Imports and Sales of Department Stores display five cycles each. Only the Total Cheque Clearing series has the exact number of cycles (four) as the reference ones. Electricity Consumption and Domestic Cement Sales, on the other hand, have three cycles each as their values after 1986 keep moving further away from their trends and have yet to reach a peak in 1990 as in the case of the other series.

Since the coincident series failed to indicate a conclusive clustering of dates at the first instance, we used the turning point dates of the trend-adjusted annual growth rates of real GDP to guide our judgement. In this manner, we grouped together the possible dates at each peak and trough, using a hand-marked circle to indicate them as shown in Table 3. This enabled us to compute a median date for each group. These median dates were subsequently used to compare with those of the composite index.

Ideally, the turning point dates of the individual indicators, their medians and the composite index should fall within the range of plus or minus three months of one another. However, as seen in Table 3, all our clusters do not meet this ideal requirement. Still, considering the lack of major coincident indicators and that most of the series used are rough proxies, the general results could be considered as satisfactory. In all the turns, the median dates and/or the composite index dates fall in the years that correspond with those of the trend-adjusted annual GDP series. These two sets of dates are also consistent with each other in general. Except for two occasions, they fall in the same year with a maximum of six months apart. They indicate exactly the same month twice in the trough of 1975 and the peak of 1984. At the peak of 1978, although the dates fall on different year, the median date lags behind the composite index by just two months and could be considered roughly coincident with each other. The worst result is at the trough

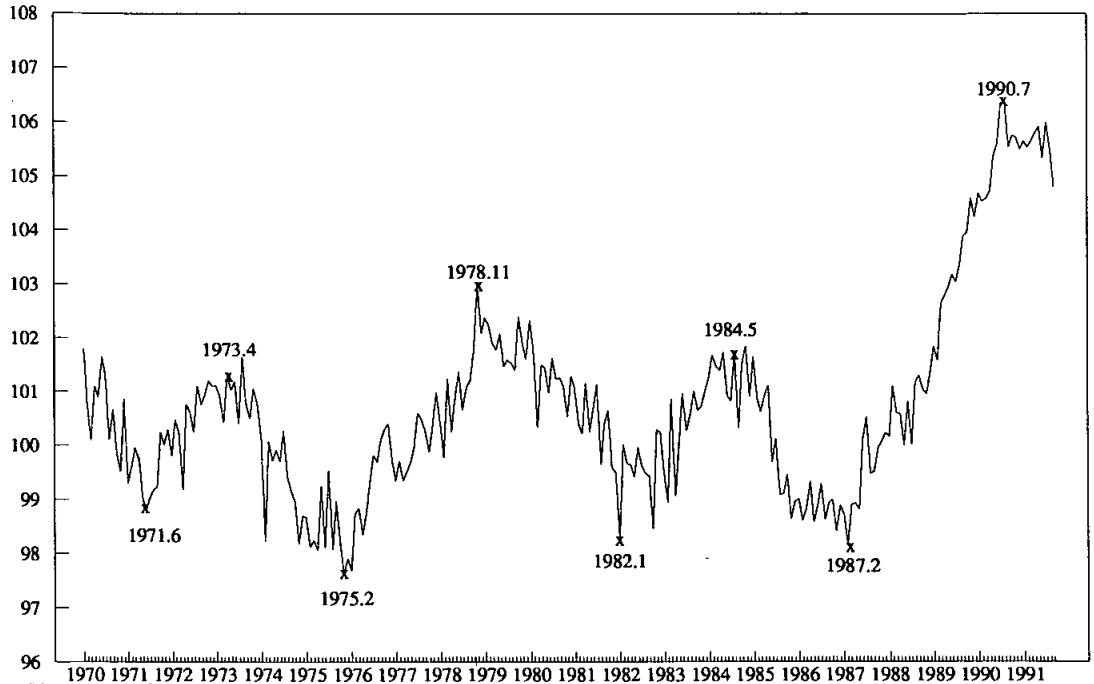
Table 3

THAILAND: GROWTH CYCLE PEAKS AND TROUGHS

Series No.	Series Title	Series																					
		Starts	(Year)	Y e a	r	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
																							1988
																							1989
																							1990
Peaks																							1991
1. Electricity Consumption	1972				4						2						1		6				
2. Total Cheque Clearing	1970					7		10		11					8								7
3. Domestic Cement Sales	1970			11					10			1				11							
4. Sales of Dept. Stores	1970				9		11		6		12					1							9
5. Imports	1970				12			7			10				12		5				6		
6. Payments for Exports	1970		12			3		11		11				2		10					12		11
Median 6 Series					10						1					5							
Composite Coincident Index					4					11						5							7
Troughs																							
1. Electricity Consumption	1972					1								1				3			11		
2. Total Cheque Clearing	1970			4			11		4					1				11					
'3. Domestic Cement Sales	1970							3		9				1				1					
4. Sales of Dept. Stores	1970						1								6				2				
5. Imports	1970		9				11							10		9		11					
6. Payments for Exports	1970				9		11			1		9			4		11						
Median 6 Series							11							5				7					
Composite Coincident Index							11							1					2				

Chart 1

COMPOSITE COINCIDENT INDEX OF 6 SERIES*
Deviations from Final Trend



* The composite index is not trend adjusted

Chart 2

ELECTRICITY CONSUMPTION, SA
Deviations from Final Trend

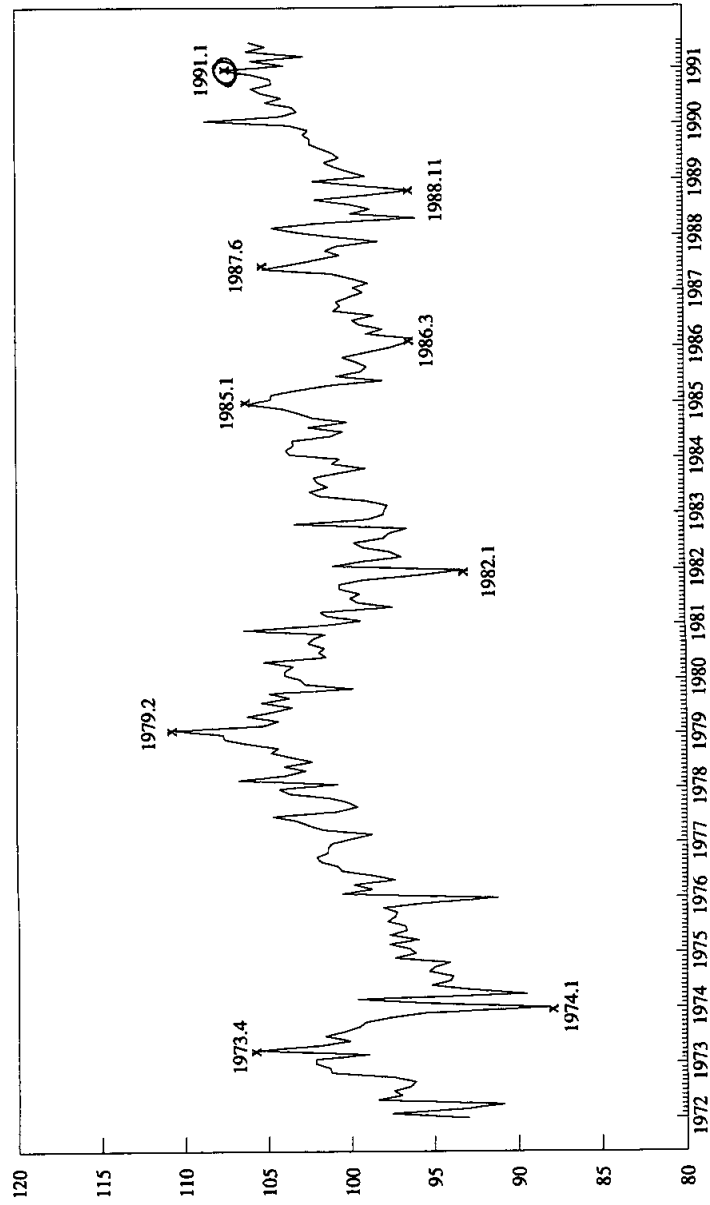


Chart 3

TOTAL CHEQUE CLEARING, SA & DEFLATED
Deviations from Final Trend

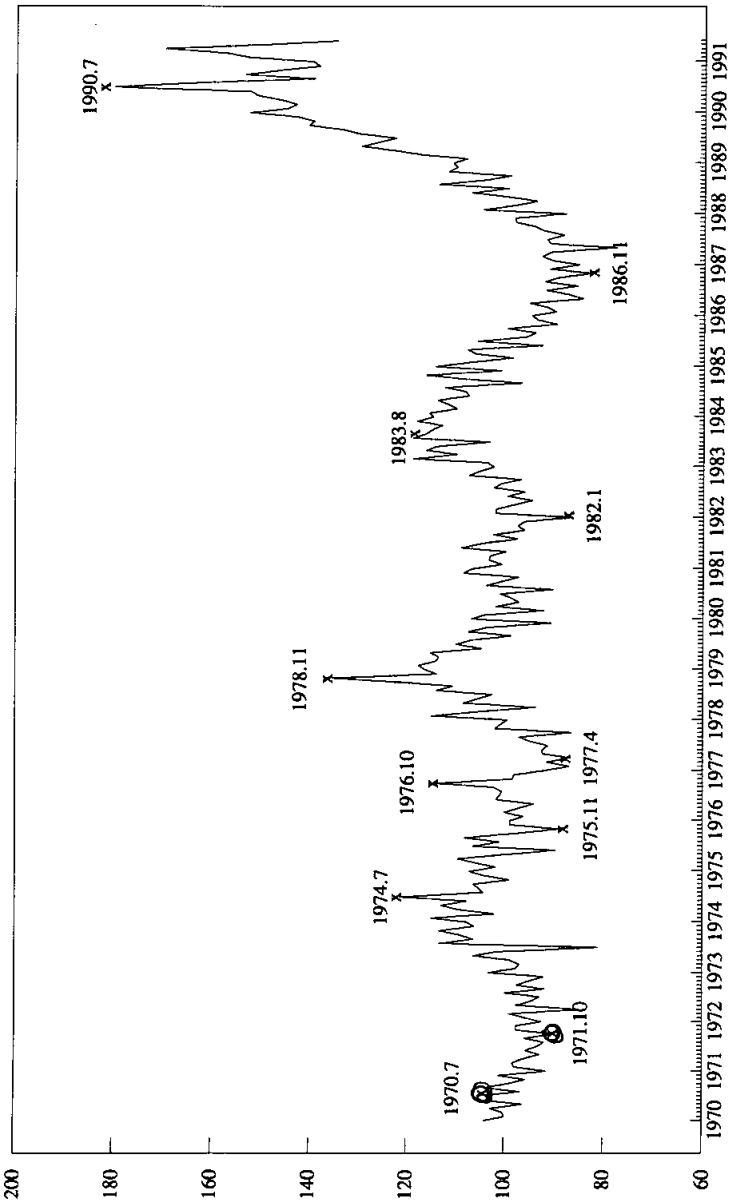


Chart 4

DOMESTIC CEMENT SALES, SA
Deviations from Final Trend

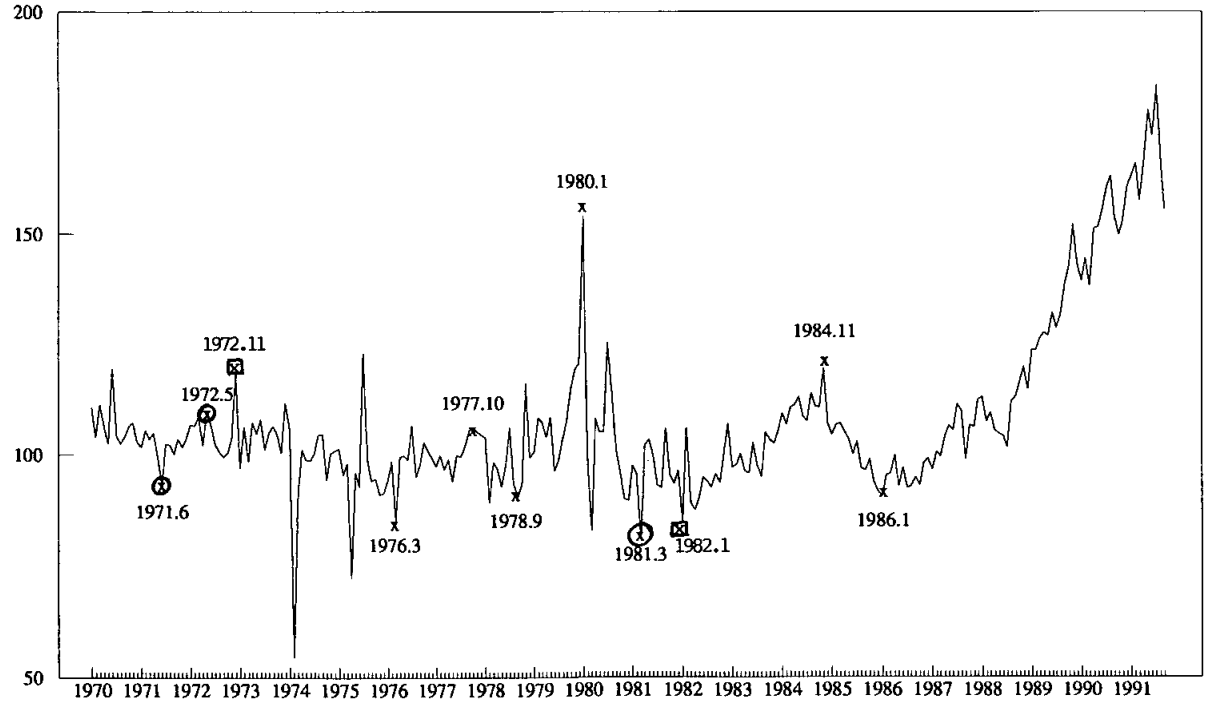


Chart 5

SALES OF DEPARTMENT STORES, SA & DEFLATED
Deviations from Final Trend

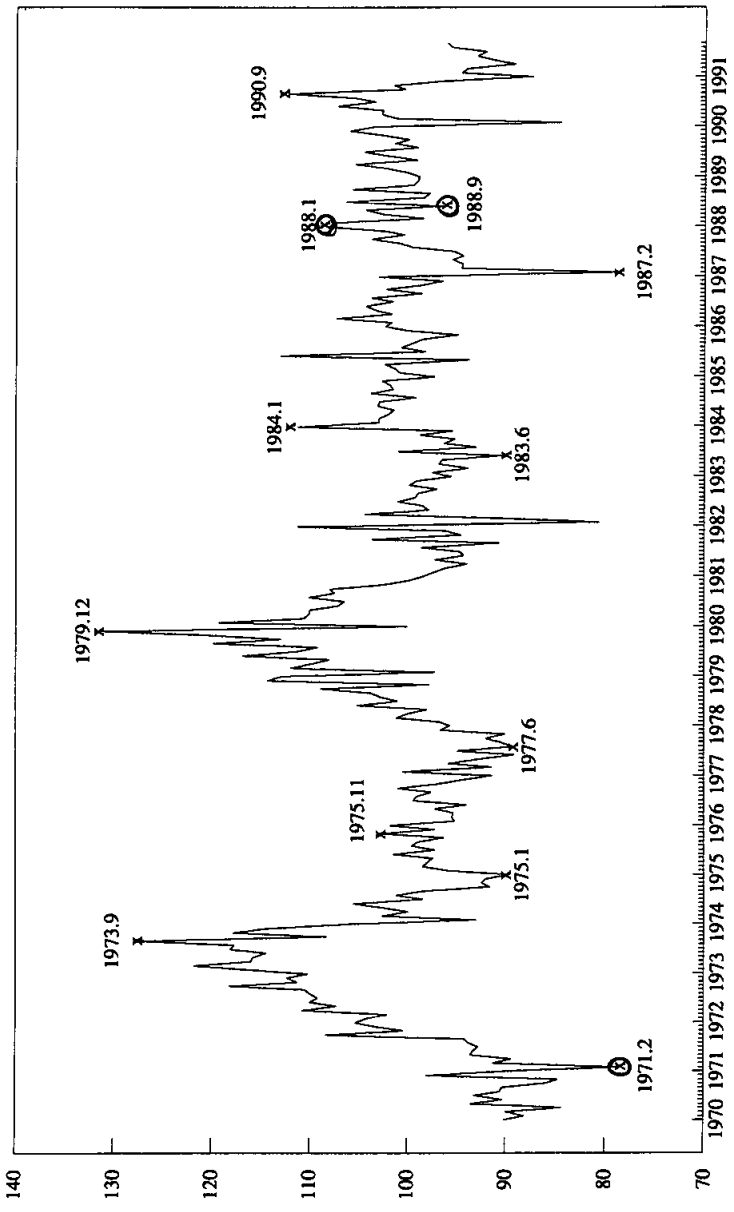


Chart 6

TOTAL IMPORTS, SA & DEFLATED
Deviations from Final Trend

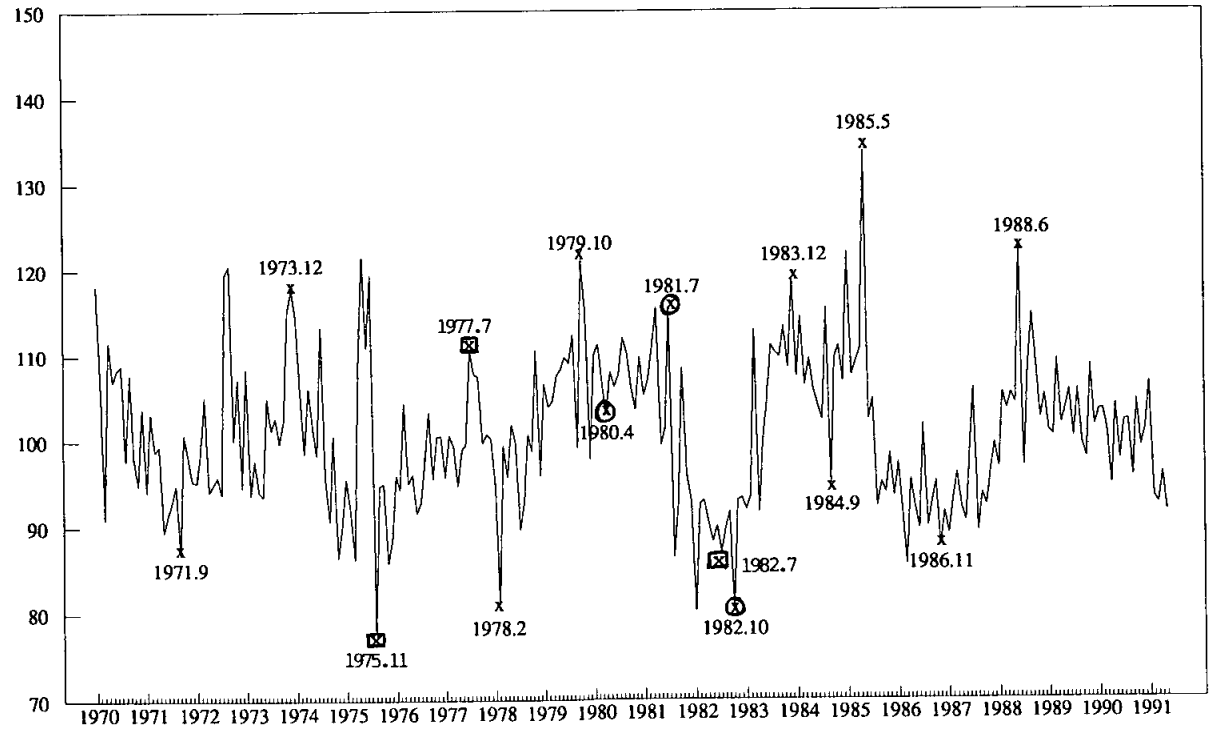
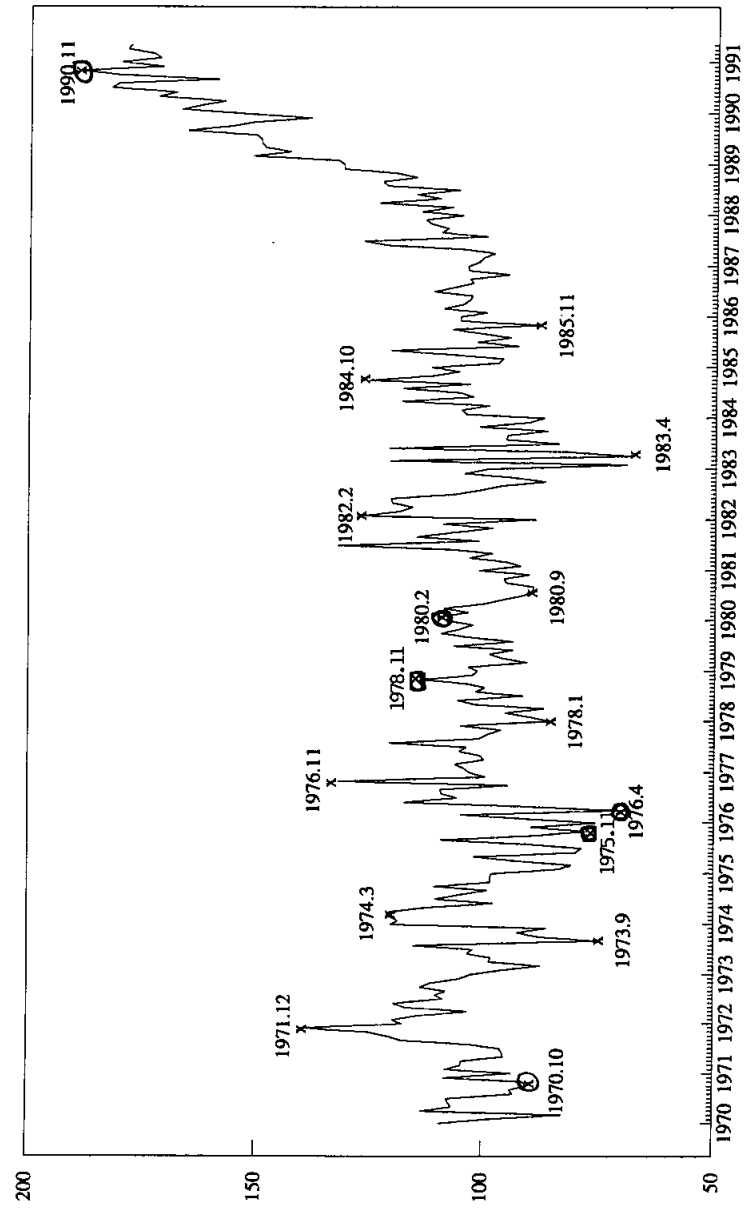


Chart 7

PAYMENTS FOR EXPORTS, SA & DEFLATED
Deviations from Final Trend



of 1986 when the composite index date lags behind by seven months.

Thus, it is clear from all the evidences available that the first peak in our period of study occurs in 1973. This corresponds with the fact that Thailand benefited a great deal from the commodity boom at the beginning of the first oil shock in 1973/1974. In terms of the exact month, however, there is a disparity of six months between the median date and the composite coincident index date. In this situation, we follow the general rule laid down by the NBER to pick the month of the actual series. Thus, September 1973, the actual peak date of the series Sales for Department Stores, is selected as the first peak of the growth cycle for Thailand in our study period.

The second peak is rather obvious as the median date only lags behind the composite date by two months. Since the trend-adjusted annual GDP series peaks in 1978, we choose the month of November of that year, to be the second peak. This also happens to be a peak month for Total Cheque Clearing and Payments for Exports. For the third peak in 1984, both the median and composite index date fall in May. However, the date of the actual series are either January, October or November. We choose November because it is the actual month and also the nearest to the median date.

For the period after 1988, it is not possible to conclude from the coincident indicators whether and when the most recent peak of the Thai economy takes place. Of the six series, three indicate a peak in 1990 and consequently the composite index points to July 1990 as the most recent peak. However, according to the Bank of Thailand CEI and its sub-index, the most recent boom should have already peaked either in 1988 or 1990. The Investment Sub-Index had a definite down-swing from September 1988. The Aggregate Demand Sub-Index, on the other hand, dipped a little after the peak in May 1988 but remained stable around this point until a definite downturn was observed after the middle of 1990.[31]

31. In this situation, according to the NBER rule of thumb, the last date before the definite turn occurs will be the preferred choice. This means the peak date should be in 1990.

Under this ambiguous situation, we turn to the monthly GDP series that the Bank of Thailand has been compiling from January 1985[32] for a clue. Since this is the most comprehensive data on the general economic condition, its turning point dates should be the most reliable. There is a little snag in using this series, though, as it has too few data points for the use of our software program.[33] To overcome this problem, we had to follow the same procedure as in the case of the annual GDP, that is, we adjusted the monthly point-to-point growth rates with the long-term average rate[34] and then compute the corresponding cumulative index. The results of these transformations are presented in Table 4 of this report. The movements of the cumulative index are tracked to determine the date of the most recent highest point.

Chart 8 depicts the cumulative index of the trend-adjusted real GDP growth rates from January 1985 to December 1991. It confirms the result of the composite coincident index that the latest peak should be in July 1990. This also corresponds to the general perception that the longest and most robust expansion period in the recent history of Thailand should have ended sometime in the second half of 1990. Initially, the break is seen to be the outcome of several adverse external factors.[35] The slowdown was further reinforced by bottlenecks in infrastructure, the shortage of skilled labour and government efforts to cool down an overheated economy. Thus, we believe that the latest peak should be in July 1990, a date which, as will be seen later, is also consistent with the results of the leading indicators.

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32. The monthly GDP is compiled by disaggregating the series into more narrowly-defined components (according to the UN definition) and using the actual monthly data of the components as far as possible. Those without monthly data are estimated using regression technique. Thus, this series is believed to be far more accurate than the one that derived from the interpolation of the annual data.
33. To run the GROCYC program, the series must have at least 99 observations.
34. It should be noted that since the Thai economy has been on an exceptionally fast track since 1987, it will be misleading for the monthly GDP series with data from 1985 to use the same long-term growth rate as that for the period 1971-1991 of the annual GDP. Accordingly, the long-term growth for the monthly GDP was calculated from the average point-to-point growth rates for the period 1985-1991 which came to about 9.6 percent.
35. These include the Persian Gulf crisis, the recession in the United States, and, the financial scandal and the downturn in property market in Japan.

For the troughs, their first date in our period of study is quite clear-cut as the median date, the composite index date as well as the date of three of the actual series (Total Cheque Clearing, Imports and Payments for exports) all coincide in November 1975. Similarly, the second trough should be January 1982 as indicated by the composite index date as well as three of the actual series (Electricity Consumption, Total Cheque Clearing and Domestic Cement Sales). For the last trough, it is not so well-defined. The median date points to July while the composite index date is February of the next year. Again, we apply the NBER general rule of thumb and use November 1986 which is the actual date of two component series (Total Cheque Clearing and Imports).

The final growth cycle chronology, in relation to the turning point dates of the median dates of the six indicators, the composite coincident index, the trend-adjusted annual real GDP and the trend-adjusted monthly real GDP, are presented in Table 5. This set of dates will form a basis for testing our choice of coincident indicators as well as selecting the leading indicators.

2.3 Comparison with Other Reference Dates

Having set the growth cycle chronology, we proceed to compare it with those of the previous studies, namely, the Bank of Thailand CEI and the IDE Diffusion Index. The dates from these three sources are presented in Table 6.

At the outset, it should be cautioned that the reference dates derived from the CEI may not be strictly comparable with the other two studies. This is because the CEI serves primarily as a barometer of economic health - whether the economy is overheating or in recession. Thus, it measures deviations from the "normal state" of the economy and not the long-term trend as in the case of the growth cycles.[36] The only situation when the CEI and the composite coincident index could be exactly the same is when the long-term trend of the composite coincident index is constant and equal to the "normal growth rate" of the economy. Nevertheless, on its strength as being the most compre-

36. Although the "normal state" of the economy is now approximated by the average long-term growth rate, the fact remains that its peak and trough depict the highest or lowest point away from this "normal" value. In the growth cycle case, the long-term trend is approximated as a trend line and not a single average value.

Table 4

THAILAND: TREND-ADJUSTED MONTHLY GDP
1985 - 1991

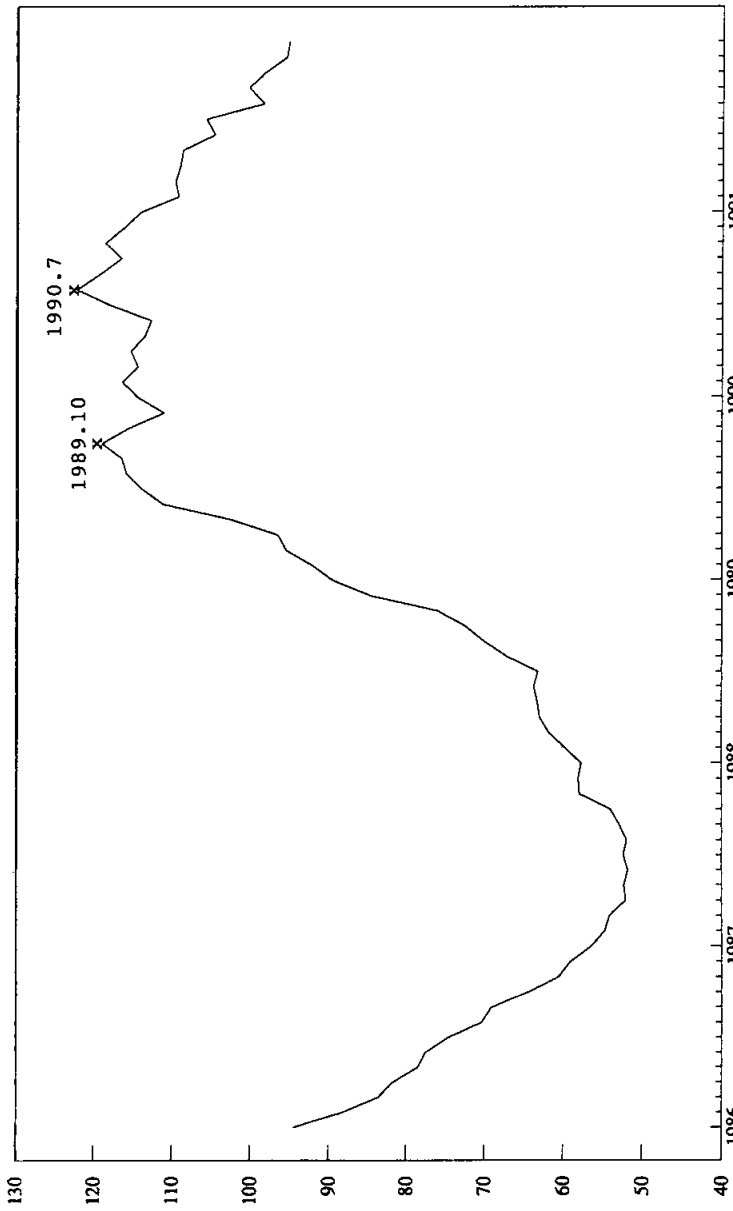
Year	Growth Rates	Trend-Adjusted Growth Rates	Cumulative Index
			100
1986 Jan.	3.529306	0.944479	94.44795
Feb.	2.430008	0.934451	88.25696
Mar.	3.872940	0.947614	83.63356
Apr.	7.119682	0.977234	81.72955
May.	5.293241	0.960572	78.50708
Jun.	8.259522	0.987632	77.53613
Jul.	5.486769	0.962337	74.61589
Aug.	3.342877	0.942779	70.34628
Sep.	7.646083	0.982036	69.08259
Oct.	2.293393	0.933204	64.46818
Nov.	3.016256	0.939799	60.58713
Dec.	6.852167	0.974793	59.05993
1987 Jan.	4.664477	0.954835	56.39251
Feb.	6.339111	0.970113	54.70710
Mar.	8.397383	0.988890	54.09931
Apr.	5.497771	0.962437	52.06720
May.	10.048383	1.003952	52.27296
Jun.	8.577624	0.990534	51.77817
Jul.	10.821332	1.011003	52.34790
Aug.	8.758357	0.992183	51.93870
Sep.	11.563063	1.017770	52.86166
Oct.	11.986530	1.021633	54.00522
Nov.	17.573731	1.072604	57.92623
Dec.	9.908624	1.002677	58.08129
1988 Jan.	8.921531	0.993672	57.71374
Feb.	13.544188	1.035843	59.78240
Mar.	13.343894	1.034016	61.81597
Apr.	11.646804	1.018534	62.96167
May.	10.133505	1.004728	63.25938
Jun.	10.418830	1.007331	63.72315
Jul.	8.708169	0.991725	63.19587
Aug.	16.379889	1.061713	67.09588
Sep.	14.437987	1.043997	70.04792
Oct.	13.377401	1.034322	72.45210
Nov.	14.892682	1.048146	75.94034
Dec.	22.007789	1.113055	84.52581

Table 4 (cont'd)

Year	Growth Rates	Trend-Adjusted Growth Rates	Cumulative Index
1989 Jan.	15.978790	1.058054	89.43286
Feb.	12.893821	1.029910	92.10782
Mar.	13.574249	1.036118	95.43455
Apr.	10.798156	1.010792	96.46447
May.	16.518183	1.062975	102.53929
Jun.	18.832891	1.084091	111.16195
Jul.	12.243063	1.023974	113.82690
Aug.	11.541921	1.017577	115.82765
Sep.	10.184236	1.005191	116.42894
Oct.	11.994934	1.021710	118.95660
Nov.	6.493506	0.971521	115.56887
Dec.	5.338763	0.960987	111.06016
1990 Jan.	12.915705	1.030110	114.40418
Feb.	11.494976	1.017149	116.366608
Mar.	7.760220	0.983077	114.39685
Apr.	10.466160	1.007763	115.28494
May.	7.932230	0.984647	113.51492
Jun.	8.814935	0.992699	112.68618
Jul.	14.778016	1.047099	117.99364
Aug.	13.515581	1.035582	122.19215
Sep.	6.934254	0.975542	119.20359
Oct.	7.123808	0.977271	116.49427
Nov.	11.609672	1.018195	118.61391
Dec.	7.391507	0.979714	116.20767
1991 Jan.	7.580152	0.981435	114.05023
Feb.	5.052746	0.958378	109.30318
Mar.	9.998187	1.003494	109.68507
Apr.	8.998831	0.994377	109.06831
May.	9.267396	0.996827	108.72224
Jun.	5.503133	0.962486	104.64367
Jul.	10.802655	1.010833	105.77727
Aug.	1.936424	0.929948	98.36735
Sep.	11.774711	1.019701	100.30527
Oct.	7.371042	0.979527	98.25171
Nov.	6.563524	0.972160	95.51640
Dec.	9.225259	0.996443	95.17661

Chart 8

CUMULATIVE INDEX OF TREND ADJUSTED REAL GDP GROWTH RATES



Source: General Economics Section, Department of Economic Research, Bank of Thailand.

Table 5

THAILAND: GROWTH CYCLE CHRONOLOGY

	Turning Point Dates						
	Peak	**Trough**	**Peak**	**Trough**	**Peak**	**Trough**	**Peak**
Median, 6 Series	10/1973	11/1975	1/1979	5/1982	5/1984	7/1986	-
Composite Coincident Index	4/1973	11/1975	11/1978	1/1982	5/1984	2/1987	7/1990
Annual GDP, trend adjusted	1973	1975	1978	1982	1984	1986	-
Monthly GDP, trend adjusted	-	-	-	-	-	-	7/1990
Growth Cycle Chronology	9/1973	11/1975	11/1978	1/1982	10/1984	11/1986	7/1990

Table 6

THAILAND: COMPARISON OF REFERENCE DATES

Turning Points	SEACEN: LEI Project	BOT: CEI [1]	IDE: SEPIA Project [2]
1st Peak	September 1973	May 1974	June 1974
1st Trough	November 1975	March 1975	November 1975
2nd Peak	November 1978	February 1979	December 1979
2nd Trough	-	-	September 1980
3rd Peak	-		- August 1981
3rd Through	January 1982	July 1982	August 1982
4th Peak	October 1984	August 1984	December 1983
4th Trough	November 1986	May 1986	December 1985
5th Peak	July 1990	July 1989 *	-

1. Composite economic indicator compiled by the General Economic Section, Department of Economic Research, Bank of Thailand.
2. Results as reported in the 1989 *Business Cycles in Five ASEAN Countries, India and Korea* by the Institute of Developing Economies, p. 317.

* The composite index of aggregate demand reached a peak in February 1990.

hensive measure of the economy, the turning point dates of the CEI could serve as a rough guide for the reference cycles of the economy.

As seen from Table 6, our reference dates are generally comparable with those from the other two sources. In terms of number of cycles, it has a one-to-one match with the CEI. The Diffusion Index, on the other hand, produces one extra cycle in 1980 to 1981. From the peak of December 1979, the cumulative diffusion index indicated a trough in September 1980 before climbing up to a peak in August 1981. This cycle, as reported in the SEPIA Project Report (1989), is caused mainly by fluctuations in exports. However, the proportion of exports to GDP, all in real terms, was less than 20 percent at that time. Thus, it is doubtful that exports alone would be responsible for the widespread fluctuations in economic activity during that time. In fact, we also found a very small and shallow cycle during this 1980-1981 period in the growth cycles of Payments for Exports (Chart 7). Similarly, a cycle of roughly the same magnitude was observed in the CEI movements. However, apart from being insignificant, such a cycle could not be observed in other coincident indicators or the real GDP.

It is also seen from Table 6 that all the turning point dates from the three sources are generally close. This is particularly the case between our chronology and the CEI because the maximum number of months difference between them is within plus and minus eight months, discounting the fifth peak.[37] The two dates are roughly coincident at the second and fourth peak (if 1980/1981 is counted as the third cycle). It is also observed that at most of the peaks, our turning point date arrives earlier than those of the CEI while for the troughs, our turns generally come later. This means our expansion phases or the economic upswings are generally shorter while our contraction phases or the downswings are generally longer. This is consistent with our a-priori expectation of the difference between the growth cycles and the classical cycles which have already been observed elsewhere.

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37. The last peak of 1989/1990 was deliberately left out of the discussion here because of the inconclusive evidences that were pointed out earlier. It is suggested that as time passes and more data and new evidences become available, the date of this peak should be reexamined.

Against the Diffusion Index, the two sets of dates are relatively more different as they coincide only once in November 1975. The next closest date is at the third trough when the growth cycle date leads by seven months. For the rest of the dates, the difference was in the range of nine to twelve months. The main reason behind this could be that the choices of coincident index in our study and the Diffusion Index are quite different. In our case, we attempt to come up with a list of indicators which represent the economy as widely as possible. In this respect, our approach is quite similar to the CEI. The Diffusion Index, on the other hand, has eight production-related series out of the total 11 series selected.[38] For the series used in compiling the CEI and those selected as coincident and leading indicators in the SEPIA Project, please refer to Appendix 3.

2.4 Cyclical Timing Analysis of Coincident Indicators

The growth cycle chronology is used to analyze the timing difference from the growth cycle chronology, or the coincident profile, of the individual coincident indicator and their composite index. This is done by observing median lead or lag in months of each indicator at peaks, at troughs and at both peaks and troughs. In addition, we also compute the percent coincident which is the number of times that the turning point dates of each indicator fall within three months either before or after the corresponding chronology date over the total number of turns at peaks, at troughs and at both peaks and troughs. The results are reported in Table 7.

As can be expected, the composite coincident index performs the best. Its median date at both peaks and troughs is zero month which means that it is an exact coincident indicator in all the seven turns. This is also the case at all the three troughs, while it is considered a "roughly coincident" indicator at peaks with a median lead of three months. In terms of percent coincident, its turning point dates coincide with all the three troughs, scoring a perfect 100 percent. Its record at peaks is, however, a little more modest at 50 percent. Of the four peaks, it turns correctly twice but on two occasions, it leads the reference date by 5 months each. For all the seven turns, the percent coincident is at a respectable level of 71 percent. The composite coincident index in a raw data form is presented in Table 8.

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38. Six series are production indexes while the other two (Consumption of Electricity by Large Users and Export Volume Index) are proxies for production.

Table 7

THAILAND: MEDIAN LEAD (-) OR LAG (+) OF INDIVIDUAL COINCIDENT * INDICATORS WITH RESPECT TO GROWTH CYCLE PEAKS AND TROUGHS

Indicators	Trough	Peak	Overall
	Lead (-) or Lag (+), in Months		
Electricity Consumption	-8	+3	-3
Total Cheque Clearing	0	0	0
Domestic Cement Sales	0	-10	-5
Sales of Department Stores	+2	0	+1
Imports	0	+3	+2
Payments for Exports	0	+2	0
Composite Coincident Index	0	-3	0
	Per cent Coincident		
Electricity Consumption	33	67	50
Total Cheque Clearing	100	50	71
Domestic Cement Sales	33	33	33
Sales of Department Stores	33	50	43
Imports	67	33	50
Payments for Exports	33	75	57
Composite Coincident Index	100	50	71

* Definition of "roughly coincident" indicators ($\pm$ 3 months) is applied in the construction of this Table.

Considering the data constraint, the performance of the component series on the whole is satisfactory as most of their median dates are roughly coincident with the reference dates and all the percent coincident are acceptable. Across the individual indicator, however, the performance is rather uneven. Of all the component series, Total Cheque Clearing - a monetary indicator for consumption expenditure - performs the best. Its median dates are zero month at troughs, at peaks and overall. It also has a perfect record of coinciding with the reference date at every trough. At peaks, it turns at the same time as the reference dates twice but lags in one occasion (1973) and leads in another (1984).

Domestic Cement Sales, on the other hand, does not perform as well, particularly at peaks when it tends to lead rather than coincide with the reference dates. Although its median dates at troughs is zero month, it leads by ten months on the average at peaks. These results, to some extent, confirm the general observation that the construction sector, which Domestic Cement Sales represents, is so well at tune with economic conditions that it adjusts the fastest during the recovery period. In spite of this observation, we still keep it as a coincident indicator for the same reason that the Bank of Thailand uses it as part of the CEI - because there is no other good option to represent the investment sector. When more data series are available, it may be necessary to reexamine the role of this variable as a coincident indicator.

The coincident profile of all the other coincident indicators are reasonably good. All of them are roughly coincident, having the median lead or lag within three months of the corresponding reference dates. Of the four peaks, Payment for Exports indicates the turn correctly three times. Electricity Consumption has a similar record except that it has yet to reach a peak in 1990 as the other indicators. Meanwhile, the Imports series is a better coincident indicator at troughs since it coincides with the reference dates two out of three times.[39]

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39. This situation where some indicators are good coincident at troughs while others are good at peaks is not unique. In New Zealand, it is reported in the *OECD Sources and Methods No. 39 on Leading Indicators and Business Cycles in Member Countries* that the coincident indicators are separated into two groups, namely, "coincident at upturns" and "coincident downturns". Due to lack of data, a similar separation is not attempted for Thailand.

Table 8

THAILAND: COMPOSITE COINCIDENT INDEX
(1980 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1970	79.82	79.09	78.63	79.50	79.41	80.09	79.89	78.94	79.55	79.07	78.96	80.19
1971	79.11	79.52	79.95	79.95	79.50	79.53	79.88	80.14	80.34	81.33	81.31	81.70
1972	81.47	82.18	82.15	81.45	82.93	82.97	82.83	83.71	83.59	83.91	84.31	84.39
1973	84.57	84.56	84.33	85.25	85.19	85.50	85.01	86.24	85.68	85.61	86.26	86.20
1974	85.83	84.36	86.12	85.99	86.33	86.33	87.06	86.54	86.54	86.61	86.16	86.84
1975	87.04	86.79	87.13	87.19	88.48	87.70	89.15	88.01	88.98	88.46	88.13	88.54
1976	88.51	89.63	89.91	89.64	90.17	90.88	91.51	91.58	92.13	92.48	92.77	92.33
1977	92.14	92.67	92.49	92.82	93.14	93.56	94.32	94.37	94.34	94.12	94.72	95.48
1978	95.09	94.64	96.18	95.41	96.16	96.80	96.28	96.83	97.13	97.81	99.19	98.47
1979	98.92	98.95	98.80	98.84	99.31	98.87	99.15	99.26	99.31	100.45	100.16	100.00
1980	100.79	100.26	98.92	100.11	100.11	99.69	100.38	100.02	100.09	99.96	99.44	100.23
1981	100.16	99.65	99.59	100.67	99.93	100.49	101.09	99.74	100.66	101.05	100.13	100.17
1982	99.07	101.00	100.78	100.90	100.83	101.52	101.32	101.33	101.42	100.57	102.54	102.58
1983	101.91	101.45	103.53	101.80	102.94	103.97	103.38	103.83	104.39	104.16	104.44	104.92
1984	105.37	106.02	106.00	106.11	106.67	106.02	106.11	107.25	105.97	107.43	107.99	107.20
1985	108.18	107.56	107.50	108.01	108.42	107.10	107.77	106.84	107.09	107.68	107.02	107.60
1986	107.89	107.70	108.19	109.00	108.44	109.05	109.77	109.32	109.95	110.29	109.93	110.74
1987	110.84	110.48	111.60	111.92	112.07	113.84	114.61	113.70	114.04	114.83	115.25	115.73
1988	115.95	117.34	117.06	117.35	116.96	118.22	117.56	119.20	119.65	119.61	119.77	120.52
1989	121.35	121.29	122.83	123.24	123.67	124.19	124.27	124.93	125.78	126.13	127.14	126.96
1990	127.75	127.81	128.12	128.53	129.57	130.14	131.32	131.56	130.82	131.34	131.55	131.53
1991	131.98	132.10	132.50	132.94	133.36	132.88	133.97	133.58	133.00			

Our last general observation of the results is that not all the coincident indicators have a one-to-one matching cycles with the reference cycles. This is especially the case for Imports and Payments for Exports, both of which portray a few extra cycles reflecting the highly volatile nature of the series. In addition, we also find that the performance of some coincident indicators is not consistent throughout the study period. They have a very good record at a certain period but fail in another period. Electricity Consumption, for example, does very well during 1970 - 1986 but turns out to be a long leader at the peak of 1990. Similarly, Sales of Department Stores has a perfect coincident record during the first two cycles but fades away after that to show very erratic and shallow cycles. Domestic Cement Sales is the opposite, its cyclical movements are erratic before 1982, thereafter the cycles are clearer and the turns closer to the reference dates.

It is recognized that our list of coincident indicators, in spite of being the best that we could come up with under the present situation, could be improved further in the future. There is a definite possibility for this exercise, judging from the current enthusiasm of the Thai authorities to enhance their data base to match the new requirement of becoming a newly industrialized country. Monthly data on GDP and some production index, for example, have begun to be collected and estimated although the time coverage of these series is still too short for our immediate purpose. Thus, to improve the list of coincident indicators further, one needs to watch out for better candidates and keep on testing them. At the same time, the existing series which persistently fail to perform should also be dropped from the list. Still, even with the less than perfect group of coincident series that we come up with, it has been demonstrated that it could yield a growth cycle chronology that corroborates with other evidences and is consistent with the general observations of the actual situation.

3. COMPOSITE INDEX OF LEADING INDICATORS

The selection of leading indicators is based on four main criteria: (i) economic justifications; (ii) consistency in leading the growth cycle chronology; (iii) data have broad coverage; and, (iv) data are most current and up to date. In the preliminary selection of candidates for leading indicators, again the Bank of Thailand CEI and the SEPIA

Diffusion Index provided useful guidance. We also looked at studies on leading indicators in other countries for ideas on additional and alternative candidates. Lastly, to ensure that the final composite leading index really represents the entire economy, the final list is carefully selected to include variables from as many economic sectors as possible.

3.1 Leading Series Used

Table 2 reports the economic time series which have been tested and concluded as good leading indicators for Thailand. On the whole, they are a fairly diversified group with one indicator each representing production (Authorized Capital of Newly Registered Companies and Partnerships); investment (Construction Area Permitted); and, profits (Stock Price Index). For consumption expenditure, there are two monetary indicators (Loans for Personal Consumption and Broad Money Supply M2).

Of the five leading indicators we selected, only three series have data as far back as January 1970. Data for Stock Price Index and Authorized Capital of Newly Registered Companies are available from April 1975 and January 1978 respectively. However, as will be seen later, these two series have very good leading records. Detailed analysis of timing differences of each of the leading indicators and their composite index is given in Section 3.2.

In the process of selecting leading indicators which satisfy all our requirements, we decided to drop a few series. One of them is Total Investment Promotion Certificates Issued by the Board of Investment (BOI). This series, according to its definition, should be a very good leading indicator as it indicates the impending investment of significant magnitude, especially during the early stage of investment promotion in Thailand. When this series was tested, however, we encountered some technical problem concerning the nature of its data.

Although data for the above series are available as far back as January 1971, they fluctuate so widely that it is almost impossible to estimate its long-term trend. Such fluctuations of data appear to result from the step-function nature of the series since the approval of investment projects is given in batches. In some months, the values are extremely high while in other months the values are

zero.[40] Accordingly, no clear cyclical patterns could be observed, making the turning points selected by the computer program less meaningful and very different from the chronology. This leaves us no choice but to drop this series from our list of leading indicators.[41] Another reason which prevents us from investing more time on this series is the fact that this series may become increasingly less important as a potential leading indicator in the future. We feel that as the general tariff level is brought downward across the board in line with the government's liberalization moves in recent years, there will not be much incentive for investors to request for a promotional status under the BOI.

We also tested the Wholesale Price Index for Construction Materials, an equivalent series for Industrial Material Price Index which is known to be a reliable leading indicator in the U.S., Canada and the United Kingdom. However, the results were not satisfactory. Measuring from trough to trough, there was only one clear cycle during October 1972 to March 1978. For the period 1979 to 1987, the cycles move along in a plateau fashion with very small and shallow cycles. This, to some extent, is an indication that prices of at least some components of the construction materials have not been allowed to move freely. Under this circumstance, their movements would not truly reflect any cyclical forces.

In conclusion, the selected five series represent fairly broad-based economic activities. As can be seen from Appendix 5, our choice of leading indicators is quite similar to that of the SEPIA Project, unlike the case of the coincident indicators when the two lists have fewer indicators in common. This similarity, however, has to be qualified in two respects. First, in our study, M2 rather than M1 is used because we believe that the former could represent the consumption expenditure better and in a broader sense. We also did not include the Refinery Production of Petroleum Product in our leading indicator list on account of the fact that the importance of petroleum production in GDP is rather insignificant except during the two oil-

40. Since the GROCYC program will not process data series with zero values, a small value of one (1) is assigned to these months.

41. There is a suggestion to smoothen the data by ways of cumulating the monthly data. However, there is a problem of how to interpret the results. In addition, not much improvement could be observed after data are smoothened in this manner.

shock periods. In stead, Authorized Capital for Newly Registered Companies and Partners is used as a proxy for production. As will be seen later, in spite of its being a relatively short series with data starting only from January 1978, this data series turns out to be one of our best leading indicators.

3.2 Cyclical Timing Analysis of Leading Indicators

When the five coincident indicators are identified, a composite index of leading indicators is constructed. As in the case of the coincident indicators, the amplitude of the composite index is adjusted to be equal to the long-term growth rate of real GDP.[42] Its base year is also set at 1980 which, apart from being the base year used in the IEI study, is considered, in the economic sense, as one of the relatively more stable years for Thailand. Table 9 presents the composite index of leading indicators which have been computed in the manner described in Part I of this report.[43]

As in the case of the coincident indicators, the leading indicators thus selected, together with their composite index, are tested for their cyclical timing conformity with the growth cycle chronology. The results are summarized in Table 10 while Charts 9 to 14 display growth cycles in terms of deviations from the trend of the composite leading index as well as the individual indicator.

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42. It should be noted that the composite index is not trend-adjusted as in the case of the IEI study. There are two reasons for this. Firstly, it seems quite odd to impose a certain trend on the series which will be trend-adjusted again later. Secondly, with the benefit of a preliminary work on the Thai case study (1970-1989) from which a trend-adjusted index is derived, the two composite indexes display more or less similar cyclical behaviour as far as turning points are concerned. To the extent that the requirement of having all the composite indexes with the same trend is not met and in view of the potential use of a composite index of leading indicators to forecast a magnitude change of the real GDP, we may attempt to incorporate a particular trend into the composite index later. However, we feel that the unadjusted index is sufficient for the purpose of the present study.

43. This computation was done on the U.S. Department of Commerce NHCOMP1 program. Although the computation can also be done by hand on COMETS, we find a few advantages in using the NHCOMP1 program. Firstly, the program will extrapolate the values of the composite index up to the earliest value of all the component series. For example, in our case only two of the five series have values from January 1970 while one series has data only from January 1978. Computation on COMETS will result in the composite index having its first value in January 1978 while the NHCOMP1 will generate values from January 1970. Secondly, NHCOMP1 program will also extrapolate three more values at the end, giving some form of forecasting. For details on the NHCOMP1 program, please refer to Appendix 6.

Leading Indicators

In general, most of the individual indicators and the composite index perform according to expectation. In fact, their performance is much better than the coincident indicators in the sense that they consistently lead the corresponding chronology as reflected in the percent lead and the median leading months. Even when compared with the reference dates derived from the SEPIA Project and the Bank of Thailand CEI, the results are similar if not better. The leading indicators and the composite index also seem to be less sensitive to the update of data which is an indication that their estimated long-term trends are quite stable.

Compared with the coincident indicator case, it is interesting to observe that the composite leading index does not perform as well as two of the component series - Loans for Personal Consumption and Authorized Capital of Newly Registered Companies. Although it has a 100-percent leading record at troughs, the coincident occurrence at the peak of November 1978 brings down its success rate of leading to 75 percent. This is because, at this peak, one of its components coincides with the chronology while the other lags behind by two months. On the average, the composite leading index leads the chronology by six months at troughs and by three months at peaks.

For series related to consumer credit, it is commonly known that its growth rates normally perform better as far as cyclical timing is concerned. However, instead of using the normal growth rate which is found to tend to shift the turning point dates, we follow Geoffrey Moore's suggestion in using the six-month smooth growth rates of the Loans for Personal Consumption.[44] The transformation costs us 12 data points as the six-month smoothed growth series begins from January 1971. However, it gives better results when compared with the original series.[45] It leads the growth cycle dates by seven months

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44. The computation is done as follows:
    (1) Compute the 12-month moving averages (12-MA) of the previous 12-months of the seasonally adjusted and deflated raw data.
    (2) Compute the annualized rate of growth of the above 12-month moving averages using the formula:

        gr. rate = 100 * ((12-MA/12-MA(-1))**(12/6.5) - 1)

45. Since the growth rate is a measure of deviation in itself, the turning points of the six-month smoothed growth rates can be identified directly without detrending the series. This is normally done by the Turning Point Program. However, in our case, the identification was done directly from the Chart due to the unavailability of the program.

Table 9

THAILAND: COMPOSITE LEADING INDEX
(1980 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1970	71.80	71.95	72.43	72.71	72.79	72.76	73.01	73.86	74.79	76.04	76.57	76.30
1971	77.10	77.24	76.58	76.36	77.05	78.56	77.75	77.43	76.01	76.03	76.47	75.98
1972	76.34	76.77	77.50	77.87	77.64	79.48	79.64	80.04	80.22	81.04	80.52	80.41
1973	80.61	81.17	81.36	82.59	83.46	81.99	81.95	81.95	83.37	83.28	83.41	82.79
1974	82.44	82.14	79.53	79.61	80.32	80.57	81.71	81.65	83.47	83.82	84.29	84.42
1975	85.34	85.64	87.11	87.02	86.75	86.96	87.16	87.64	86.97	86.92	86.87	87.49
1976	87.40	87.12	86.13	86.51	86.35	87.58	87.73	88.72	88.90	89.24	89.24	89.55
1977	89.34	89.65	91.46	92.61	92.66	92.18	94.19	95.52	95.83	97.42	98.42	98.67
1978	100.07	101.14	101.15	101.70	102.27	102.81	103.11	104.13	104.37	105.77	106.42	106.48
1979	105.32	105.65	103.55	102.98	102.58	103.83	102.46	102.65	102.47	102.18	101.58	101.99
1980	101.20	100.57	100.21	100.32	99.18	99.74	99.57	99.45	99.32	99.92	99.95	100.56
1981	100.38	100.78	100.95	101.43	102.19	101.72	101.29	100.94	100.70	100.55	100.40	101.08
1982	101.48	101.64	101.82	102.72	102.52	103.82	104.08	105.74	106.79	107.15	106.94	107.95
1983	108.43	108.98	109.80	110.93	111.19	111.65	112.13	112.42	112.50	113.17	113.07	114.08
1984	114.58	114.69	114.33	114.44	114.15	114.36	114.41	114.32	114.76	114.83	116.06	116.34
1985	114.07	114.50	117.07	116.59	116.86	117.54	117.67	117.54	118.03	118.52	117.93	117.17
1986	117.56	116.98	116.10	116.61	116.99	117.75	118.50	120.48	120.80	121.64	121.66	122.67
1987	123.10	123.35	125.20	126.76	128.06	129.44	130.82	132.47	134.36	133.30	133.36	134.94
1988	136.58	138.22	138.64	139.75	139.56	140.35	140.56	141.05	141.54	142.83	143.36	144.56
1989	154.08	145.15	145.60	146.69	147.67	149.49	148.56	149.99	151.48	152.90	154.66	157.02
1990	159.02	158.45	160.98	160.11	161.91	163.93	162.15	162.24	163.51	162.48	161.75	161.39
1991	161.66	163.35	164.60	164.92	164.73	165.41	166.72	166.42	166.58	166.45	167.69	169.23

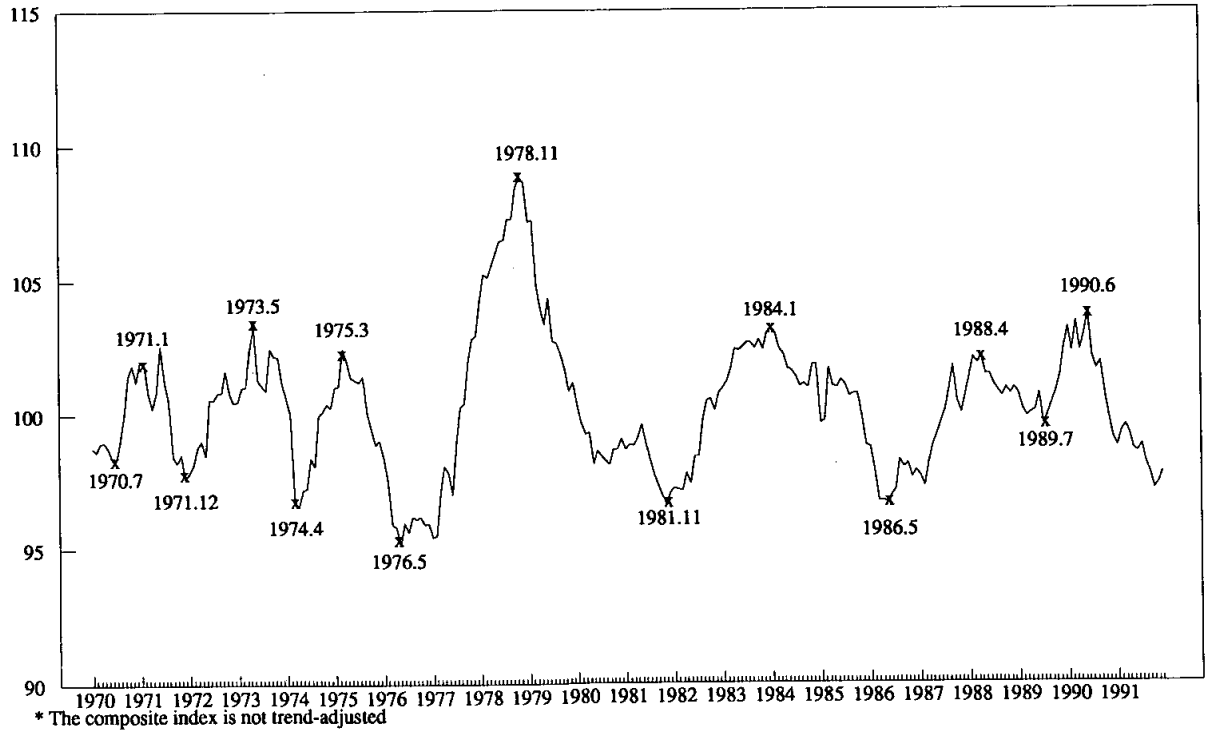
Table 10

THAILAND: MEDIAN LEAD (-) OR LAG (+) OF INDIVIDUAL LEADING INDICATORS WITH RESPECT TO GROWTH CYCLE PEAKS AND TROUGHS

Indicators	Trough	Peak	Overall
	Lead (-) or Lag (+), in Months		
Stock Price Index	-1	-1	-1
Broad Money Supply (M2)	-2	+2	+2
Construction Area Permitted	+1	-9	-1
Loans for Personal Consumption (6-month smoothed growth rates)	-7	-7	-7
Authorized Capital of Newly Registered Companies	-9	-4	-6
Composite Leading Index	-6	-3	-4
	Per cent Coincident		
Stock Price Index	50	67	60
Broad Money Supply (M2)	67	25	43
Construction Area Permitted	33	75	57
Loans for Personal Consumption (6-month smoothed growth rates)	100	100	100
Authorized Capital of Newly Registered Companies	100	100	100
Composite Leading Index	100	75	86

Chart 9

COMPOSITE LEADING INDEX OF 5 SERIES*
Deviations from Final Trend



* The composite index is not trend-adjusted

Chart 10

STOCK PRICE INDEX
Deviations from Final Trend

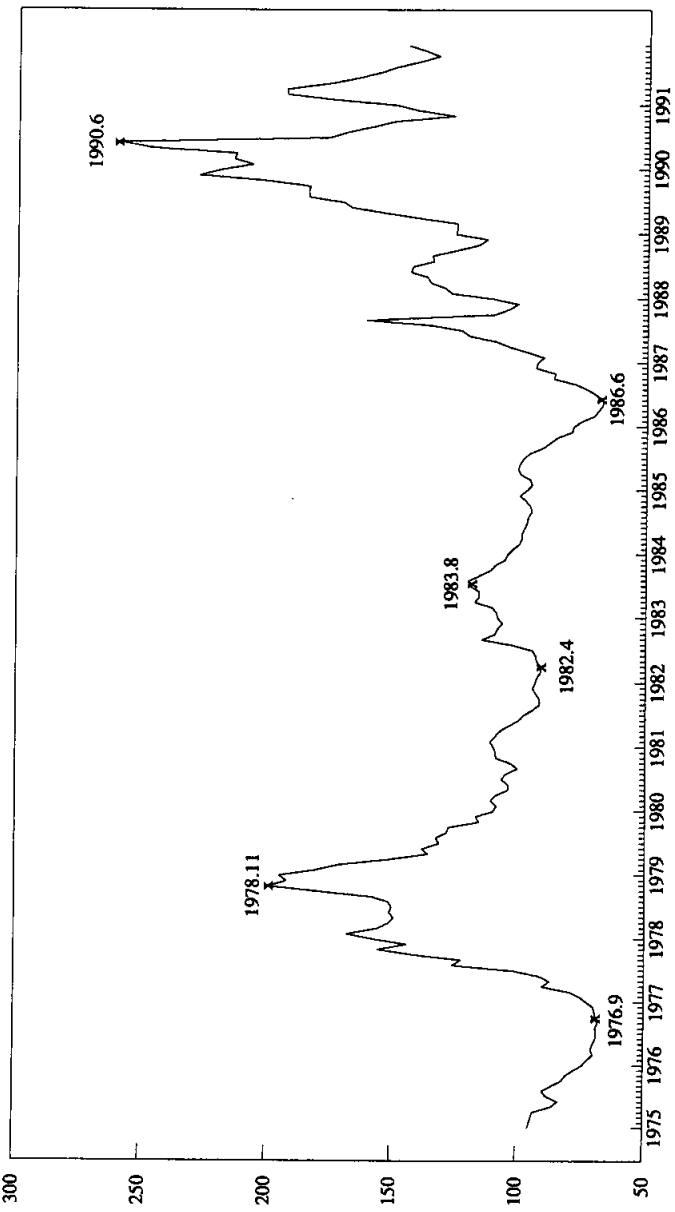


Chart 11

MONEY SUPPLY, SA & DEFLATED
Deviations from Final Trend

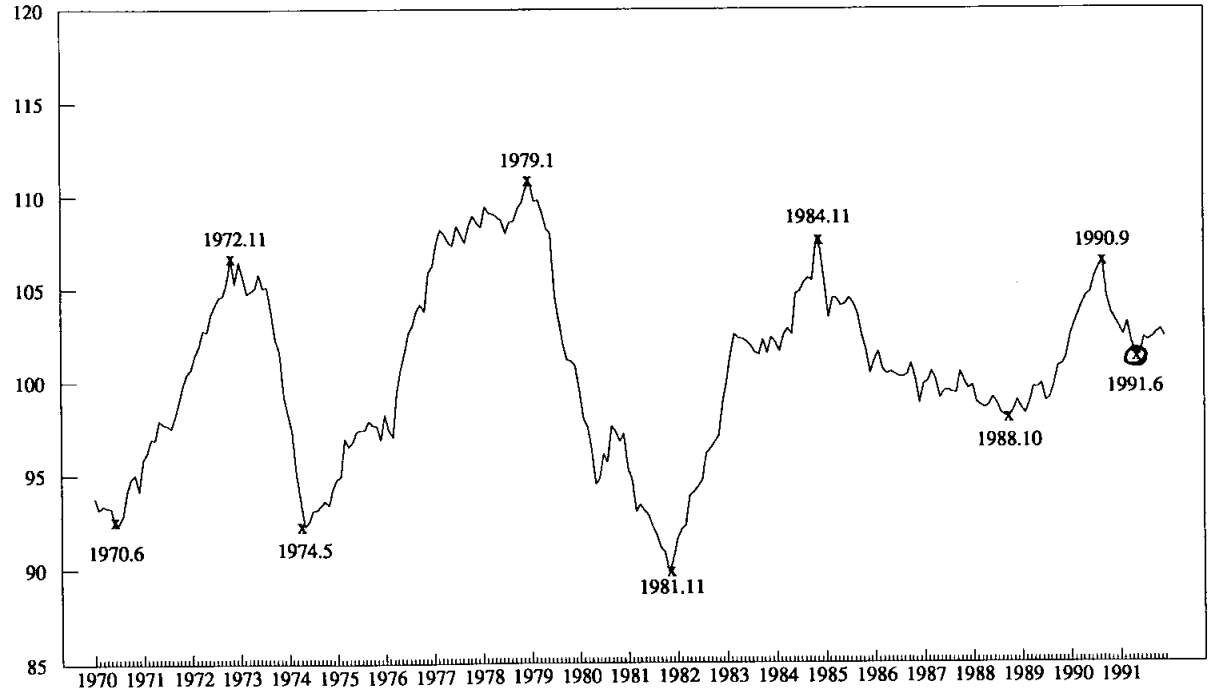


Chart 12

CONSTRUCTION AREA PERMITTED IN BANGKOK, SA & 5-MA
Deviations from Final Trend

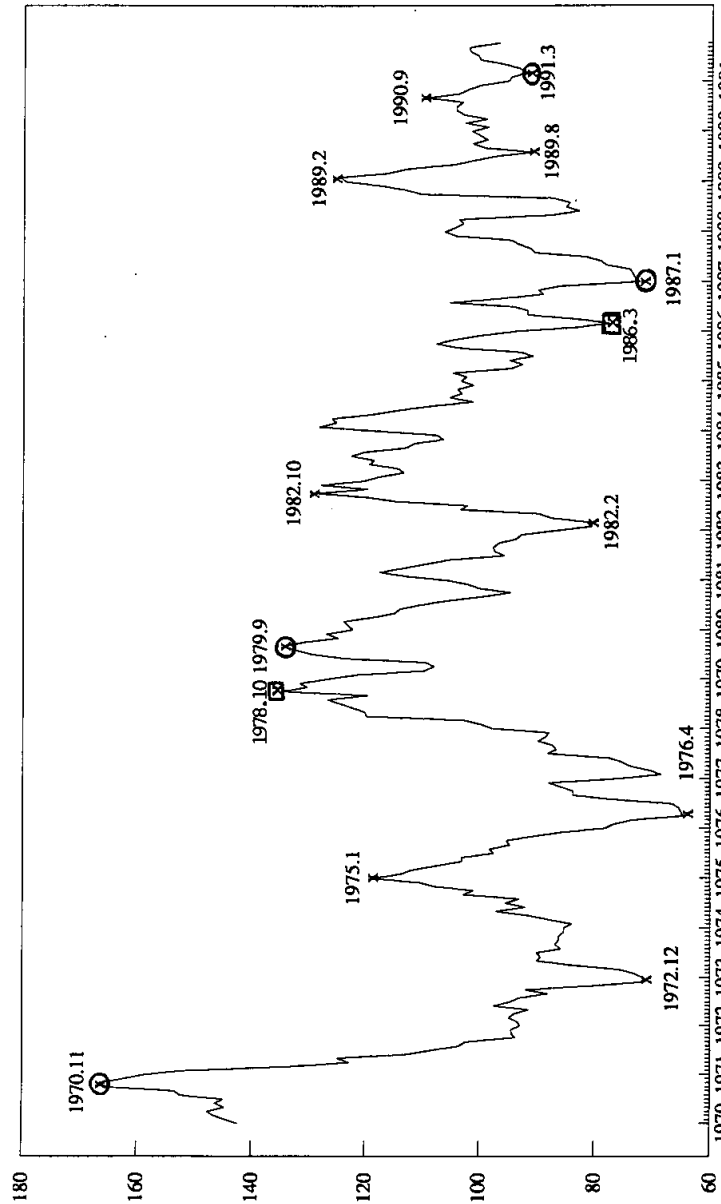
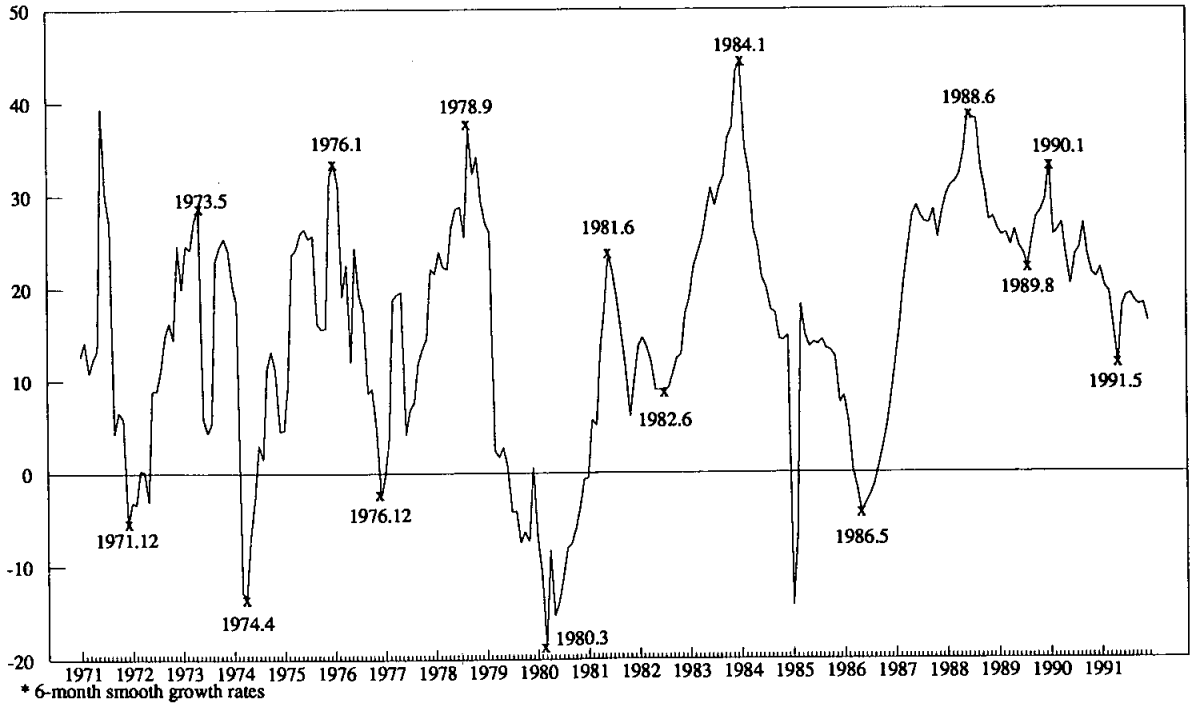


Chart 13

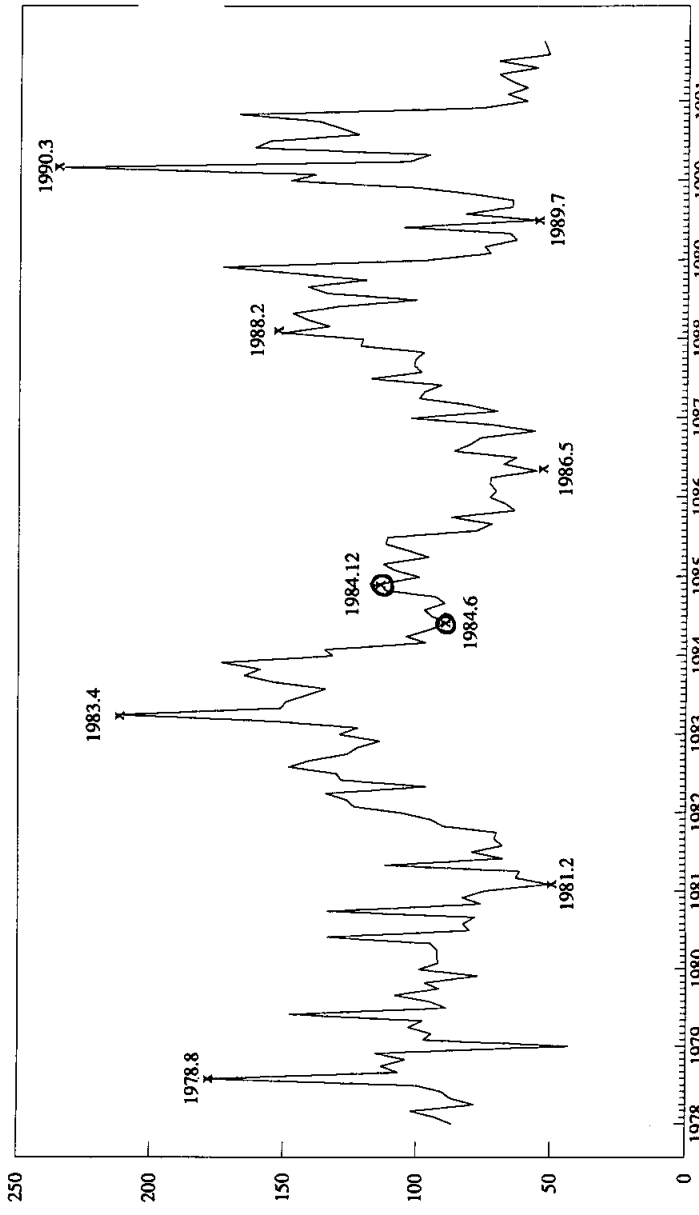
LOAN FOR PERSONAL CONSUMPTION*
Deviations from Final Trend



* 6-month smooth growth rates

Chart 14

AUTHORIZED CAPITAL OF NEWLY REGISTERED COMPANIES, SA
Deviations from Final Trend



on the average at both peaks and troughs. Although it has two extra cycles, it has a perfect 100-percent lead record.

The other series which does very well is the Authorized Capital for Newly Registered Companies, which also has a 100-percent lead record. It has the median lead at peaks of nine month and at troughs of four months. It also has one-to-one matching cycles with the growth cycle chronology. However, it must be remembered that the data for this series are available from January 1978 which means that we only have three peaks and two troughs to observe from. In addition, the latest figure is available after a three-month lag. Unless the preliminary figures can be estimated fairly accurately, the usefulness of this series as a leading indicator may be quite limited.

Stock Price Index is another series that quite consistently leads at both peaks and troughs.[46] However, its median lead is around one month both at troughs and at peaks which means that it gives a very short warning time. It is also observed that the Stock Price Index series has a better record at peaks than at troughs. Out of the two troughs in January 1982 and November 1986, it only leads once, by five months at the latter trough. Its performance at peaks is relatively better as it leads in two occasions (October 1983 and July 1990) and coincident in one occasion (November 1978). In terms of consistency in cyclical timing, however, the series exhibits quite an erratic pattern. It gyrates from being coincident at the peak of 1978 to lag by three months in the trough of 1982 and thereafter leads all the peaks and troughs by a large variation of months.[47] Thus, compared with other countries, the Stock Price Index has a less impressive record as a leading indicator for Thailand.

For Money Supply (M2), its lead record at troughs is better than at peaks. Out of the three troughs, it leads at the first two troughs of 1975 and 1982 while lags by nearly two years at the last trough,

46. Since the Stock Price Index has data only from April 1975, and the requirement of the GROCYC Program is that a series must start from January, we assume that the index remains constant during the first four months of 1975. That is, we use the value of April 1975 for January-March 1975 as well. We do not think that this assumption will adversely impact the overall results. Since the PAT method generates different trends for different phases, whatever the values of the first four observations will have no impact on the cyclical estimation from the second phase onwards.

47. It leads by 14 months at the peak of 1983, five months at the trough of 1986 and one month at the peak of 1990.

indicating an exceptionally long but shallow contraction phase of 35 months. Chart 11 also reveals that, compared to its long-term growth, money supply drops sharply in 1986 but continues to drift slightly downward to reach its trough in October 1988. However, this long contraction period conceals the fact that private credit has in fact begun to recover from a low growth rate of 5 percent in 1986 to 27 percent in 1987 and remained at above 20 percent since then. Since money supply also includes net credit to the government, the turnaround from deficit to surplus of the government budgetary operations was responsible for preventing the money supply to move into a recovery stage in 1987. Instead, the budgetary surplus continued to dampen the money supply growth until the trough of 1988.

We also found that, with the exception of the first peak of 1973, Money Supply tended to be coincident at peaks as reflected in its median leading date of +2 months at peaks. This, as in the case of the long contraction period of 1984-1988 discussed above, may partly suggest a problem associated with using an aggregated data, especially when its components are moving in opposite directions. However, in spite of these setbacks, money supply is such an important monetary measure that it should be retained. In addition, its exclusion from our leading indicator list will also mean that the composite index for the early 1970s will comprise only two series. This is not desirable especially when one of the two series - Construction Area Permitted - does not perform very well as a leading indicator.

According to its definition, Construction Area Permitted[48] should be a good leader as it is the most direct measure that indicates future activity in the construction sector. However, its role as a leader also depends on how strict the permit rule is enforced. If the problem of illegal construction can be settled easily, the construction area figures as indicated in the permits issued could be grossly underestimated. Unfortunately, this seems to be the case for Thailand, particularly during the 1970s and early 1980s when incidences of "build first, permits later" were quite rampant. This partly explains the poor performance of this indicator for the period 1970-1982 when it consistently turns at a later date than the corresponding chronology. For the

48. This is the only series in our study which was smoothed over five months so that the erratic and unexplained component of the series is minimized and the cyclical pattern could be observed more clearly.

recent period since 1982, however, it has performed consistently well and provided the longest lead time of all the other leading indicators.

4. CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE WORK

This study has shown that the CIBCR procedure to construct a composite index of leading indicators can be applied to Thailand with reasonably good results. Despite the lack of some key variables, it has been demonstrated that the growth cycle chronology established in this study is consistent with the outcomes of other related studies as well as the perceived reality. The list of leading indicators is comparable to those of other countries. The cyclical timing of these leading indicators as well as their composite index is shown to lead the chronology by a fairly good number of months. In addition, the performance of these indicators is generally consistent over time while their economic justifications are sound.

Still, there are rooms for further improvements when data permits. As in the case of business cycle study any where, for a study to be useful and relevant, it has to be dynamic and able to keep up with the changing conditions as well as to make full use of better facilities. In the U.S. Department of Commerce, it is a matter of routine to keep looking out for and testing new candidates for all the groups of indicators it has been publishing. The list of indicators in each category is also revised from time to time. Even the methodology itself is not spared of this constant effort for further improvements. This underscores the importance of periodic reviews and assessments of the existing indicator system in light of the new evidences that emerge.

In the Thai case, the area that needs further refinements in the near future is that of the coincident indicators. Although, taken together, they do generate a good chronology, not all the indicators in our present list performs to expectation. This may indicate a few underlying problems. Firstly, data problem is most felt in the selection of coincident indicators. Monthly real GDP is available only from January 1985 while data series on important production indexes such as that of manufactured goods starts even later. Thus, we have to rely on proxy variables for this economic sector. For employment and wages, not only are their monthly data not available, there are not even suitable proxies for them. Secondly, the Thai economic

structure itself is changing rapidly from being an agriculturally based economy to becoming more and more industrialized. The transition is hastened by the recent extensive liberalization moves leading the country even further away from the old structure of the 1970s and even the 1980s.

Thus, the most immediate task for future work is to reexamine the list of coincident indicators bearing in mind the two factors cited above. As far as data are concerned, it is merely a matter of time before a very good list of coincident indicators can be identified.[49] To match its fast growing economy, serious efforts have been made to enhance the country's database. Reliable monthly GDP and the Production Index of Manufactured Goods are already available now. Meanwhile, to capture the structural change, it may be necessary to have two sets of coincident indicators using the year when pervasive structural changes occur as a cut-off point. The series which could be reconsidered for future use are Personal Income Tax, on account of its being quite promptly available, and Imports of Capital Goods. Even some micro indicators such as Sales of Automobiles and Sales of Motor Cycles could also become more important in the future as the Thais become more affluent.[50] Another series that should be closely watched is the Domestic Cement Sales. We feel that as the market could function more freely, this series could serve as a good leading indicator.

The other area that should be closely looked at as more data are available is how soon the update of the chosen indicator will become available and how often and how large will the revisions be. It should be reminded that the forecasting value of the leading indicator technique lies in its ability to present the evidence fairly accurately and in the fastest possible time. If the CLI has median lead of about three months, the index which becomes available with a three-month lag will be of little use. The situation could be worse if the index is based

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49. Even with the new list, we are quite confident that it will not drastically affect the present growth cycle chronology. This confidence is based on the consistent procedure that we have established, both internally through the leading indicators and externally through the Bank of Thailand CEI, the new monthly GDP series and the general perception of economic conditions.

50. Incidentally, these two series were tested and concluded as good coincident indicators during the period for which data were available (January 1978 - December 1991). However, at this point, we consider the two series too micro in the sense that they impact only a small section of the economy. Accordingly, they were not included in the present list.

on preliminary values which turn out to be significantly off the mark, as the index might give a wrong signal altogether.

It is acknowledged that this particular aspect of the series is not strictly looked at in our study since the choices between series are quite limited. Accordingly, in a subsequent revision of the indicator system when more series are available, the series which are stable and available more promptly should be preferred. An example of this is the series on Loans for Personal Consumption. We understand that due to the recent change in the reporting system, the actual data for this series will be available only on a bi-annual basis. Although estimates are routinely made to bridge this gap by the Bank of Thailand, it may be a better idea to replace this series with Total Private Credit.

Another area worthy of future effort is the establishment of lagging indicators and, if resources permit, the conduct of a business expectation survey. With the former, the indicator circuit for Thailand will be complete. The lagging indicators will not only help confirm the turning points of the coincident and the leading indicators but will also be useful in themselves as measures of excesses and imbalances. Meanwhile, the results of the business expectation survey will be among the quickest possible evidences of all the repertoire of forecasting tools that a country can have.

While attention is closely paid to the selection of the indicators and the construction of their composite index, efforts should also be made to find the best way to use the composite leading index (CLI). It has been acknowledged that even with the present ad-hoc manner in which the CLI is used and interpreted, the CLI is still the first available solid evidence to indicate whether the economy is in its upswing or downswing. Although the main criticism of the indicator approach is its probability of giving false signals, the fact that the approach continues to have widespread followers shows that the fault probably lies more on the way the CLI movements is being interpreted rather than the CLI itself.

Although there are no short cuts to finding out the best way of using the CLI, the task may not be that difficult. Since many rules or derived measures have already been developed and used, one can take full advantage of them. Apply these rules or measures on a particular case such as the CLI for Thailand and determine which performs the best in light of the past experience. One might even

wish to go a step further by conjuring up a new rule or formula which may include an element of probability to make the index more exact in its predictive power. One conclusion is clear, however, that it would not have been possible to do all these without a good and reliable set of leading economic indicators in the first place.

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APPENDICES

THE COINCIDENT SERIES USED TO DERIVE REFERENCE DATES IN SELECTED OECD COUNTRIES

Countries	Series
The United States (NBER/U.S. Department of Commerce)	1. Employees on non-agricultural payrolls; 2. Persons engaged in non-agricultural activities; 3. Employee-hours in non-agricultural establishments; 4. Personal income in 1972 $; 5. Total civilian employment; 6. Industrial production; 7. Manufacturing and trade sales in 1972 $; 8. Sales of retail stores in 1972 $; 9. Number of unemployed, total (millions, inverted); 10. Final sales in 1972 $ (quarterly); 11. GNP in 1972 $ (quarterly).
Japan (Economic Planning Agency)	1. Use of electric power (million Kwh); 2. Index of capacity utilisation (Mfg.); 3. Index of consumption of raw materials (Mfg.); 4. Index of industrial production (mining and manufacturing); 5. Index of producers' shipment (mining and manufacturing).
Spain (Banco de España)	1. Industrial production; 2. Apparent cement consumption; 3. Railroad activity index; 4. Maritime transport index; 5. Air transport index; 6. Gasoil (transport) consumption (land transport);

Countries	Series
	7. Foreigners visiting Spain; 8. Telephone calls - communications.
Switzerland	1. Total industrial production (quarterly); 2. Number of nights spent in hotels (monthly); 3. Cement deliveries (monthly).
United Kingdom	1. Gross Domestic Product, expenditure estimate; 2. Gross Domestic Product, output estimate; 3. Gross Domestic Product, income estimate; 4. Index of Industrial Production, manufacturing; 5. Retail Sales Index (volume).pVrHV

Source: Department of Economics and Statistics, *OECD Leading Indicators and Business Cycles in Member Countries, 1960-1985,* Sources and Methods No. 39, January 1987, Table 4.1, p. 25.

TURNING POINT / GROWTH PROGRAM
A Brief Explanation[1]

The Program handles two major tasks:

(1) It selects turning points of a data series; and,
(2) It estimates the long-term trend of the series and its rate of change and produces the final trend-adjusted series.

1. The Turning Point Selection

Since a moving average of a series represents its trend and cycle component, the Programme makes use of several moving averages to identify the specific cycles and their corresponding peaks and troughs, basing on the general rules laid down by the NBER. The moving averages used in the Program are of 12-month, 15-month Spencer curve[2] and 3-6 months duration.

The Program procedure is summarized as follows:

(i) Determine and substitute extreme values in the seasonally adjusted and deflated series.

(ii) From the 12-month moving average of the series, determine specific cycles by identifying points higher (or lower) than 5 months of either side. Select the highest (or lowest) of the multiple peaks (or troughs) and ensure that

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1. The information covered in this Appendix are taken from Bry, Gerhard and Charlotte Boschan, in *Cyclical Analysis of Time Series: Selected Procedures and Computer Programs,* NBER Tehnical Paper No.20, New York, 1971 and Boschan, Charlotte and Walter W. Ebanks, "The Phase-Average Trend: A New Way of Measuring Economic Growth", in *Proceedings of the Business and Economic Statistics Section,* American Statistical Association, 1978, p.332.

2. This is a weighted moving average with the highest weights in the center and the negative weights at the ends, which ensures that the curve follows the original data closely. It is known to be considerably more flexible than the unweighted 12-month moving average and follows the peaks and troughs of the original data without drastic effects on the location of the turning points. However, its flexibility also causes it to follow minor fluctuations of less than cyclical importance and sometimes negligible amplitude.

a peak must be followed by a trough and vice versa. In case of equal values, choose the month before the reversal of the cyclical process begins.

(iii) From the Spencer Curve of the series (extreme values replaced), determine the corresponding turns by identifying the highest (or lowest) value within ± 5 months of the selected turns in the 12-month moving average. Test for minimum cycle duration of 15 months and eliminate lower peaks and higher troughs of shorter cycles.

(iv) From the short-term moving average (3 to 6 months, depending on the months of cyclical dominance) of the series determine the corresponding turns by identifying the highest (or lowest) values within ± 5 months of selected turn in the Spencer Curve.

(v) From the unsmoothed series, determine the turning points using the following guides:

- Identify the highest (or lowest) value within $\pm$ 4 months, or months of cyclical dominance which ever is larger, of selected turn of the short-term moving average (step (iv));
- Eliminate turns within 6 months of begining and end of series;
- Eliminate peaks (or troughs) at both ends of series which are lower than values closer to end;
- Elimination of cycles whose duration is less than 15 months; and,
- Elimination of phases whose duration is less than 5 months.

2. The Phase-Average Trend

At the heart of growth cycle analysis is the ability to approximate rather accurately the long-term trends in economic time series. Although the methods available are numerous, ranging from free hand trend setting to modified exponential growth trend, it is argued that the inter-cycle secular trend originated at the NBER is the most suitable for the growth cycle analysis purpose.

Rather than decomposing a time series into four components, namely, trend; cycle; seasonal; and random, the NBER believes that the cyclical forces and secular trend are interrelated due to the "cycle of experience" and hence it is conceptually meaningless to separate them. The trend forces in the NBER analysis, therefore, are the inter-cyclical ones, i.e., a step function of changes in levels from cycle to cycle, not a continous trend line. This is the basis for the "phase-average trend" technique.

The procedure for computing "phase-average trend" is an improved version of the methodology used by the late Ilse Mintz in her work on measuring economic fluctuations in the U.S. and West Germany.[3] It is designed to remove the bias caused by Mintz's assumption that an average duration of business cycles is about four years, while it maintains the fit and flexibility of the trend line. An overview of the entire procedure as used in the Program is given below:

(i) Compute 75-month moving average of deseasonalized data as a first approximation of a secular trend.

(ii) Extrapolate beginning (end) using rate of change between the average of the first (last) 75 month and that of the 75 months starting two years later (earlier).

(iii) Compute deviations of individual observations from moving average.

(iv) Determine cyclical turning points and thus expansions and contractions in deviations.

(v) Compute "phase-averages" (i.e., averages during cyclical phases) of original deseasonalized data for all expansions and contractions.

(vi) Compute 3-item moving averages of phase averages (triplets).

(vii) Compute "slope" of the second approximation of trend by connecting mid-points of triplets.

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3. Mintz, Ilse, *Dating Postwar Business Cycles: Methods and Their Application to West Germany, 1950-67,* Occasional Paper No. 107, NBER, New York, 1970.

(viii) Adjust "level" of trend by making the sum of each segment between the two consecutive triplets equal to the sum of the original observations during that period of time.

(ix) Extrapolate as follows:
- in the beginning, assume first phase average to start with first month and end with first turning point and extrapolate first trend segment (from first to overlapping triplet) on straight line; and,
- in the end, compute slope from last triplet midpoint so that the trend values of the last segment are equal to the sum of original observations.

(x) In order to smooth the transition from step to step, compute a 12-month moving average of the second approximation trend to yield the final trend.

THE CIBCR CHOICE OF LEADING AND COINCIDENT SERIES

United States	Canada	United Kingdom
Leading Indicators	***Leading Indicators***	***Leading Indicators***
Average workweek, mfg.	Average workweek, mfg.	Average workweek. mfg.
Average initial claims unemployment insurance (inverted)	Initial claims, unemployment insurance (Inverted)	
Net business formation		New companies registered
		Business failures (inverted)
New orders, consumer goods and materials*	New orders, durable goods*	
Contracts & order, plant and equipment	New orders, machinery and equipment*	New orders, engineering industries, volume
	Non--residential building permits	New orders, construction, private industry*
New building permits, private housing unit	Residential building permits	Housing starts, thousands
Change in business inventories (q)*	Change in non-farm businee inventories (q)*	Change in stocks and work in progress (q)
Industrial material price index	Industrial material price index	Basic materials price index
Stock price index, 500 S&P common	Stock price index, Toronto Stock Exchange	Common stock price index
Corporate profits after taxes (q)	Corporate profits after taxes (q)*	Companies' profits less U.K. taxes (q)*
Ratio, price/unit labor cost, non-farm business (q)	Ratio, price to unit labor cost, mfg.	Ratio, price to unit labor cost, mfg.
Change in consumer installment credit*	Change in consumer credit outstanding*	Increase in hire purchase debt*
Roughly Coincident Indicators	***Roughly Coincident Indicators***	***Roughly Coincident Indicators***
Personal income*	Personal income*	Personal disposable income (q)*
Gross national product (q)*	Gross national expenditure (q)*	Gross domestic product (q)*
Industrial production	Industrial production	Industrial production
Mfg. and trade sales*	Retail trade*	Retail trade*
Employees on non-farm payrolls	Non-farm employment	Employment in production industries
Unemployment ratio (inverted)	Unemployment rate (inverted)	Unemployed (inverted)

West Germany	France	Italy
Leading Indicators	***Leading Indicators***	***Leading Indicators***
Number working short hours (inverted)	Average workweek, mfg.	Hours per month per worker in industry
Applications for unemployment compensation (inverted)		
	Change in unfilled orders, total	Change in unfilled orders, total
Insolvent enterprise (inverted)		Declared bankruptcies (inverted)
New orders, inverstment goods industry, volume		
Housing permits, interior space		
Residential construction orders*	Building permits, residential	Building permits, residential
Inventory change		
Stock price index	Index of stock prices	Stock price index
Net income from entrepreneurial activity*		
Ratio, price to unit labor cost	Ratio, price to unit labor cost, mfg. (q)	
Change in consumer credit*		
Roughly Coincident Indicators	***Roughly Coincident Indicators***	***Roughly Coincident Indicators***
Employment in mining & manufacturing	Employment, non-farm	Non-farm employment
Unemployment rate	Registered unemployment (inverted)	Unemployment rate (inverted)
Gross national product*	Gross domestic product (q)*	Gross domestic product (q)*
Industrial production	Industrial production	Industrial production
Disposable income*		
Manufacturing sales volume	Retail sales volume	Retail sales*
Retail trade volume		

Belgium	Netherlands	Sweden	Japan
Leading Indicators	***Leading Indicators***	***Leading Indicators***	
Monthly hours working	Temporary short-time workers	Number of hours worked (in industry)	Index of overtime workers, mfg.
		Number of new job offerings	
Inland orders*	Change in unfilled order	Value of new orders*	
Bankruptcies (inverted)	Bankruptcies (inverted)		Business failures, number (inverted)
No. of non-residential building permits	Non-residential building permits (q)		New orders, machinery and construction works
Number of residential building permits	Dwelling started	Number of housing starts	Dwelling units started
	Change in industrial inventories (q)*		Change in inventories (q)*
	Prices, raw materials and semi-mfred goods.	Raw material prices	Raw materials price index
Industrial share price	Stock price index	Stock price	Stock price index
	Ratio, price to labor cost (q)	Ratio, price to unit labor cost	Ratio, price to unit labor cost, mfg.
		New loans to households	Change in consumer and housing credit outstanding (q)*
Coincident Indicators	***Coincident Indicators***	***Coincident Indicators***	***Coincident Indicators***
	Employment, mfg. (q)	(Non-farm) employment	Regular workers' employment, all industries
Unemployment rate (inverted)	Registered unemployed, no. (inverted)	Unemployment rate	Unemployment rate (inverted)
Real gross domestic product*		Gross domestic product	Gross national expenditures (q)
Industrial production	Industrial production	Industrial production index	Industrial production
		Disposable income, 1975 prices	Wage and salary income*
Retail sales*	Manufacturing sales (q)*	Retail sales, volume	Retail sales*
	Retail sales*		

* = Deflated series.
q = Quarterly series. All other series are monthly.

Source: P. H. Klein and G. H. Moore, *Monitoring Growth Cycles in Market-Oriented Economies,* NBER Studies in Business Cycles No. 25, 1985, Appendix 2C

COMPONENTS OF CEI

1. Aggregate Demand
   - 1.1 Government Expenditure at Constant Price
   - 1.2 Real Export Value
   - 1.3 Private Consumption
     - 1.3.1 Department Store Sales (in Real Term)
     - 1.3.2 Real Import of Consumer Goods
     - 1.3.3 Bills and Loans for Personal Consumption (in Real Term)
   - 1.4 Private Investment
     - 1.4.1 Real Import of Capital Goods
     - 1.4.2 Domestic Cement Sales (in Real Term)
     - 1.4.3 Bills and Loans for Private Investment (in Real Term)
     - 1.4.4 Construction Area Permitted in Municipal Zone, Whole Kingdom
     - 1.4.5 Real Foreign Equity Inflow
     - 1.4.6 Domestic Galvanized Iron Sheet Sales (in Real Term)

2. Aggregate Supply
   - 2.1 Gross Domestic Product at Constant Price
   - 2.2 Real Import Value

3. Price Pressure
   - 3.1 Consumer Price Index
   - 3.2 Import Price Index
   - 3.3 Export Price Index
   - 3.4 Price Index for Investment

4. Monetary Expansion
   - 4.1 M1 Seasonally Adjusted
   - 4.2 M2 Seasonally Adjusted
   - 4.3 Domestic Credit Seasonally Adjusted

5. External Stability (Unit: Absolute Amounts)
   - 5.1 Current Account
   - 5.2 International Reserves in Term of Months of Import

Source: General Economic Section, Department of Economic Research, Bank of Thailand.

Appendix 5

COMPONENT VARIABLES OF DI SEPIA PROJECT

1 Coincident Index

- 1.1 Production of Motorcycle
- 1.2 Production of Commercial Vehicles
- 1.3 Production of Beer
- 1.4 Production of Lignite
- 1.5 Production of Tinplate
- 1.6 Sales of Department Stores
- 1.7 Number of Tourist
- 1.8 Consumption of Electricity by Large Users
- 1.9 Number of Cheque
- 1.10 Export Volume Index
- 1.11 Production of Gypsum

2. Leading Index

- 2.1 Domestic Bills of Commercial Bank
- 2.2 Refinery Production of Petroleum Products
- 2.3 Stock Prices (SET Index)
- 2.4 Money Supply (M1)
- 2.5 Construction Area Permitted in Bangkok

Source: Institute of Developing Economics, *Business Cycles in Five ASEAN Countries, India and Korea (II)*, Tokyo, 1989, p. 317.

THE SOFTWARE PROGRAMS USED IN THE THAI CASE STUDY

Due to some technical problems, we have to use the software programs developed by the U.S. Department of Commerce. In terms of methodology, these programs are basically similar to those used at the CIBCR and the results derived from the two sources of programs are basically the same. The basic difference is that the whole package of the U.S. Department of Commerce programs can be run on a Personal Computer with a specific requirement that all data must be kept in a special database program called COMETS. Thus, the programs are basically divided into two groups - the database or COMETS program and the specialized programs for business cycle analysis which consist of the following:

(1) The X-11 program for seasonal adjustment. The program also gives the usual F-test for seasonality test and computes a number of tables such as Final Seasonal Factors, Final Seasonal Adjusted Series and Final Irregular Series. The X-11 program handles both monthly and quarterly data.

(2) The GROCYC program which is the U.S. Department of Commerce version of Charlotte Boschan's Turning Point/ Growth Program. It estimates the long-term trend of the series using the PAT method and computes deviations of the deseasonalized and deflated orignal data from trend. Although the program serves our work adequately, it has some limitations compared with the CIBCR version. Firstly, the option for trend-estimation (triplet or doublet) is not available and only "triplet" is used. Secondly, it does not cater for selection of turning points in the classical cycle concept. Thirdly, there is no provision for the program to run only part of the data series.

(3) The NHCOMP1 program to run a composite index. Unlike the version used at the CIBCR, the program only generates the raw index. The six-month and twelve-month smoothed growth rates have to be done in COMETS.

Other forms of data transformations such as deflating the series, computing growth rates and moving averages are also done in COMETS.

The great advantage of these software packages is that all are conveniently done in personal computers making the conversion of data from main frame to PC unnecessary. There is also a facility to read data from Lotus into COMETS and vice-versa. The major disadvantage, however, is the lack of documentation of the specialized programs. Although the programs are admittedly very easy to use, there are some parameters that need to be specified. Unless one is trained to use the programs at the U.S. Department of Commerce, it is not only time-consuming to decipher the parameter values but also limits the usefulness of the programs.