ADB

ERD WORKING PAPER SERIES NO. 32
ECONOMICS AND RESEARCH DEPARTMENT

Leading Indicators of Business Cycles in Malaysia and the Philippines

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December 2002

Asian Development Bank

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Asian Development Bank
P.O. Box 789
0980 Manila
Philippines

December 2002
ISSN 1655-5252

Foreword

The ERD Working Paper Series is a forum for ongoing and recently completed research and policy studies undertaken in the Asian Development Bank or on its behalf. The Series is a quick-disseminating, informal publication meant to stimulate discussion and elicit feedback. Papers published under this Series could subsequently be revised for publication as articles in professional journals or chapters in books.

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Abstract

This paper attempts to construct leading indicator systems for the Malaysian and Philippine economies using publicly available economic and financial data, with a view to predicting turning points of growth cycles in the two countries. The results show that during the sample period of January 1981-March 2002, the composite leading index constructed from six individual leading indicators is able to predict all the nine turning points in industrial production in Malaysia, with an average signal leading time of 1.5 months for peaks and 3.4 months for troughs; and seven out of the eight turning points in manufacturing production in the Philippines, with an average signal lead time of 5.8 months for peaks and 6 months for troughs. This prediction performance is comparable to that of leading indicator systems of the G-7 economies maintained by the Organisation for Economic Co-operation and Development.

I. Introduction

The leading indicator approach to economic and business forecasting, pioneered by the National Bureau of Economic Research (NBER) of the United States (US) more than half a century ago, is now widely used in predicting turning points of business cycles in many countries. The popularity of this method is due to three reasons. Firstly, early detection and timely recognition of business cycle turning points is important as it would allow policymakers to trigger pre-emptive countercyclical policy measures, businesses to adjust their sales or investment strategy, and investors to reallocate assets among alternative investments to optimize their return. Secondly, it has long been recognized that procedures for making quantitative forecasts, such as standard macroeconometric models, are not appropriate for making turning point predictions that involve detecting regime shifts (Samuelson 1976). Thirdly, since its birth, the leading indicator approach has maintained its standing as a reliable and inexpensive forecasting tool quite successfully.

Until recently, however, the application of this approach has been largely limited to the industrialized countries. The Organisation for Economic Co-operation and Development (OECD) publishes leading indices for its member countries every month. In the US, the Department of Commerce maintains a leading indicator system for the US economy. A number of research institutes and consultancy firms also compile leading indices of major industrialized economies. On the other hand, the application of the leading indicator approach to developing countries is still relatively rare. A major constraint is data availability. Constructing leading indicators of business cycles requires high frequency data, typically on a monthly basis, and for each indicator, a long time series. Many of the commonly used leading indicators are usually not available at a high frequency in cases of developing countries, and, even if they are available, they may not have a long enough time series to be of any use.

Since the 1997 Asian financial crisis, many developing Asian countries have taken major initiatives to improve their national statistical systems as part of their efforts in strengthening national as well as regional economic monitoring and surveillance and crisis prevention measures. Many economic and financial indicators, which were previously not available, have now become available. Despite these encouraging developments, some indicators that have proved to be good leading indicators of business cycles in developed countries such as working hours, housing starts, and manufacturing new orders are either still not available, or only available for more recent years.

In this paper, we explore the possibility of constructing leading indicators of business cycles and predicting turning points in developing Asian countries by using publicly available macroeconomic and financial indicators. Using Malaysia and the Philippines as cases,[1] this paper has two objectives. Firstly, we examine patterns of business cycles in the two countries and show how they differ from those of the developed countries such as Japan, United Kingdom (UK), and US. Secondly, we investigate whether business cycles and turning points in the two countries could be predicted by leading indicators constructed from publicly available macroeconomic and financial data. The rest of this paper is organized as follows. Section II describes methodology, Section III reports results, and finally, Section IV concludes.

II. METHODOLOGY

The leading indicator method of predicting turning points of business cycles involves four major steps. The first is to select an appropriate indicator as a measure of economic activity, which is also called a reference series, and to identify dates of turning points (peaks and troughs) of the underlying business cycles in that series. The most commonly used measure of economic activity is the monthly index of industrial production or manufacturing production. The second step is to select appropriate economic and financial indicators as predictors of the turning points of business cycles. As indicators selected are expected to lead turning points of business cycles, they are also called leading indicators. The third step involves constructing a composite leading index from the selected individual leading indicators. Finally, turning points in the reference series are predicted on the basis of outcomes of the composite leading index and an appropriate decision rule system. These steps are discussed in detail below.

A. Dating Turning Points

The first consideration in dating turning points is to define what constitutes a business cycle. The leading indicator method was originally developed to analyze the so-called “classical business cycles”, that is, declines and rebounds in economic activity in absolute levels (i.e., recessions and recoveries). By the end of the 1960s, however, many industrial economies had not experienced a recession for many years and this led many to ask whether it was still relevant to study classical business cycles. Subsequently, there was a move among researchers of business cycles to study growth cycles, focusing on cyclical movements of economic activity around its trend. Consequently, most leading indicator systems in operation now, including those maintained by OECD, are based on growth cycles.

Niemira and Klein (1994) provide four reasons for analyzing growth cycles: (i) growth cycle peaks lead their comparable business cycle peaks, (ii) growth cycles are more symmetric in length and amplitude than business cycles, (iii) growth cycles are closely tied to inflation cycles, and (iv) the

[1] Malaysia and the Philippines were selected entirely due to data considerations.

US Commerce Department's composite index of leading indicators has a better track record in forecasting growth cycles than classical business cycles.

In applying the leading indicator approach to developing Asian countries, it is surely more appropriate to focus on growth cycles than classical business cycles as most of these economies were dominated by a strong upward trend over the last several decades, and have rarely experienced cyclical declines in absolute levels. Therefore, the leading indicator systems developed in this paper deal with growth cycles.

Considering a business cycle as a growth cycle, dating turning points involves separating cyclical movements of a reference series from its trend. The identification of cyclical movements is usually based on the so-called "three P's", i.e., whether the movements are pronounced, pervasive, and persistent (Banerji 1999). The fundamental features of a business cycle are pervasive and pronounced: many variables are synchronized cyclically and upturn and downturn regimes can be clearly distinguished. In addition, business cycles are persistent; this means no decline or rise would be recognized as a cyclical movement unless it has lasted for a while.

Moore and Zarnowitz (1986) describe in detail procedures for dating turning points of business cycles.[2] These involve the following steps: adjusting for seasonality, detrending, smoothing, and identifying cyclical turning points.

(i) **Adjusting for seasonality.** Seasonal fluctuations of economic activity, which are periodic over a calendar year, may obscure cyclical movements and need to be removed first. For this purpose, we use the exponential smoothing method.

(ii) **Detrending.** This involves taking away a trend component from the seasonally adjusted reference series. We use the Hodrick-Prescott (HP) filter to estimate the trend.[3] Formally, we characterize the seasonally adjusted reference series, y_t, as the sum of a cyclical component, y_t^c, and a trend component, y_t^G. Let λ be a parameter that reflects the relative variance of the trend component to the cyclical component. Given a value for λ, the HP filtering chooses the trend component, y_t^G, to minimize the loss function:

$$\sum_{t=1}^{n}(y_t^C)^2 + \lambda\sum_{t=1}^{n}[(y_{t+1}^G - y_t^G) - (y_t^G - y_{t-1}^G)]^2 \quad (1)$$

[2] In practice, turning points of business cycles are usually dated by authoritative organizations, such as the National Bureau of Economic Research in the US, the Central Statistical Office in the UK, and the OECD for its member countries. Once turning points are dated, they are widely accepted by governments, academic researchers, and business analysts. In the case of Malaysia and the Philippines, no such dating exercises appear to have been conducted as yet.

[3] An alternative is to use a band-pass filter. But this is feasible only with very long data series. In practice, there seem to be no significant difference in the properties of identified business cycles between the two filters (see Cooley and Prescott 1994).

For $\lambda = 0$ the trend component is simply the original series; for $\lambda \to \infty$, the trend component approaches a linear trend. To get the optimal result, it has been suggested to choose λ=1,600 for quarterly data and λ=129,600 for monthly data (Ravn and Uhling 1999). Therefore, in this study, the value for λ is fixed at 129,600 for all time series requiring detrending.

(iii) **Smoothing.** Cyclical movements could be volatile and some short-lived false cycles may obscure true cyclical movements. One way of reducing the importance of short-lived cycles and hence solving the so-called spurious cyclicality problem is through smoothing using a simple centered moving average.[4] In this study, the moving average length is chosen at seven months.[5] Compared to similar studies on industrialized countries, this moving average length is on the upside. This can be justified by the fact that developing economies such as Malaysia and the Philippines are usually smaller than developed economies in size, and are expected to be less diversified and hence more volatile. So smoothing over a relatively longer period may be needed to screen out false cycles.

(iv) **Identifying turning points.** Turning points are identified from deseasonalized, detrended, and smoothed reference series using a rule-based method. This paper follows the method suggested by Artis et al. (1995a) who identified almost identical turning points for the G-7 countries recognized by OECD using this method. The method involves searching for potential turning points on the basis of the following rules: (i) a peak and a trough follow each other, (ii) the minimum length required between two consecutive turning points (a phase) is nine months, (iii) the minimum length required for any two alternate turning points (a cycle of peak to peak or trough to trough) is 24 months, and (iv) the turning point is located at the extreme value in the intervening phase. If more than one extreme value is found in one phase, the latest observation is chosen as the turning point; and (v) an observation that coincides with a known noneconomic event (strike, natural disaster, etc.) or an outlier will be ignored for the purpose of dating analysis unless the turning point subsequently defined is located immediately adjacent to that observation.

B. Selecting Leading Indicators

Having identified turning points and established business cycles, the next step is to select appropriate leading indicators as predictors of turning points. Economic rationales and statistical properties are important selection criteria. In practice, data availability is also a major constraint, and the actual selection process usually involves many rounds of trials and errors.

4 For a stationary series, the induced spurious cyclicality has its principal effect for a cycle of two thirds the length of the moving average (Artis et al. 1995b).

5 Seven months is the shortest possible moving average that yields approximately similar smoothness in the reference series and all the leading indicator series (to be discussed below). The selection makes use of the spectrum analysis (see, for example, Fishman 1969).

1. Economic Criteria

de Leeuw (1991) and Yap (2001) listed a number of economic rationales as criteria for selecting leading indicators of business cycles:

(i) **Production time.** For many goods it takes months or even years between a decision to produce and actual production. Therefore, indicators that record production intentions, such as new production orders or imports of raw materials, could give advance warnings of changes in the direction or tempo of economic activity.

(ii) **Market expectations.** Some economic variables tend to reflect, or to be very sensitive to, anticipations about future economic activity. Survey results of business expectations or confidence, stock prices, and futures prices are good examples of such indicators. Changes in these indicators could signal changes in economic activity in the future.

(iii) **Policy impacts.** Fiscal and monetary policies are often used in an attempt to influence future level of economy activity. To the extent that these policies are effective, measurable changes in their settings may provide useful leading indicators.

(iv) **External shocks.** Economic activity is also likely to be influenced by a range of factors that are beyond the control of domestic policymakers. Examples are changes in global demand, terms of trade, or global interest rates. These could have an impact on domestic economic activity, and act as useful leading indicators.

(v) **Buffer stocks.** Some variables can adjust more quickly than others. For example, producers may meet an unanticipated increase in demand by first running down their inventories, and then by increasing factory utilization rates before hiring new workers, purchasing new machines, and increasing production. By observing changes in the levels of stocks, factor utilization, and overtime, we may get some information of future changes in output.

2. Statistical Criteria

In terms of statistical properties, Jones and Ferris (1993) suggest the following criteria for selecting leading indicators: (i) ability to significantly lead turning points of business cycles, (ii) consistency with the general up and downturns of economic activity, (iii) having clear upward or downward trends rather than volatile monthly movements that may cloud the underlying trend, (iv) high data quality, (v) high speed of data releases, and (vi) having small size of revision to provisional data.

3. Selection Process

In practice, in addition to economic rationales and statistical properties, data availability is also a major constraint in selecting leading indicators. The process for screening cyclical leading indicators in this study involves the following:

(i) Choosing a set of economic and financial indicators, satisfying at least one of the economic criteria, observable at a monthly frequency, and with a long history.

(ii) Deseasonalizing, detrending, and smoothing the time series of these indicators using the same procedures used for identifying turning points in the reference series.

(iii) Visually inspecting cyclical movements in these indicators together with those in the reference series, and eliminating those indicators whose cyclical movements are very different from those of the reference series, or which do not lead turning points in the reference series.

(iv) Predicting turning points in each selected candidate leading indicator using the sequential probability model (to be discussed below).

(v) Calculating the quadratic probability score of each candidate indicator as a quantitative measure of its performance in predicting turning points of business cycles. The quadratic probability score, *QPS*, is given by

$$QPS^{[H_1, H_2]} = \frac{\sum_{t=1}^{N} 2(P_t - R_t)^2}{N} \tag{2}$$

In Equation 2, P denotes predicted outcomes from a candidate leading indicator and R observed realizations in the reference series, both equal to one for a turning point and zero otherwise. N is the total number of sample observations. By construction, the value of *QPS* ranges between zero and two with zero indicating perfect prediction and two indicating no single correct signal from a candidate leading indicator. $[H_1, H_2]$ is the prediction window, which is used to determine whether a predicted outcome represents a correct signal or a false one when it takes the value of one, and whether or not it has missed a turning point when taking the value of zero. This can be illustrated in the following matrix:

	A turning point occurs within $[H_1, H_2]$	No turning point occurs within $[H_1, H_2]$
Signal ($P=1$)	Correct signals (A)	False signals (B)
No signal ($P=0$)	A turning point is missed (C)	Correct predictions (D)

If we assume that H_1=4 months and H_2=12 months, then a signal issued by a leading indicator in a particular month will be considered a correct (or false) signal, denoted as A (or B), if a (or no) turning point in the reference series occurs within next 12 months or has occurred within previous four months. Similarly, if no signal is issued by the leading indicator in a particular month, it will be considered having missed a turning point (or a correct prediction), denoted as C (or D), if a (or no) turning point actually occurs within next 12 months or has occurred within previous four months.[6] This study chooses [4, 12] as the prediction window on the basis of visual inspection of relative movements in the reference series and candidate leading indicators. We have also experimented with alternative prediction windows, such as [0, 12] and [4, 6], and found no significant change in the results.

C. Constructing a Composite Leading Index

On the basis of QPS, the search for leading indicators can be narrowed down to a manageable number. From the selected leading indicators, a composite leading index can be constructed.

There are two ways to construct a composite leading index. One is to attach different weights to different indicators depending on their relative ex post predictive power (measured by QPS). The other is to give equal weights to all the indicators. In this study the equal weighting method is adopted based on the consideration that the *ex post* performance is no guarantee for *ex ante* performance. To construct the composite leading index, each of the seasonally adjusted, detrended, and smoothed candidate indicators is standardized such that it has a mean of 100 and a variance of unity. The composite leading index series is simply the sum of the standardized individual series. A leading indicator will be finally selected only if its inclusion reduces QPS of the composite leading index. Therefore, the composite leading index, if properly constructed, is more reliable and accurate than any individual indicators in predicting turning points in the reference series.

D. Predicting Turning Points

The purpose of constructing the leading index is to predict turning points and provide early warnings of economic downturns/upturns. Assuming that there are two time series, X and Y, where

[6] B (false signals) is usually referred to as Type-II errors and C (turning points are missed) Type-I errors.

Y denotes the composite leading index and X the reference series. Movements in X may be considered as comprising two regimes: a downturn regime and an upturn regime. A turning point occurs when the regime shifts. By design, we expect the pattern of movements in Y to be similar to movements in X, but with some time lag: Y leads X by a certain period so that Y could give advance signals about movements in X.

In real time forecasting, an important question is how to balance the need for early or timely recognition of turning points (to reduce Type-I errors) with the accuracy of predictions (to reduce Type-II errors). From the viewpoint of policymakers, businesses, and investors, it is ideal to receive warning signals of turning points with sufficient lead time so that appropriate pre-emptive actions could be designed and taken. But if the lead time is too long, the risk of having false signals will also be high. In fact, increasing lead time of signalling tends to increase the risk of having more false signals.

Over the years, numerous decision rule systems have been developed for screening out false signals in the leading indicator literature (Niemira 1991). In this study, we use the sequential probability model (SPM), which was proposed by Neftci (1982) and is now widely used as a decision rule system for interpreting movements in the composite leading index. This method uses sequential analysis to calculate the probability of a cyclical turning point. The model makes use of three pieces of information. The first is the likelihood that the latest observation in the composite leading index is from the recession sample or the recovery/expansion sample. The second is the likelihood of a recession (recovery) given the current length of the expansion (recession) relative to its historical average. Finally, these two components are combined with previous months' probability estimates. In this model, the probability of a cyclical turning point for an upturn regime is given by

$$P_t = \frac{[P_{t-1} + (1 - P_{t-1})\,\Gamma_{t-1}^{U}]\; f(Y_t \mid Y_t \in D_{t-1})}{[P_{t-1} + (1 - P_{t-1})\,\Gamma_{t-1}^{U}]\; f(Y_t \mid Y_t \in D_{t-1}) + (1 - P_{t-1})(1 - \Gamma_{t-1}^{U})\; f(Y_t \mid Y_t \in U_{t-1})} \qquad (3)$$

where $f(Y_t/Y_t \in D_{t-1})$ and $f(Y_t/Y_t \in U_{t-1})$ denote the conditional probability densities of the latest observation Y_t coming from either a downturn regime, D, or an upturn regime, U, and Γ_t^U denotes the probability of a peak at time t conditional upon a peak having not already occurred in the upturn regime being investigated. For predicting troughs in downturn regimes, we simply need to exchange $f(Y_t/Y_t \in D_{t-1})$ for $f(Y_t/Y_t \in U_{t-1})$ and replace Γ_t^U by Γ_t^D, the probability of a trough at time t conditional on a trough having not already occurred in the downturn regime being investigated.

The SPM model will issue a signal warning that a turning point is approaching when the estimated probability from Equation (3) exceeds a preset critical (threshold) level. In this study, three critical values, 0.85, 0.9, and 0.95, were examined, and 0.9 was chosen as it yields the best results in terms of balancing the need for early recognition of turning points and the accuracy of prediction.

III. LEADING INDICATORS OF BUSINESS CYCLES IN MALAYSIA AND THE PHILIPPINES[7]

A. Turning Points in Business Cycles: 1981-2002

The reference series selected for the Malaysian economy is the monthly index of industrial production and the Philippine economy the monthly index of manufacturing production, both covering the period from January 1981 to March 2002. Turning points of business cycles for the two economies are reported in Table 1 and plotted in Figures 1a and 1b where shaded areas correspond to downturns in the reference series and unshaded areas upturns; a cyclical peak is indicated by the left-hand edge of any particular shaded block, while a subsequent trough is represented by the right-hand edge of the block.

Table 1. **Turning Points of Business Cycles in Malaysia and the Philippines: 1981-2002**

Trough	Date	Duration of Upturn	Peak	Date	Duration of Downturn
Malaysia					
T1	Apr 1983	16	P1	Aug 1984	33
T2	May 1987	43	P2	Dec 1990	34
T3	Oct 1993	46	P3	Aug 1997	15
T4	Nov 1998	22	P4	Sep 2000	15
T5	Dec 2001	—			
Average		31.8			24.3
Philippines					
T1	Nov 1982	21	P1	Aug 1984	27
T2	Nov 1986	32	P2	Jul 1989	42
T3	Dec 1992	59	P3	Nov 1997	15
T4	Jan 1999	21	P4	Oct 2000	—
Average		33.3			28

Note: T denotes trough and P denotes peak.

There were five troughs and four peaks in the Malaysian economy during the sample period. The average duration of downturn is about 24 months and of upturn is 32 months. During the period, there were four complete upturns: T1-P1 (Apr 1983 - Aug 1984), T2-P2 (May 1987- Dec 1990), T3-P3 (Oct 1993 - Aug 1997), and T4-P4 (Nov 1998 - Sep 2000); and four complete downturns: P1-T2 (Aug 1984 - May 1987), P2-T3 (Dec 1990 - Oct 1993), P3-T4 (Aug 1997 - Nov 1998), and P4-T5 (Sep 2000 - Dec 2001). According to Pillay (2000), the 1984-1987 (P1-T2) downturn in Malaysia was quite severe. "Export earnings suffered a massive contraction, with commodity prices plunging to unprecedented lows due to lower demand in the developed countries. The government was unable

[7] All the results discussed in this section were produced by computer programs written in RATS (see RATS version 5 for detailed information).

to engage in countercyclical spending due to its earlier investment in heavy industry. This investment had been financed by external borrowings. In the early 1980s, given its petroleum resources, banks had lined up to lend to Malaysia. So when the recession hit, Malaysia had exhausted its borrowings capacity." The downturn of P3-T4 was associated with the 1997 Asian financial crisis. The last upturn started in December 2001.

In the case of the Philippine economy, during the sample period, there were four troughs and four peaks. The average duration of downturn is 28 months and of upturn is 33.3 months. There were four complete upturns: T1-P1 (Nov 1982 - Aug 1984), T2-P2 (Nov 1986 - Jul 1989), T3-P3 (Dec 1992 - Nov 1997), and T4-P4 (Jan 1999 - Nov 2000); and three complete downturns: P1-T2 (Aug 1984 - Nov 1986), P2-T3 (Jul 1989 - Dec 1992), and P3-T4 (Nov 1997 - Jan 1999). The downturn of P3-T4 was also associated with the 1997 Asian financial crisis. The last downturn started in November 2000, and as of March 2002, it was still not clear whether the trough had been reached.

Figures 1a and 1b show significant similarities in the pattern of business cycles and turning points between Malaysia and the Philippines. In fact, peaks and troughs in the two economies were almost synchronized. In Table 2 we calculated time differences between turning points of the two countries. With the exception of P2 and T3, most turning points were very close between the two economies, with lead or lag time ranging from zero to six months. On average, turning points in the Philippines led those in Malaysia by 3.9 months during the sample period. But since 1997, turning points in Malaysia appear to have been leading those in the Philippines.

Figure 1a. **Business Cycles in Malaysia**

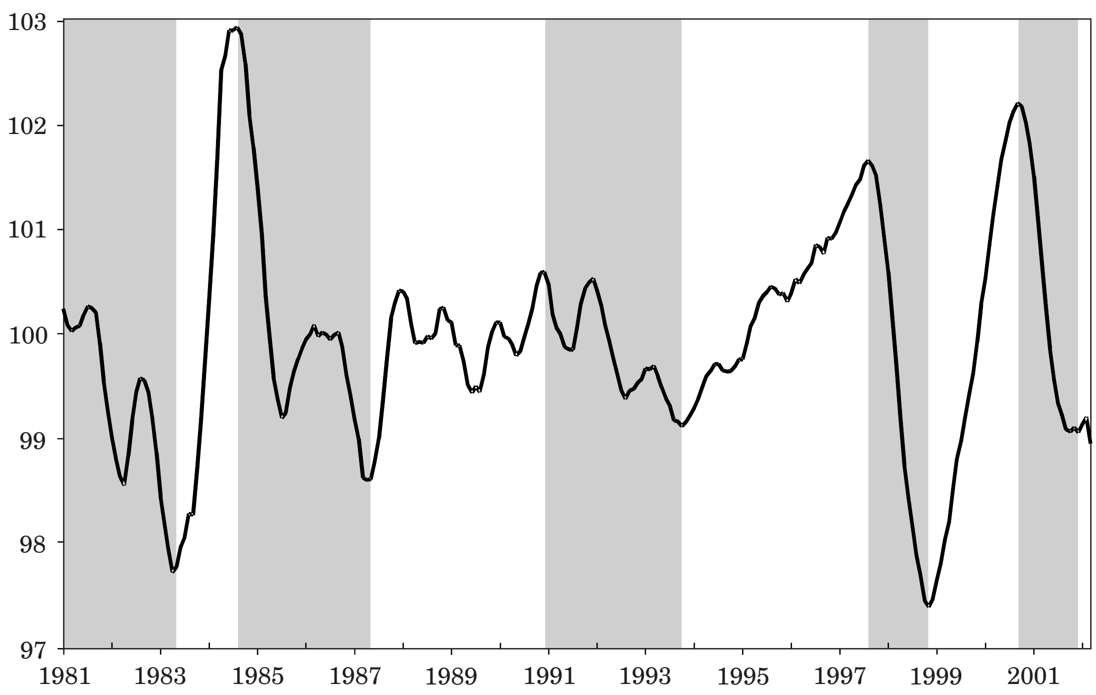


Figure 1b. **Business Cycles in the Phiippines**

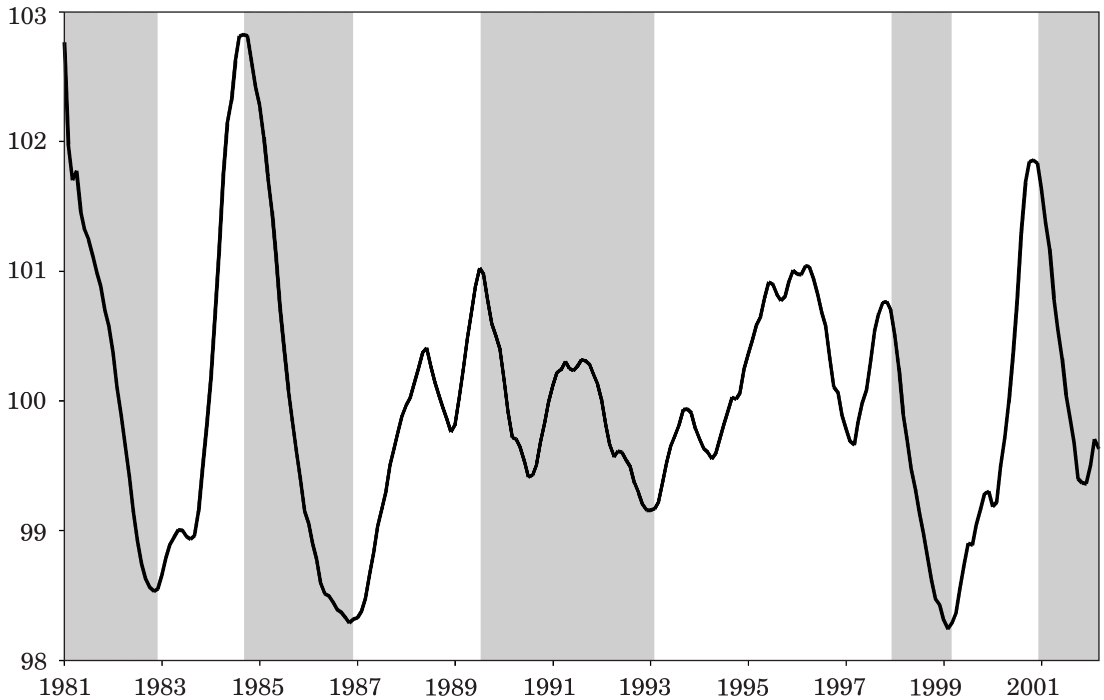


Table 2. **Cross-country Comparisons of Turning Point Dates**

	Malaysia	Philippines	Lead/Lag[1]	US[2]	Japan[2]
T1	Apr 1983	Nov 1982	-5	Dec 1982	Oct 1982
P1	Aug 1984	Aug 1984	0	Jun 1984	Oct 1984
T2	May 1987	Nov 1986	-6	Sep 1986	May 1987
P2	Dec 1990	Jul 1989	-17	Jan 1989	Oct 1990
T3	Oct 1993	Dec 1992	-10	Mar 1991	Feb 1994
P3	Aug 1997	Nov 1997	+3	n.a.	May 1997
T4	Nov 1998	Jan 1999	+2	n.a.	n.a.
P4	Sep 2000	Nov 2000	+2	n.a.	n.a.
T5	Dec 2001	—	—	n.a.	n.a.
	Average		-3.9		

n.a. means not available.

[1] Refers to the number of months by which a turning point in the Philippines leads (—) or lags (+) a turning point in Malaysia.

[2] The turning point dates for Japan and the US were identified by OECD and obtained from its web site (http//:www.oecd.org).

In Table 2 we also report dates of turning points of growth cycles in Japan (up to 1997) and the US (up to 1991). It is interesting to note that T1, P1, and T2 of Malaysia and the Philippines were very close to those of Japan and the US. For instance, both the Malaysian and Philippine economies started to turn downward in August 1984, two months after the US economy reached the peak and two months before the Japanese economy reached its peak. Subsequently, the US economy bottomed out in September 1986, and the Philippine economy in November, with the Japanese and Malaysian economies both reaching trough in May 1987. P2 of the Philippines was close to that of the US; and P2, T3, and P3 of Malaysia were very close to those of Japan. Turning point dates after 1991 for the US and after 1997 for Japan are not available from OECD.

Many studies found an asymmetry in duration between upturns and downturns of business cycles, with the duration of upturns in general longer than that of downturns. In Table 3, we compare durations of upturns and downturns in Malaysia and the Philippines with those of France, Japan, UK, and US. The results confirm that there is also such an asymmetry in Malaysia and the Philippines. In the US, for example, on average, the upturn duration is about 25 months and downturn duration about 17 months. The average upturn duration was about 32 months for the two Asian economies, and downturn duration is about 24 months for Malaysia and 28 months for the Philippines.

Table 3. **Duration of Upturns and Downturns (months)**

Country	Average Upturn Duration	Average Downturn Duration
Malaysia	31.8	24.3
Philippines	33.3	28.0
US	24.4	17.3
UK	33.3	25.3
Japan	24.5	18.6
France	26.9	24.5

Notes: Turning point dates and length of duration for Japan, Germany, UK, and US were obtained from OECD (Artis et al. 1995a).

B. Leading Indicators

Selection of leading indicators in this paper involves inspecting and screening more than 50 indicator series provided by *International Financial Statistics* published by the International Monetary Fund. We score indicators in terms of five criteria: availability of monthly data, economic rationale, having cyclical movements, leading turning points in the reference series, and having low *QPS* itself as well as leading to a reduction in *QPS* of the composite leading index. On the basis of these criteria, six series were finally selected as leading indicators for Malaysia and the Philippines, as reported in Table 4.

Table 4. **Components of the Composite Leading Index for Malaysia and the Philippines**

Leading Indicators	Sample Period	Seasonal Adjustment
Malaysia		
Stock price index (local currency)	Jan 1981 - Mar 2002	No seasonality
Stock price index in US$	Jan 1981 - Mar 2002	No seasonality
Export (in US$)	Jan 1981 - Mar 2002	Adjusted
Money supply (M1)	Jan 1981 - Mar 2002	Adjusted
Industrial production in Korea	Jan 1981 - Mar 2002	Adjusted
US federal fund rate	Jan 1981 - Mar 2002	No seasonality
Philippines		
Stock price index (in US dollars)	Jan 1981 - Mar 2002	No seasonality
Exchange rate (peso per US$)	Jan 1981 - Mar 2002	No seasonality
Discount rate (reversed)	Jan 1981 - Mar 2002	No seasonality
Manufacturing employment	Jan 1981 - Apr 1995	Adjusted
Money supply (M1)	Jan 1991 - Mar 2002	Adjusted
Industrial production in Korea	Jan 1981 - Mar 2002	Adjusted

To a large extent, selection of leading indicators remains an empirical question. Stock price is one of the most frequently used leading indicators in many countries. Pearce (1983) noted that stock prices play many roles, such as reflecting profit expectations, reacting to interest rate changes, and incorporating market psychology. Monetary shocks could have important real effects because of rigidities in prices or wages (Cooley and Hansen 1995). In the case of interest rates, the US Department of Commerce/NBER method classifies them as lagging indicators. But the UK's Central Statistical Office uses the rate of interest on three-month prime bank bills (inversed) as a leading indicator. Our search results suggest that industrial production in Republic of Korea (henceforth Korea) is a good leading indicator of industrial production in Malaysia and manufacturing production in the Philippines. The cross-country co-movement is one of the common features of business cycles.

Leading indicator systems developed for the industrialized economies often include indicators such as the average workweek of the manufacturing industry, new housing starts and building permits, manufacturing new orders, claims for unemployment benefits, and changes in inventories as components of the composite leading index. These indicators are not available for both Malaysia and the Philippines.

As described earlier, in the selection process, all the candidate indicator series were deseasonalized, detrended, smoothed, and standardized with a mean of 100 and variance of one. These processed indicator series were then inspected and their turning points were identified. *QPS* was calculated on the basis of these turning points and turning points of the reference series.

Table 5 reports *QPS* of the selected leading indicators. With the prediction window [4, 12], a signal is considered correct if it is issued during 12 months before an actual turning point in the reference series (an early recognition of the turning point), or within four months after a turning point has actually occurred (a "timely recognition" of the turning point). The justification for considering signals issued within four months after the occurrence of a turning point as correct signals is that our results indicate it takes approximately four months to recognize a turning point in the composite leading series (see Table 6).

In the case of Malaysia, industrial production in Korea has the best performance in predicting business cycle turning points, with its *QPS* being the lowest; while stock price index (in national currency) has the least predictive power with its *QPS* being the highest. In the case of the Philippines, the discount rate has the best performance, with its *QPS* being the lowest; while the money supply (M1) has the least predictive power, with its *QPS* being the highest.

Table 5 also shows that the composite leading index has a much lower *QPS* compared with any of the individual leading indicators. This suggests that aggregating individual leading indicators does improve the predictability of a leading indicator system. Let us now look at more results of the composite leading index.

Table 5. **Evaluation of Prediction Performance by QPS**

Leading Indicators	Prediction Window [4, 12]
Malaysia	
Stock price index in local currency	0.99
Stock price index in US$	0.85
Export (in US$)	0.79
Money supply (M1)	0.92
Industrial production in Korea	0.73
US federal fund rate	0.90
Composite leading index	0.58
Philippines	
Stock price index (in US dollar)	0.72
Exchange rate (local currency per US dollar)	0.75
Discount rate (inversed)	0.54
Manufacturing employment	0.63
Money supply (M1)	0.81
Industrial production in Korea	0.76
Composite leading index	0.48

C. Composite Leading Indices

The composite leading index is constructed by aggregating with equal weights six individual leading indicators each of which has been deseasonalized, detrended, smoothed, and scaled to have a mean of 100 and variance of one. The composite leading index together with the reference series is shown in Figures 2a and 2b. The solid line denotes the composite leading index and the dotted line denotes the reference series; shaded areas correspond to the downturns in the reference series, unshaded areas upturns; a cyclical peak is indicated by the left-hand edge of any particular shaded block, while a subsequent trough is represented by the right-hand edge of the block. Visual inspection of the graph reveals that the composite leading index starts to turn before the left-hand and right-hand of the shaded areas indicating that it indeed leads the reference series.

Figure 2a. **Reference Series and Composite Leading Index, Malaysia**

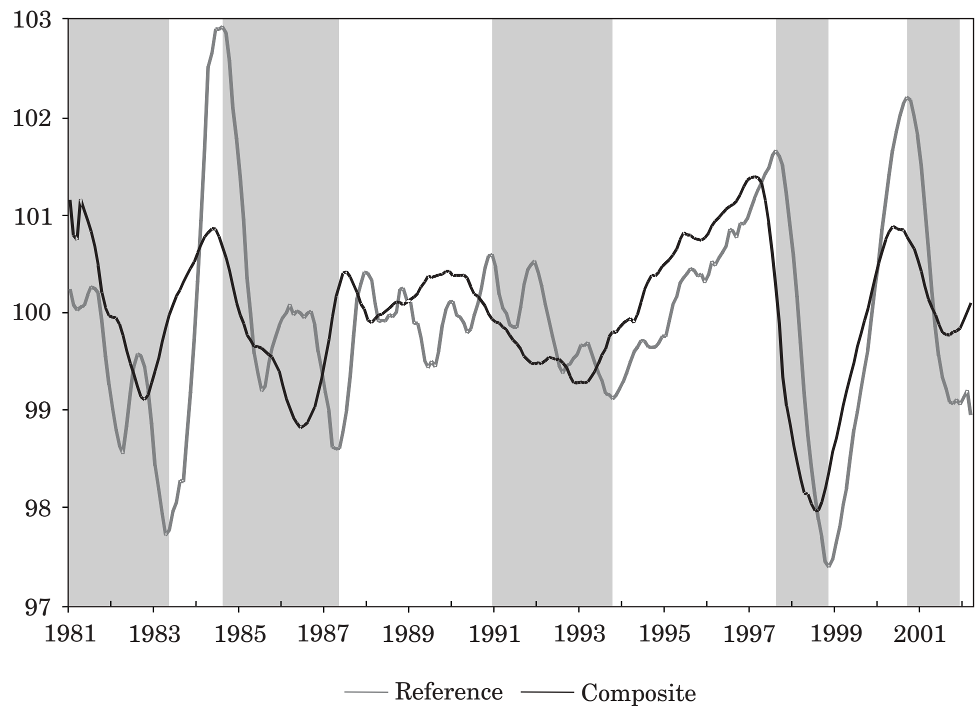
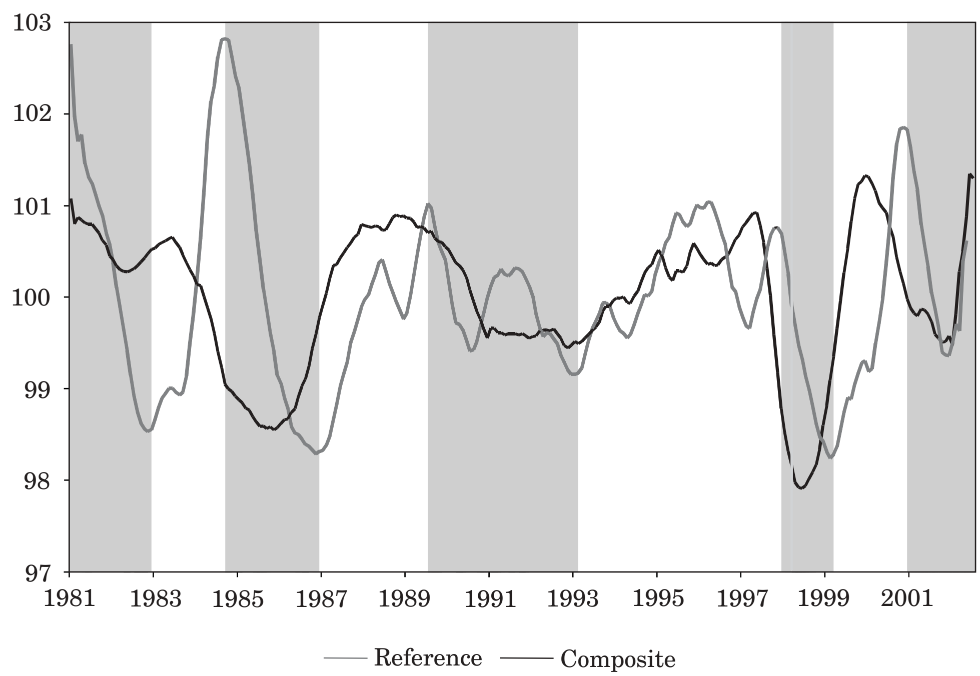


Figure 2b. **Reference Series and Composite Leading Index, Philippines**



D. Predicted Turning Points

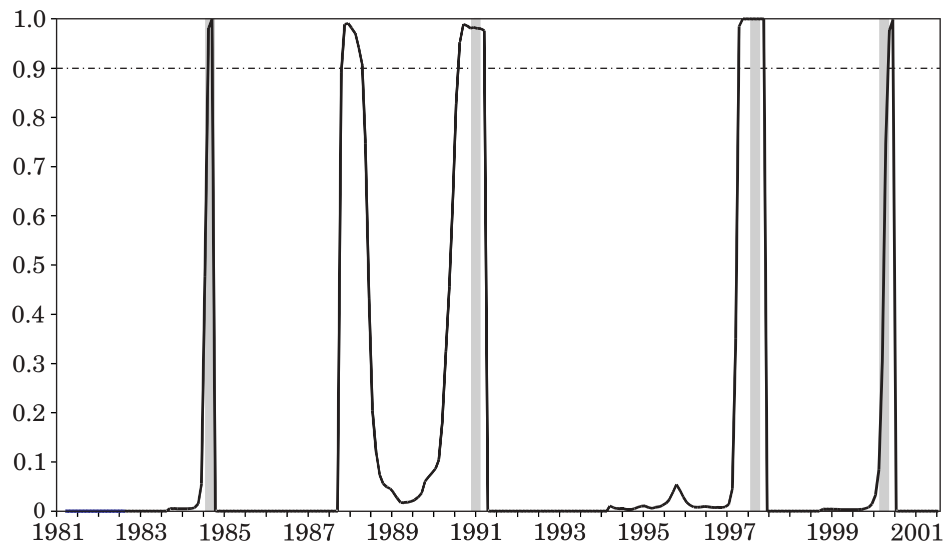
A change in the direction of the composite leading index does not necessarily signal a turning point. There could be many false signals, and these false signals need to be screened out. As described earlier, the SPM model is used as a decision mechanism for signalling turning points in this paper. In this model, the probability of a turning point is calculated sequentially using current information and previously estimated posterior probability. A signal of a turning point will be issued when the probability reaches a certain threshold level.

Figures 3a and 3b plot time series of the probability of a turning point, estimated from outcomes of the composite leading index using the SPM model, against the actual turning points in the reference series during the sample period, as indicated by vertical lines. For convenience we differentiate between peak and trough predictions and report the results of the former in the top panel and results of the latter in the lower one with the sequential probability of a turning point being represented by a solid line. The horizontal dotted lines represent the 0.9 threshold value. A warning signal will be issued if the sequential probability crosses above the 0.9 threshold line.

Inspection of Figures 3a and 3b reveals the tendency for the probability to rise rapidly when an actual turning point is approaching. This is a very attractive feature of the sequential probability method. For example, in the case of the Philippines, the sequential probability rose rapidly from 0.12 in May 1983, 12 months ahead of the actual turning point P1 in August 1984, to 0.99 in August 1983, and remained at that level until the turning point had been reached. As noted earlier, another feature of the sequential probability method is that warning signals tend to be persistent before the actual turning point, rather than simply flashing "on" or "off." For example, for predicting P1, the signal started flashing 12 months before the turning point and kept flashing until the actual turning point had been reached.

Figure 3a. **Sequential Prediction for Turning Points, Malaysia**

Peaks



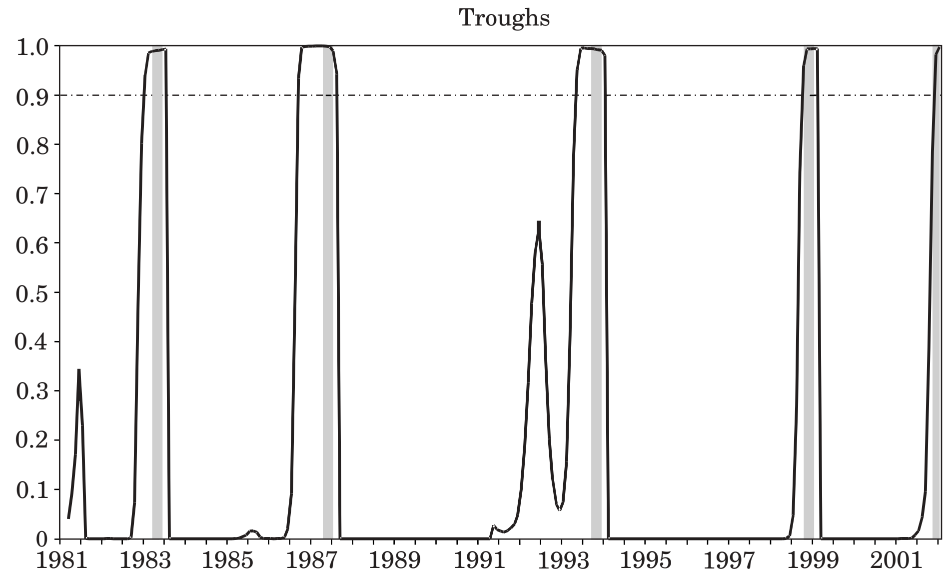
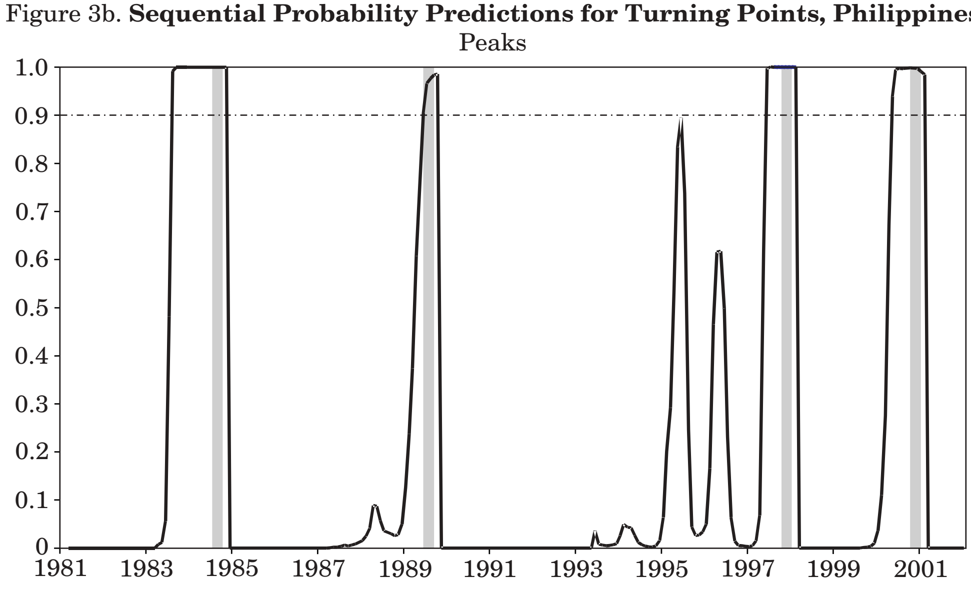


Figure 3b. **Sequential Probability Predictions for Turning Points, Philippines**



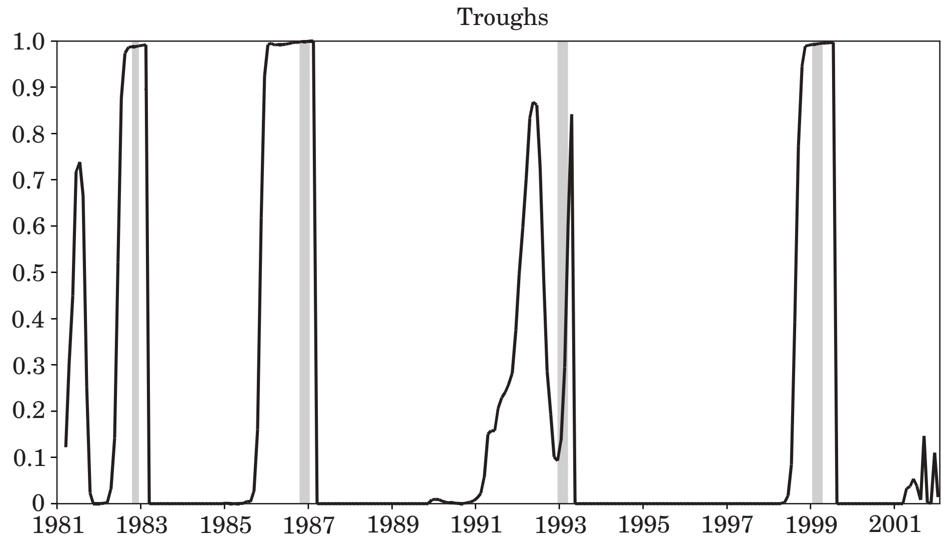


Table 6 compares dates of peaks and troughs of the reference series during the sample period with those of the composite leading index. To provide a more detailed analysis of the predictive power of the leading indicator systems, Table 6 also shows leading time, signal leading time, and recognition lag of the composite leading index. The leading time is calculated as the difference (in month) between the time when a turning point in the composite leading index appears and the time when the corresponding turning point in the reference series that the composite leading index attempts to predict arrives. The negative sign "–" denotes lead and positive sign "+" denotes lag. The signal leading time is the difference between the time when a signal of a turning point is issued and the time when the turning point in the reference series arrives. The recognition lag is the time required to recognize that a turning point in the composite leading index signals a turning point in the reference series. This is the difference between the leading time and signal leading time, and is due to the fact that the SPM model requires the probability of a turning point to reach 0.9 before it issues a signal. So even if visual inspection identifies a turning point in the composite leading index, no signal would be issued if the probability produced by the SPM model is below 0.9.

For Malaysia, on average, turning points of the composite leading index lead those of the reference series by 6.8 months in cases of troughs and 6.3 months in cases of peaks. The shortest leading time is three months at P1 and T4 and longest is 12 months at P2. For the Philippines, turning points of the composite leading index lead those of the reference series by 6.5 months in cases of troughs and 9.8 months in cases of peaks on average. The shortest leading time is one month at T3 and longest is 14 months at P1.

With the prediction window [12, 4], in the case of Malaysia, all the nine turning points during the sample period may be considered as being timely and correctly recognized by the model. There is one false signal (as shown in Figure 3a), but no turning point is missed. Although the signal leading time in predicting P4 is +2, this may still be considered timely recognition of the turning point. The average signal leading time is 1.5 months in predicting the peaks and 3.4 months in predicting the troughs.

Table 6. **Turning Point Prediction**

Composite	Reference	Leading Time	Signal Leading Time	Recognition Lag
		Malaysia		
Peak				
P1 May 1984	Aug 1984	-3	0	+3
P2 Dec 1989	Dec 1990	-12	-4	+8
P3 Feb 1997	Aug 1997	-6	-4	+2
P4 May 2000	Sep 2000	-4	+2	+6
Average		-6.3	-1.5	4.8
Trough				
T1 Oct 1982	Apr 1983	-6	-3	+3
T2 Jun 1986	May 1987	-11	-8	+3
T3 Dec 1992	Oct 1993	-10	-5	+5
T4 Aug 1998	Nov 1998	-3	-1	+3
T5 Aug 2001	Dec 2001	-4	0	+4
Average		-6.8	-3.4	3.4
		Philippines		
Peak				
P1 Jun 1983	Aug 1984	-14	-12	+2
P2 Oct 1988	Jul 1989	-9	-1	+8
P3 May 1997	Nov 1997	-6	-5	+1
P4 Dec 1999	Oct 2000	-10	-5	+5
Average		-9.8	-5.8	4
Trough				
T1 May 1982	Nov 1982	-6	-3	+3
T2 Nov 1985	Nov 1986	-12	-11	+1
T3 Nov 1992	Dec 1992	-1	Missed	n.a
T4 Jun 1998	Feb 1999	-7	-4	+4
Average		-6.5	-6.0	2.7

n.a. means not applicable.

In the case of the Philippines, seven out of the eight turning points during the sample period may be considered being correctly and timely recognized by the model. There is no false signal, but one turning point, T3 (Nov 1992), is missed. The average signal leading time is about

6 months in predicting both peaks and troughs. On average it takes 4 months (or 2.7 months) for the model to recognize that a peak (or trough) has already occurred in the composite leading index.

E. An Evaluation Using *QPS*

To further assess the predictive power of the leading indicator systems developed in this study, we compare their *QPS* with those of two nonindicator-based, naïve models: Naïve 1, where the model issues a signal every month during the sample period, and Naïve 2, where the model never issues a signal during the sample period.[8] By construction, the sum of *QPS* of Naïve 1 and Naïve 2 equals two.

Table 7. **QPS of Composite Leading Index and Nonindicator-based Models**

	Malaysia	Philippines
Naïve 1	0.92	0.90
Naïve 2	1.08	1.10
Composite leading index	0.58	0.48

Table 7 shows that the composite leading indices constructed in this paper have a much lower QPS than the two nonindicator-based models, indicating that the leading indicator systems we have developed have a significant power in predicting turning points of growth cycles in Malaysia and the Philippines.

IV. CONCLUSION

This paper has attempted to construct leading indicator systems for the Malaysian and Philippine economies using publicly available economic and financial data, with a view to predicting turning points of growth cycles in the two countries. Overall, it is found that the leading indicator systems work quite well for both economies.

The results show that during January 1981-March 2002, there were nine turning points in Malaysia, consisting of five troughs and four peaks; and eight turning points in the Philippines, consisting of four troughs and four peaks. Turning points of Malaysia were almost synchronized with those of the Philippines.

After inspecting over 50 publicly available economic and financial indicators, six were selected as leading indicators of industrial production in Malaysia and manufacturing production

[8]The two models, Naïve 1 and Naïve 2, may be represented by $P_t = 1$ and $P_t = 0$, respectively.

in the Philippines, respectively. For Malaysia, they are stock price index in local currency, stock price index in US dollar, exports (in US dollar), money supply (M1), industrial production in Korea, and US federal fund rate. For the Philippines, they are stock price index in US dollar, exchange rate (local currency per US dollar), discount rate (reversed), manufacturing employment, money supply (M1), and industrial production in Korea.

Using the sequential probability model, the composite leading index constructed from these individual leading indicators is found to be able to predict all the nine turning points in the case of Malaysia, with one false signal and an average signal leading time of 1.5 months for peaks and 3.4 months for troughs. In the case of the Philippines, the composite leading index is found to be able to predict seven out of the eight turning points, with an average signal lead time of 5.75 months for peaks and six months for troughs. In evaluating the performance of OECD's leading indicators systems for the G-7 countries in predicting turning points in industrial production, Artis et al. (1995a) found no errors in calling 13 turning points in the US, but two errors in calling five peaks in Germany, France, and UK, respectively. Therefore, the performance of the leading indicator systems developed in this study is comparable to that of OECD's.

QPS indicates that the composite leading index significantly outperforms the two nonindicator-based models for both Malaysia and the Philippines, further suggesting that the leading indicator systems have significant predictive power and could be used as a useful tool for economic forecasting in the two countries.

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