OECD LEADING INDICATORS

Ronny Nilsson

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INTRODUCTION

The OECD Secretariat makes economic projections for each Member country twice a year. These are published in the ***Economic Outlook*** and in the annual *OECD* ***Economic*** Surveys of each Member country. The preparation of these projections is a complex exercise, involving most of the professional economists in the Economics and Statistics Department. A general description of the forecasting process at the OECD is given in the "Sources and Methods" chapter of ***Economic Outlook.***

Economic projections are based on knowledge of the workings of individual economies and judgement of the economic forces likely to affect these economies over the projection period. Together with an accurate appraisal of the actual state of the economy at the beginning of the projection period, this knowledge and judgement are combined to produce forecasts of the likely evolution of the economy in question.

In practice, accurate information on many aspects of the state of the economy at the beginning of the projection period is difficult or impossible to obtain. Many OECD countries publish only annual data on GDP and its demand components, while quarterly data become available only with a lengthy delay for most of those countries which publish them, and may be subject to considerable subsequent revision. Another common problem facing forecasters is the prediction of turning points of economic activity. The timing of turning points is notoriously difficult to predict, largely because they are often provoked by sharp movements in demand components which are themselves volatile, chiefly private investment. If a turning point occurs unexpectedly close to the beginning of the projection period, the errors in forecasting growth rates and end-period levels will be unusually large.

For these reasons, professional forecasters are obliged to estimate their "jumping-off" point using a variety of data which experience shows to be closely correlated with economic activity, but available with a shorter delay than direct measures. They also rely on indicators that give a good guide to the overall performance of the economy a short period ahead to test for the possibility of near-term turning points. Clearly, an indicator that performs the latter function will also perform the first. Such indicators are known as leading indicators.

The OECD Secretariat, in co-operation with Member countries, has developed a system of leading indicators for twenty-two Member countries. The maintenance and development of this system is now part of the regular work of the Economics and Statistics Department. This paper sets out the framework in which the OECD leading indicator system is based, and appraises the ability of these indicators in forecasting changes in aggregate output.

I. THE INDICATOR SYSTEM

A. The reference cycle

In the construction of a system of cyclical indicators, it is necessary first to identify the past cyclical behaviour of the "reference" series, i.e. the series whose future movements it is intended to predict. The OECD indicator system uses the index of total industrial production – mining, manufacturing and public utilities – as the reference series. Indices of industrial production are available promptly for most Member countries and industrial production constitutes the more cyclical subset of the aggregate economy. In addition, the cyclical profiles of industrial production and Gross Domectic Product have been found to be closely related as can be seen from Chart A, so that the composite leading indicators for industrial production serve well as leading indicators for the GDP cycle. The "reference chronology" – the historical cyclical pattern – for total industrial production is shown in Table 1 for all Member countries covered by the OECD system. Annex Table A gives the reference chronology for GDP.

B. Selection of indicators

Once the underlying cyclical behaviour of the reference series has been established, the next step is to select economic time series whose cyclical movements typically predate those of the reference series. Candidate series are evaluated using the following criteria:

Relevance:

i) Economic significance – there has to be an economic reason for the observed leading relationship before the series can be accepted as an indicator;

Table 1. Reference
Total industrial

Country	P	T	P	T	P	T	P
Canada	10/59	(3/61	7/62)	8/63			12/65
United States	1/60	(2/61	12/61)	12/62	(5/63	10/64)	10/66
Japan			1/62	12/62	2/64	2/66	(11/67
Australia					2/65	9/66	(2/67
Austria	11/60			2/63	1/65		
Belgium			7/61	1/63	1/65		
Luxembourg			8/61	2/63	2/65		
Denmark							
Finland			4/62	3/63	6/65		
France	9/60			3/63	1/64	(1/65	7/66)
Germany			3/61	2/63	1/65		
Greece					6/63	10/65	5/66
Ireland		Q4/60	Q2/61	Q2/63	Q3/64	Q2/66	(Q1/67
Italy	(6/60	12/60)	(1/62	9/62)	9/63	3/65	(2/67
Netherlands	12/60			2/63	3/64		
Norway (Manufacturing)	12/60			3/63	(4/65	2/66)	1/67
Norway (Total)	12/60			6/63	4/65	(12/65	1/67)
Portugal							
Spain			12/61	7/63	(5/65	12/65)	10/66
Sweden			3/61	3/63	1/65		
Switzerland			Q4/61	(Q1/63	Q3/63)		
United Kingdom	3/60			1/63	5/65		
Yugoslavia* 7/71, 3/73	6/60			5/62	11/64		
Big Four			3/61	2/63	2/64	7/65	3/66
Major Seven	1/60	(12/60	12/61)	1/63	(2/64	9/65)	7/66
EEC				2/63	2/64	(7/65	1/66)
OECD-Europe			3/61	2/63	3/64	(7/65	4/66)
North America	1/60	(2/61	12/61)	12/62	(5/63	10/64)	10/66
OECD-Total	1/60	(1/61	12/61)	3/63	(2/64	8/65)	3/66

P = Growth cycle peak
T = Growth cycle trough
( ) = Turning points of minor growth cycles

chronologies 1960-1984
production

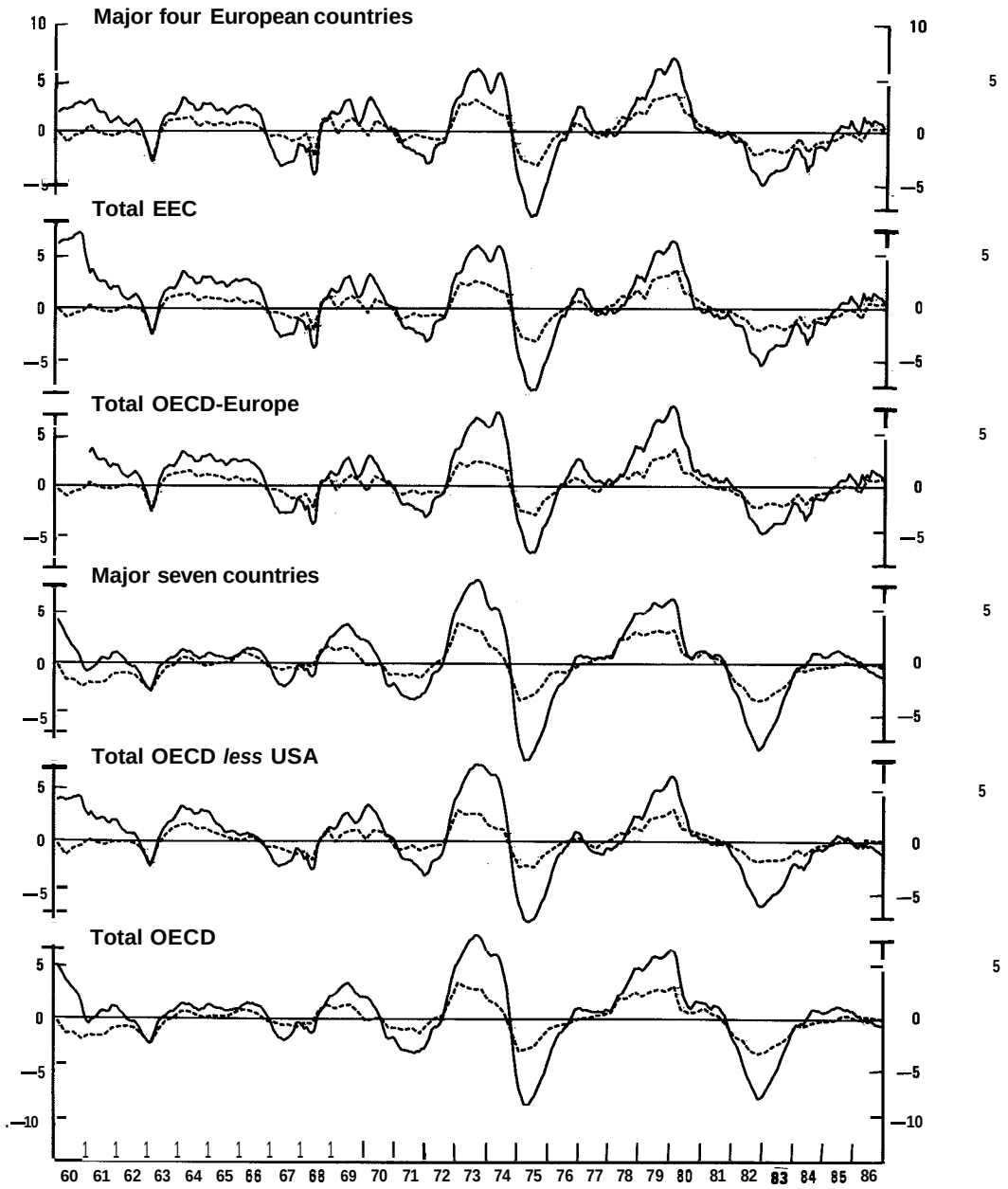
T	P	T	P	T	P	T	P	T	P	T
2/68	3/69	10/70	1/74	10/75	(1/77	9/77)	9/79	6/80	6/81)	12/82
7/67	8/69	11/70	9/73	3/75			3/79	(7/80	7/81)	11/82
9/68)	6/70	1/72	11/73	3/75	(1/77	7/77)	2/80	15/81	10/81)	2/83
1/68)	3/70	1/72	1/74	6/75	(10/76	8/78)	(9/79	9/80)	5/81	1/83
8/67	2/70	12/71	4/74	10/75	(1/77	12/77)	12/79			12/82
7/67	8/69	5/71	12/73	9/75	(10/76	1/78)	12/79			12/82
2/68	11/69	2/72	8/74	8/75			12/79	(1/81	2/82)	12/82
	8/70	5/71	1/74	3/75	(6/76	4/77)	10/79	(11/80	7/81)	10/82
7/68	7/70	12/71	7/74	(9/75	12/76)	7/78	7/80			10/82
10/67	5/69	5/71	7/74	5/75	(1/77	12/77)	7/79			8/82
5/67	5/70	12/71	8/73	7/75	(3/77	3/78)	12/79			12/82
1/68	6/69	4/71	9/73	7/74	(11/76	4/77)	5/79			5/83
Q3/67)	02/69	01/72	Q1/74	10/75			9/79	(9/80	12/81)	12/82
3/68)	1/69	4/72	1/74	5/75	(12/76	12/77)	4/80			6/83
5/67	3/70	12/71	8/74	8/75	(9/76	5/78)	11/79			11/82
11/68	8/69	11/71	10/74	(12/75	1/77)	5/78	7/80	(12/80	9/81)	11/82
4/69	7/71	8/72	(5/74	1/75)	8/76	5/77	2/80			10/82
	12/69	3/71	1/74	2/76	(9/77	8/78)	1/80	(8/81	3/82)	4/84
8/68	2/70	9/71	8/74	1/76	(3/77	6/77)	7/79			1/82
2/68	7/70	1/72	6/74	(1/76	6/76)	6/78	12/79			11/82
Q2/68	02/70	02/72	01/74	Q1/75	(Q3/77	03/78)	01/80			04/82
8/67	6/69	2/72	6/73	8/75			6/79	5/81		
2/68	(7/69	3/70).	12/74	4/76			3/79	(7/80	6/81)	2/84
4/67	3/70	1/72	9/73	6/75	(1/77	2/78)	1/80			11/82
6/67	7/69	8/71	9/73	4/75	(3/77	10/77)	1/80	(8/80	1/81)	11/82
5/67	3/70	1/72	9/73	7/75	(1/77	2/78)	1/80			11/82
5/67	3/70	1/72	6/74	7/75	(1/77	2/78)	1/80			11/82
7/67	3/69	11/70	7/73	3/75			3/79	(7/80	7/81)	12/82
5/67	7/69	12/71	10/73	5/75	(3/77	10/77)	2/80	(9/80	2/81)	11/82

CHART A

CYCLES IN INDUSTRIAL PRODUCTION AND GDP

Percentage deviation from trend, seasonally adjusted

Total industrial production ••••••• Gross domestic product



ii) Breadth of coverage – series with a wide coverage, in terms of the representation of the economic activity concerned, are preferred to narrowly-defined series;

Cyclical behaviour:

iii) Length and consistency of the lead of the indicator over the reference cycle at turning points;

iv) "Cyclical conformity" between the indicator and the reference series – if the cyclical profiles are highly correlated, the indicator will provide a guide, not only to approaching turning points, but also to developments over the whole cycle;

v) Absence of extra or missing cycles in comparison with the reference series;

vi) Smoothness, that is, how promptly a cyclical turn in the series can be distinguished from irregular movements;

Practical considerations:

vii) Frequency of publication – monthly series are preferable to quarterly ones;

viii) Absence of excessive revisions;

ix) Timeliness of publication and easy accessibility for data collection and updating;

x) Availability of a long time series of the data with no breaks.

To determine how well candidate series meet criteria three through six, two separate tests are carried out – a peak-and-trough analysis and a cross-correlation analysis.

For peak and trough analysis, statistics are assembled on each series' behaviour at cyclical turning points: the mean or median leads, the mean devation from the median and the number of extra or missing cycles when compared with the reference series. Usually these figures are not statistically significant in the usual sense because of the limited number of turning points available over the period investigated, and because most series contain irregular movements and double or multiple peaks and troughs. Peak and trough analysis therefore involves a substantial amount of judgement. Cross-correlation analysis is used to complement the peak-and-trough analysis concerning the average lead of the indicator, and to give information about the extent to which the cyclical profiles of indicator and reference series resemble each other.

Certain practical factors – criteria seven through ten – need to be considered too, if the indicator system is to be updated regularly and used for current analysis of

the economic cycle. These factors refer to matters of data collection, updating and computation, so that the final composite indicator can be calculated quickly and, as far as possible, automatically.

C. Leading indicators

The OECD system does not use a standard set of leading indicators for all countries, because of important differences between them in economic structure and statistical systems. Leading indicator series which perform well in both tracking and forecasting cyclical developments differ from country to country and may also change over time.

The different subject areas from which the leading indicator series are chosen are set out in Table 2. Certain types of series recur regularly in the list of leading indicators for different countries. Business survey series are among those most frequently used in the countries where they are available. These series concern business expectations on production, inflow of new orders, level of order books, stocks of finished goods and the general economic situation. The most frequently used other series are monetary and financial series such as stock-market prices, money supply and interest rates. Series relating to stocks and orders, construction, retail sales, prices and foreign trade are also used frequently. Several series, such as stocks of finished goods, interest rates and prices, have to be inverted to obtain a positive correlation with the reference series.

D. Turning point and trend estimation

In common with most similar systems, the OECD leading indicator system uses the "growth cycle" or "deviation-from-trend" approach. This is necessary because essential cyclical similarities between series may be obscured by different long-term trends. Trend estimation is thus a crucial step in detecting cyclical movements and identifying turning points.

The method of trend estimation adopted by the OECD is a modified version of the Phase-Average Trend method developed by the United States National Bureau of Economic Research (NBER)[1]. This method has been designed specifically to separate the long-term trends from medium-term cycles, with the latter defined according to the criteria programmed in the Bry-Boschan computer routine[2] for selection of cyclical turning points.

The Phase-Average Trend (PAT) of a series is estimated by first splitting the series into phases, defined as the number of months between successive turning

Table 2. Leading indicators used in the OECD system

Indicator series by subject area	CANADA	UNITED STATES	JAPAN	AUSTRALIA	AUSTRIA	BELGIUM	DENMARK	FINLAND	FRANCE	GERMANY	LUXEMBOURG	GREECE	IRELAND	ITALY	NETHERLANDS	NORWAY	PORTUGAL	SPAIN	SWEDEN	SWITZERLAND	UNITED KINGDOM	YUGOSLAVIA	INDICATORS
Production, stocks and orders																							
Industrial production in specific branches					1											1	2				1		5
Orders		1								1				1					1				4
Stocks – materials	1															1							2
– finished goods	1		1													2							4
– imported products																1							1
Ratios, eg. inventory/shipment			1																				1
Construction, sales and trade																							
Construction approvals							1					1					1						3
Construction starts	1	1		1		1	1												1				6
Sales or registrations of motor vehicles	1						1		1									1			1		5
Retail sales							1					1	1		1							1	5
Labour force																							
Ratio new employment/employment																			1				1
Layoffs/initial claims, unemployment insurance		1																	1				2
Vacancies																						1	1
Hours worked	1												1										2
Prices, costs and profits																							
Wages and salaries per unit of output	1									1									1				3
Price indices		1							1			2			1	1							6
Profits, flow of funds, net acquisitions of financial assets																					2		2
Monetary and financial																							
Foreign exchange holdings								2															2
Deposits															1								2
Credit		1	1									1									1		4
Ratios, e.g. loans/deposits			1																				1
Money supply	1	1	1	1	1	1	1	1	1	1		1	1	1	1				1	1		1	1 7
Interest rates		1	1			1	1		3	1			1	1	1				1	1	1		14
Stock prices	1	1	1	1		1			1	1			1			1			1	1	1		12
Company formation		1																					1
Foreign trade																							
Exports aggregates																1							1
Exports components								2															2
Trade balance			1																				1
Terms of trade			1	1			1		1				1	1	1					1			8
Business surveys																							
General situation			1	1				1	1	1						1							6
Production	1			1	1	1	1	2	1			1	1	1	1	1		1	1		1		15
Orders inflow/new orders	1			1		1		1		1		1			1	1	1		1	1			11
Orderbooks/sales					1					1		1	1	1	1		1	2	1		1	1	1
Stocks of raw materials																	1		1		1		3
Stocks of finished goods	1		1						1	1			1	1	1				1	1	1		10
Capacity utilization																		2					2
Bottlenecks								1										1					2
Employment				1			1						1										3
Prices						1																	1
Economic activity in foreign countries	1				5						2				1								9
INDICATORS	12	9	11	8	9	7	9	10	11	9	2	9	9	7	11	11	6	7	12	7	10	4	190

points. The means of the observations in each phase are then calculated and these ***phase-averages*** are used to compute a three-term moving average. The values obtained from the moving average are assigned to the mid-point of the three-phase period – known as a "triplet" – to which they refer. The trend is then obtained by computing the slope between the mid-point of successive triplets and adjusted to match the level of the original data. The trend is extrapolated by constructing a log-linear line extended from the mid-point of the last triplet. The slope of this line is computed so that it goes through the original data.

It will be appreciated that the estimation of the peak and trough dates is a crucial step in the PAT procedure. First estimates are made using the Bry-Boschan routine, which begins by calculating a rnoving-average trend estimate for the identification of turning points. The routine then executes a series of tests on the deviations from this first trend estimate, so as to eliminate extreme values and turning points that are judged to be too close together; the Bry-Boschan routine specifies a minimum duration of five months for a phase and fifteen months for a cycle. These operations are applied to various smoothed curves in order to identify turning points which coincide more and more closely with observable variation in the original series. Last, the turning points are sought in the original series within the five months on both sides of the turning points found at the preceding stage. The points thus identified are taken as the preliminary turning points.

The main problem with the Bry-Boschan routine is that it tends to select too many turning points, thereby giving a long-termtrend which is too variable; relatively minor fluctuations may be selected by the routine and given the same weight as more important cycles. The turning points finally chosen as input to the trend calculation are selected taking into account the relationship between the variables used in the indicator system. That is, care is taken to select the cyclical turning points corresponding to the reference chronology so that the trend estimation for each variable is done in a manner consistentwith that for the other indicators and for the reference series itself. The same considerations apply in making the trend estimate for the reference series; here the main consideration is consistency between the turning points selected for a given country and the turning points for the other twenty-one countries included in the system.

E. Composite indicators

Once a set of leading indicators has been selected these need to be combined to a single composite indicator for each country. This is done in order to reduce the

risk of false signals, and to provide a leading indicator with better forecasting and tracking qualities than any of its individual components.

The reason why a group of indicators combined into a composite indicator should be more reliable over a period of time than any of its individual components is related to the nature and causes of business cycles. Each cycle has its unique characteristics as well as features in-common with other cycles. But no single cause explains the cyclical fluctuation over a period of time in overall activity. The performance of individual indicators will then depend on the causes behind a specific cycle. Some indicators will perform better in one cycle and others in a different cycle. It is therefore necessary to have signals for the many possible causes of cyclical changes, i.e. to use all potential indicators as a group.

A number of steps are involved in combining individual series to obtain the composite indicator. First, the detrended indicator series are all Converted to a monthly basis. Most indicators used in the OECD system are in fact monthly series, but it is sometimes necessary to accept quarterly data. These are converted to monthly frequency by linear interpolation.

Next, it is necessary to ensure that all component series have equal "smoothness"; this is to ensure that month-to-month changes in the composite indicator are not unduly influenced by irregular movements in any one indicator series. The OECD procedure is to use the "Months for Cyclical Dominance" (MCD) moving average[3]. This procedure ensures approximately equal smoothness between series, and also ensures that the month-to-month changes in each series are more likely to be due to cyclical than to irregular movements.

The third step is to normalize the series so that their cyclical movements have the same amplitude; if this were not done series with particularly marked cyclical amplitude would have undue weight in the composite indicator. The method used to calculate normalized indices is, for each component series, the subtraction of the mean and divide by the mean of the absolute values of the difference from the mean. The normalized series are then converted into index form by adding 100.

Finally, it may sometimes be necessary to lead or lag particular indicators. In the OECD system this is done only in one case, where the indicators selected for a particular country fall into two distinct groups of "longer-leading" and "shorter-leading" indicators. Combining the two types of indicators gave unsatisfactory results because of the interference between the two cycles. The alignment was improved by lagging the longer-leading group of indicators.

The indicator series having now been detrended, converted to a monthly basis, smoothed, normalized and, possibly, lagged to improve alignment, they are then ready to be combined into a single composite indicator. At this stage it would be possible to assign different weights to the component series depending, for

example, on their past record in forecasting and tracking cycles or on their relative freedom from revisions. In the OECD system, equal weights are used almost invariably to obtain each country's composite indicator; this does not mean that there is "no weighting" in the OECD system, because equal weighting implies by default a judgement on appropriate weights, and the normalization process is itself a weighting system in reverse. However, when the composite indicators for individual countries are combined into indicators for country groups, each composite indicator is assigned the weight used in calculating group totals for the industrial production index.

II. PERFORMANCE AND FORECASTING ABILITY

The performance of the leading indicators can be evaluated in different ways. One is to examine the behaviour of the indicators in relation to the cyclical turning points of the reference series. Forecasting turning points is one of the main objectives of the leading indicator technique, because predicting the timing of cyclical turning points is one of the least reliable activities in economic forecasting. However, the OECD system of leading indicators is designed not only to give advance warning of turning points, but also to give information about the likely rate and amplitude of movements in the reference series. Hence, it is also useful to examine the "general fit" of the composite indicators in relation to the reference series at all stages of the cycle.

An important consideration in evaluating leading indicators is that, in the current period, some of the components series may not be available or may only be provisional, so that the composite series are based on an incomplete or unreliable set of indicators. In the OECD system, composite indicators are published for a country once at least 40 per cent of the component series are available, and they are published for zones once 60 per cent, by weight, of the component country indicators are available. The next section examines the historical performance of the OECD indicators, where the data sets are complete both for individual countries and for country zones. However, this gives a somewhat flattering picture of their performance in the current period which is, of course, precisely the time when they are potentially of most interest for economic forecasting and analysis. The historical review is therefore followed by an appraisal of their current performance when they are based on incomplete, or provisional, data sets.

A. Historical performance

The performance of the composite leading indicators for all Member countries covered by the OECD system is set out in Table **3.** To check their performance at turning points the table shows the number of extra and missing cycles in the indicators, and the median leads at peaks, troughs and at all turning points, together with the absolute mean deviation from the median. The median, rather than mean, is usually used in this kind of analysis because there are relatively few observations

Table **3.** Summary of historical performance of leading indicators

		Turning points analysis						General fit analysis		
	Start date	Extra (x) or missing (m) cycles	Median lag (+) in months at			Turning points successfully predicted 1960-1985			Mean absolute deviation around median	Months lag (+)	Cross correlation R^2
			Peaks	Troughs	All turning points	Major	Minor	All			
Canada	55		–11	–9	–10	9/10	**5/6**	14/16	3.8	–6	0.88
United States	55	l m	–9	–3	–7	10/10	**4/6**	14/16	3.8	-6	0.85
Japan	60		-4	-6	–5	10/10	**5/6**	15/16	2.9	-6	0.87
Australia	66		–3	–2	–2	5/6	5/6	10/12	2.8	-6	0.85
Austria	63		-6	-4	-6	**7/8**	**2/2**	9/10	3.4	–7	0.82
Belgium	66		–7	–9	–9	**7/7**	2/2	9/9	2.8	-6	0.75
Luxembourg	62	l x	-6	–5	-6	8/9	**1/2**	9/11	2.6	–7	0.70
Denmark	55		–11	–5	–5	6/6	1/2	7/8	4.9	–6	0.85
Finland	55		–10	-6	–8	10/10	2/2	12/12	3.6	–9	0.17
France	63		–8	-6	–7	8/8	1/2	9/10	2.8	–7	0.81
Germany	62		–7	–5	-6	**8/9**	–	**8/9**	2.0	–8	0.88
Greece	63		–7	**–9**	–8	7/8	2/2	9/10	3.3	–8	0.80
Ireland	**67**		-6	–5	–5	9/10	**5/5**	14/15	2.1	–5	0.88
Italy	63		–3	-6	-4	**6/7**	**4/4**	10/11	2.5	-6	0.75
Netherlands	62		–10	**–7**	–8	9/9	2/2	11/11	3.9	-6	0.81
Norway	71		–5	-4	-4	**4/5**	3/4	**7/9**	3.9	-6	0.84
Portugal	**70**		–3	0	–1	**4/5**	0/2	**4/7**	2.9	–1	0.79
Spain	64		–9	-8	–8	10/10	0/2	10/12	4.3	-6	0.81
Sweden	60		-4	–12	9	8/9	1/2	9/11	5.1	–8	0.80
Switzerland	66		–10	–15	–12	6/7	**2/2**	**8/9**	5.6	–12	0.17
United Kingdom	59		–17	–10	–13	10/10	–	10/10	5.0	–11	0.75
Yugoslavia	61	½ m	–8	-4	-6	8/9	5/6	13/15	4.8	-6	0.13
Big Four Europe	63	l x	-6	-6	-6	**8/8**	**4/4**	12/12	2.6	–8	0.92
Major Seven	60		–5	-4	–5	**9/9**	**8/8**	17/17	1.6	-6	0.94
EEC	63	l x	–7	-6	**–7**	8/8	**3/4**	11/12	2.5	–	0.93
OECD-Europe	63	l x	–7	–5	**–7**	8/8	2/2	10/10	3.3	–7	0.94
North America	55	l m	–9	-4	–5	10/10	**4/6**	14/16	3.3	-6	0.86
OECD-Total	60	l m	–5	–5	–5	9/9	6/8	15/17	1.9	-6	0.94

Source: OECD (1987), *OECD Leading Indicators and Business Cycles in Member Countries 1960-1985, OECD MEI, Sources and methods.*

– only eight or nine for some countries. These measures can be relied upon to give a true picture if the cycles are clear and irregular variation is not a problem. However, with a twin-peaked pattern, the choice of one date rather than another can alter these measures significantly. The classification of a cycle as a major cycle/no cycle at all can give such measures a spurious appearance of accuracy, and so Table **3** also shows how many out of all cyclical turning points have been successfully predicted since **1960.** These figures should be treated with caution because an extra cycle in the composite indicator is not penalized, but a missing cycle is penalized twice – once for the peak and once for the trough.

A further desirable characteristic is that the mean of the absolute deviations from the median should not be too great in itself and should not be too great in comparison with the median. If the distribution of leads around the median were normal (which it is not), the indicator could be expected to fail to lead at turning points no more than **1** in **40** times if the median lead is about double the mean deviation. This condition holds for most countries with the exception of Australia, Denmark, Italy, Norway, Portugal, Spain, Sweden and Yugoslavia. The mean deviation exceeds the median lead only for Portugal.

In testing the general fit, the cross-correlations between lagged smoothed leading indicators and reference series is used. The number of months lag at which the correlation has the highest R^2 value is a guide to the average lead of the indicator over the reference series, and the value of the correlation coefficient shows the extent to which the cyclical profiles of composite indicator and reference series resemble each other. There are limitations to this method however. First, it is a measure only of the linear relationship between variables, and second, the presence of extreme values can affect the estimate of the cross-correlation coefficient. The second problem is, however, generally solved by using MCD-smoothed series in the cross-correlation calculations.

From Table **3** it can be seen that, in general, the historical record of the composite indicators both at turning points and concerning closeness of fit has been rather good. There are few occasions where the composite indicator does not reflect a cyclical fluctuation in the reference series at all. The most striking example of the failure of a composite indicator to show a cycle is the **1963-64** subcycle in the United States. The correlation coefficients give only a guide to the closeness of fit, but are high for all country groups and for a number of the major countries, as well as for some of the smaller countries.

The average lead of the composite indicator, as measured by the lag at which the closest correlation occurs, should not be too different from the median lag at all turning points if the composite indicator is to give reliable information both about approaching turning points as well as the evolution of the reference series. This

difference has been four months for both Australia and Canada, and three months for Belgium, but otherwise two months or less. In the case of Australia there seems to have been a genuine difference between the timing at turning points and the fit in general.

For most countries, the composite indicators have in the past led the reference series by at least six months, taking both measures into account. The only exception is Portugal, with a lead of only one month. The average lead of the composite indicators is rather long for some countries, notably Finland, Switzerland and the United Kingdom. However, these countries, as well as some others, are suitable candidates for the development of longer and shorter leading composite indicators, and when recombining these indicators into a total the lead time could be reduced to gain in precision and accuracy.

B. Current period performance

When a composite indicator is first released, it may be based on only 40 per cent of the component series and some or all of the components may be preliminary figures which will subsequently be revised. In addition, the trend estimate used to detrend the series will be subject to, usually small, changes as extra data are added beyond the last turning point. How reliable, then, are the composite indices when they are first released?

Table 4 shows the average size of revisions to month-to-month percentage changes in the OECD leading indicators during the 34-month period from August **1983** to June **1986.** Two measures are given on the size of revisions to the first, second and third estimates of each country's composite indicator. The first measure – the arithmetic mean of the revisions – behaves in a reassuring fashion. There is no evidence of bias. The revisions are fairly small, negative values appear as often as positive ones, and they diminish in size from the first to the third estimate. The second measure is the mean absolute revision, i.e. the average of the revisions without regard to sign. The revisions between the first and second estimate are within the range of **0.1** to 0.4 percentage points for all zones and countries with the exception of Japan, France, Spain and Yugoslavia. For the second estimate a better performance is obtained, but France and Yugoslavia are still showing revisions above 0.4 percentage points. The third estimate gives a much improved performance with revisions of **0.1** percentage points for all zones, with most of the countries within the range of 0.1 to 0.2 percentage points and no country with revision above 0.4 percentage points.

The revisions indicate that it could be dangerous to draw conclusions about turning points or even trends from one or two months' figures. To test the

Table 4. Revisions to month-to-month percentage changes in OECD leading indicators
August 1983 to June 1986

	First estimate		Second estimate		Third estimate	
	Mean	Mean absolute revision	Mean	Mean absolute revision	Mean	Mean absolute revision
Canada	–0.1	0.4	–0.1	0.3	0.0	0.2
United States	0.1	0.4	0.0	0.3	0.0	0.1
Japan	–0.1	0.5	–0.1	0.4	0.0	0.2
Australia	0.0	0.1	0.0	0.1	0.0	0.1
Austria	0.1	0.4	–0.1	0.2	0.0	0.1
Belgium	0.1	0.4	0.0	0.2	0.0	0.1
Luxembourg	0.1	0.4	0.1	0.2	0.0	0.2
Denmark	0.0	0.4	–0.1	0.3	0.0	0.2
Finland	–0.1	0.4	0.0	0.4	–0.1	0.3
France	-0.2	0.5	0.1	0.5	0.1	0.3
Germany	0.0	0.2	0.1	0.2	0.0	0.1
Greece	0.0	0.4	0.0	0.4	0.0	0.4
Ireland	–0.1	0.3	0.0	0.2	0.0	0.2
Italy	0.0	0.4	0.0	0.2	0.0	0.2
Netherlands	0.0	0.4	0.0	0.2	0.0	0.1
Norway	0.0	0.2	0.0	0.2	0.0	0.2
Portugal	0.3	0.4	0.1	0.4	0.0	0.2
Spain	0.1	0.7	–0.1	0.4	–0.1	0.3
Sweden	–0.1	0.3	0.0	0.2	0.0	0.2
Switzerland	-0.2	0.4	0.0	0.3	0.0	0.1
United Kingdom	0.0	0.3	-0.1	0.3	0.0	0.3
Yugoslavia	0.0	0.6	–0.1	0.5	0.1	0.2
OECD-Europe	0.0	0.2	0.0	0.1	0.0	0.1
North America	0.1	0.4	0.0	0.2	0.0	0.1
OECD-Total	0.0	0.2	0.0	0.1	0.0	0.1

performance, over a longer timespan, of the composite indicators when they are based on an incomplete set of data, a simulation has been carried out in which composite indicators have been calculated for nine countries using only those component series which are typically available in each of the countries when the composite indicator is first published for that country. The indicators have also been calculated for three zones; these are based on incomplete data sets and on incomplete country-sets. This exercise gives more information about the reliability of the first published incomplete composite indicators concerning both turning points prediction and evolution over the whole cycle.

Charts B to M show the evolution of the incomplete composite indicators, the final versions and the reference series. Table 5 gives the cross-correlations between

CHART E

COMPARISON BETWEEN FINAL AND INCOMPLETE INDICATORS AND REFERENCE SERIES

Reference series — Final indicator ---- Incomplete indicator

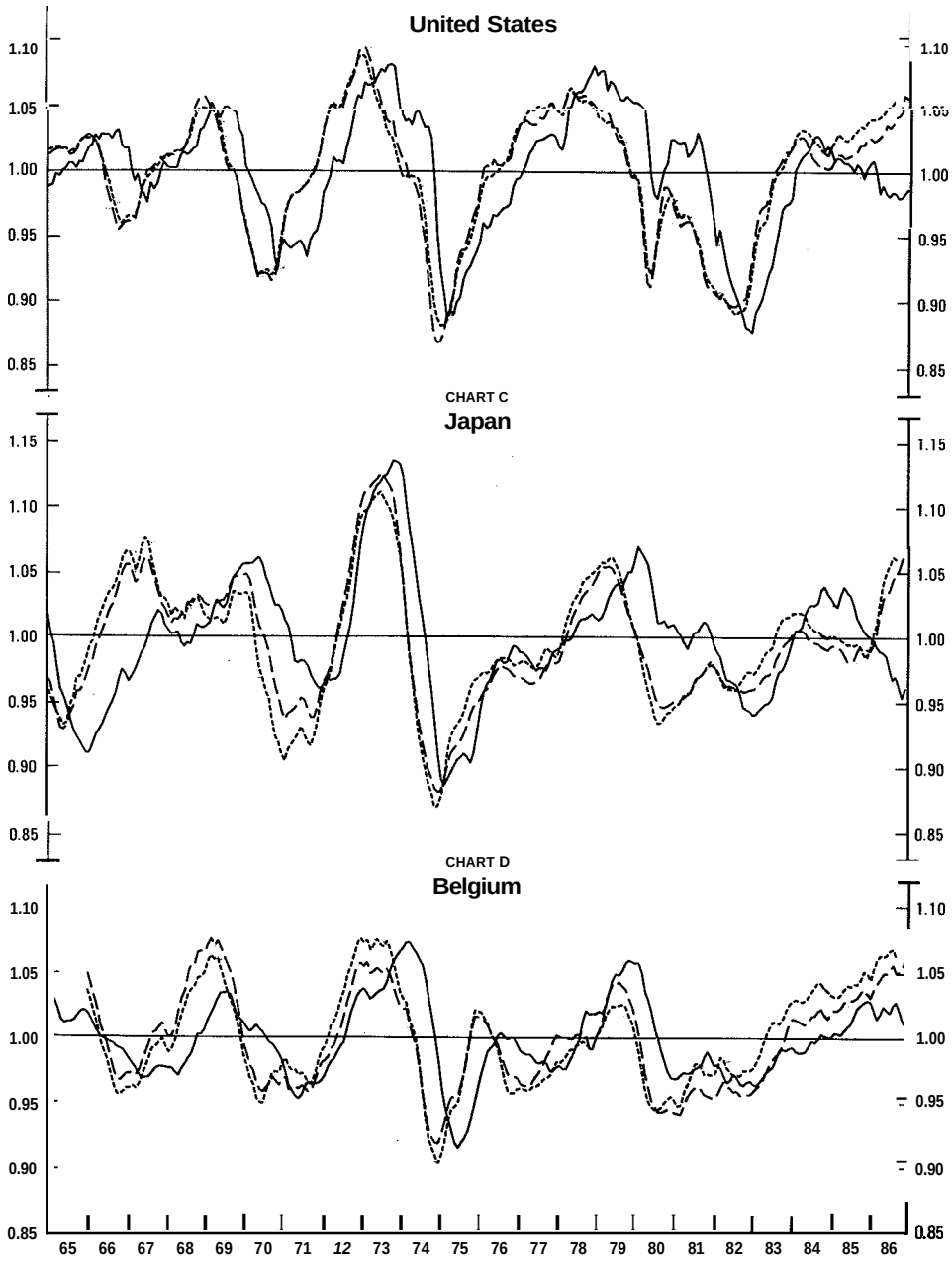


CHART E

COMPARISON BETWEEN FINAL AND INCOMPLETE INDICATORS AND REFERENCE SERIES

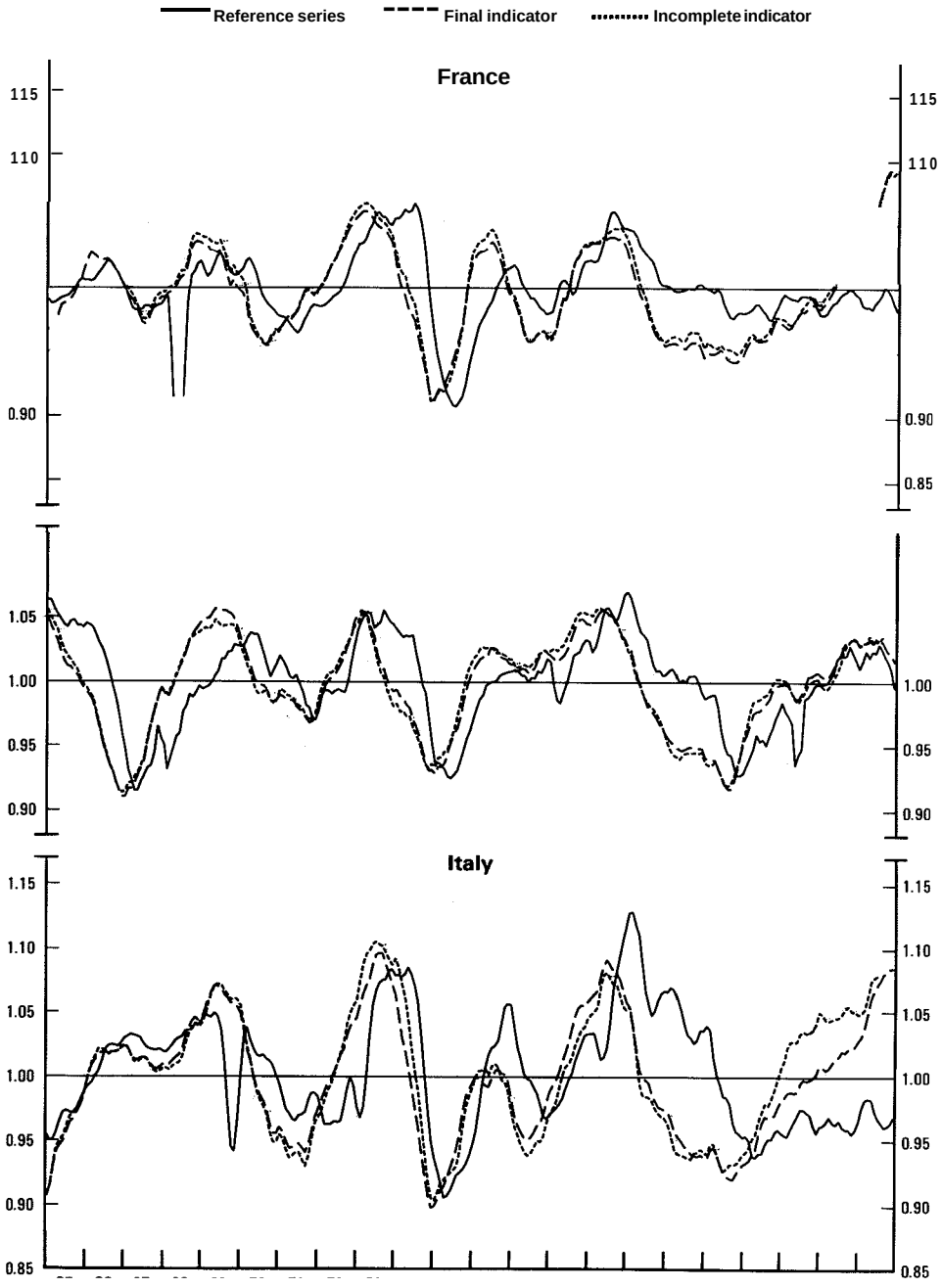


CHART H

COMPARISON BETWEEN FINAL AND INCOMPLETE INDICATORS AND REFERENCE SERIES

Reference series — Final indicator ---- Incomplete indicator ••••••••••

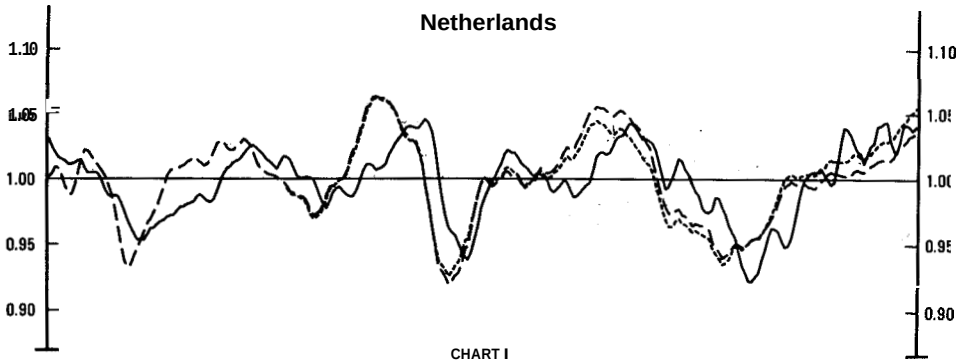


CHART I

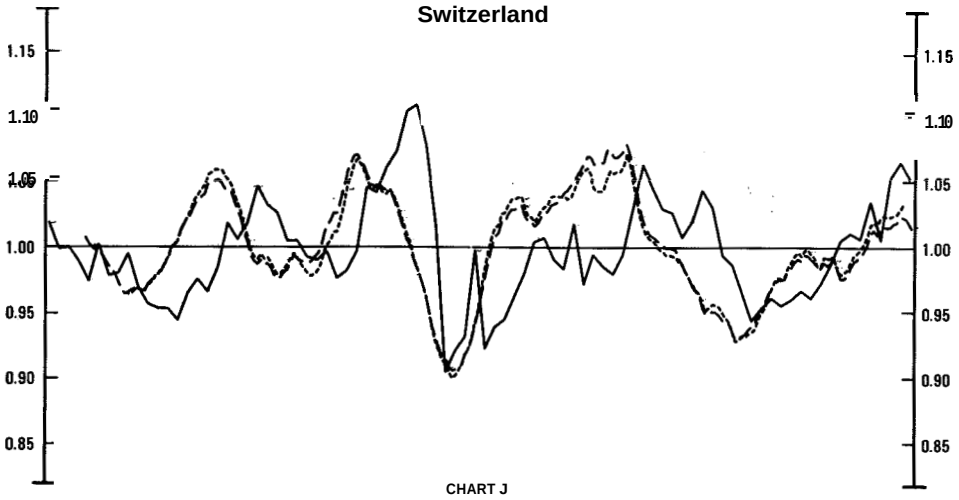


CHART J

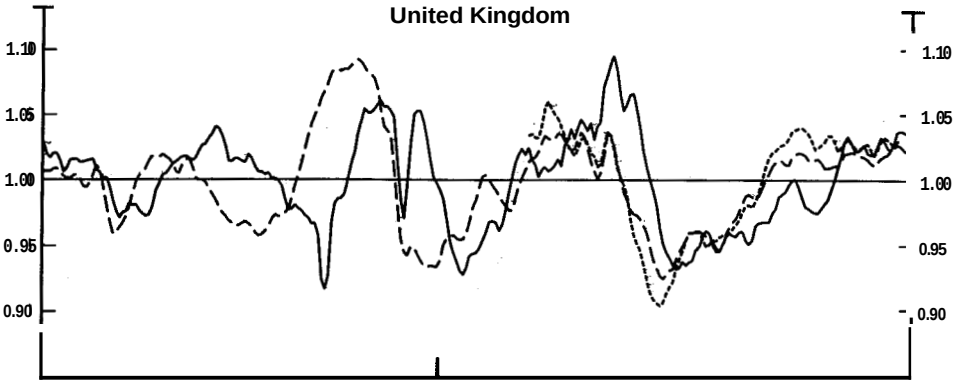


CHART K

COMPARISON BETWEEN FINAL AND INCOMPLETE INDICATORS AND REFERENCE SERIES

Reference series Final indicator Incomplete indicator

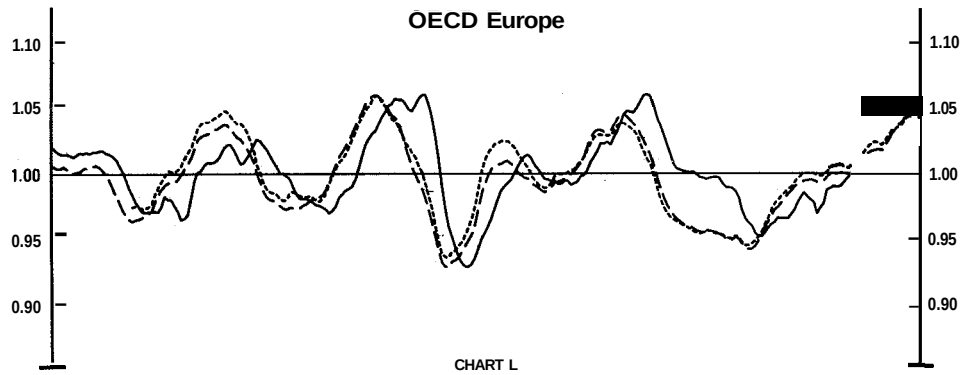


CHART L

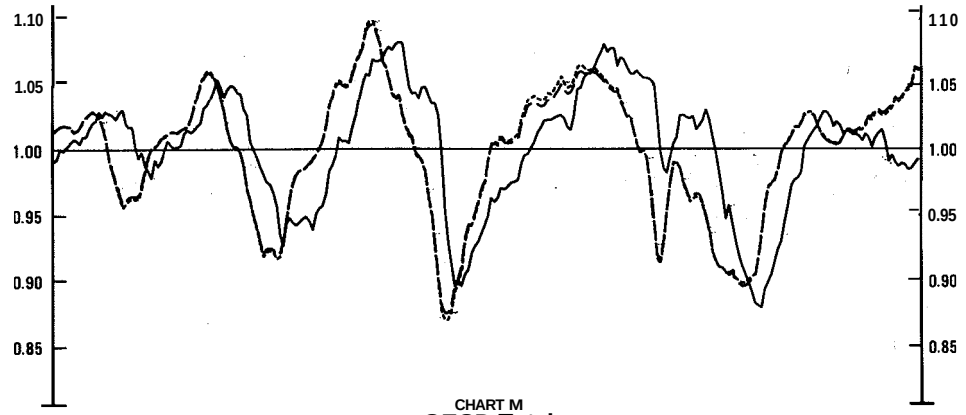


CHART M

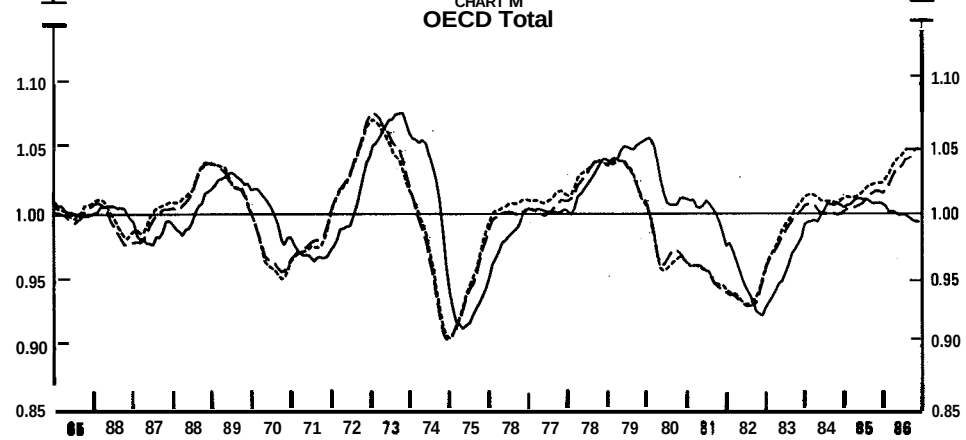


Table 5. Performance of incomplete composite indicator and final version

	Period covered	Final composite indicator		Incomplete composite indicator	
		Cross-correlation		Cross-correlation	
		Lag	R^2	Lag	R^2
United States	1959-Sept 1986	–7	0.86	-6	0.84
Japan	1960-Sept 1986	-6	0.86	-6	0.80
Belgium	1966-Jul 1986	-6	0.81	-6	0.82
France	1967-Aug 1986	–7	0.73	-4	0.74
Germany	1963-Aug 1986	–8	0.88	–8	0.88
Italy	1963-Jul 1986	-6	0.71	–5	0.60
Netherlands	1971-Aug 1986	-6	**0.84**	–7	0.87
Switzerland	1967-Jun 1986	–11	0.72	–11	0.70
United Kingdom	1977-Aug 1986	–9	0.90	–9	0.87
OECD-Europe	1967-Aug 1986	–7	0.90	–7	0.85
North America	1955-Sept 1986	-6	0.86	-6	0.86
OECD-Total	1963-Aug 1986	–7	0.93	–7	0.90

the different versions of the composite indicators and the reference series as a guide to their performance, both as regards lead at turning points and closeness of fit. In general, there seem to be no large differences between the different versions of the composite indicators. In terms of average lead, the difference is at most one month. The closeness of fit, as measured by the cross-correlation coefficient, is very similar between the different versions of the composite indicators, with the exception of Italy. For Italy, this difference is due partly to the fact that the first-available components have a lower cross-correlation than average. Further information about the performances of the incomplete composite indicator is presented in Tables 6 and 7.

Table 6 shows the revision to month-to-month percentage changes between final and incomplete composite indicators. The measure given is the mean absolute revision. The mean revision is within the range of 0.1 to 0.2 percentage points for all countries and zones with the exception of the United Kingdom. The larger average revision of **0.3** percentage points for the United Kingdom can be explained by the fact that only half the number of components is used in the incomplete indicator and the shorter timespan available for the evaluation. The distribution of the revisions with respect to the size of revision shows that approximately 70-95 per cent of the revisions are below 0.2 percentage points for all countries and zones, again with the exception of the United Kingdom.

Large revisions, above 0.5 percentage points, are not common. France, the Netherlands and Switzerland have no revisions above this range, and OECD-Europe

Table 6. Revisions to month-to-month percentage changes between final and incomplete composite indicator

	Period covered	Mean absolute revision	Percentage of revisions in range		
			→ 0.2	0.3-0.5	0.6 →
United States	1959-Sept 1986	0.2	74.3	20.5	5.2
Japan	1960-Sept 1986	0.2	67.3	26.7	6.0
Belgium	1966-Jul 1986	0.1	71.6	24.7	3.7
France	1967-Aug 1986	0.1	94.1	5.9	0.0
Germany	1963-Aug 1986	0.1	89.3	9.3	1.4
Italy	1963-Jul 1986	0.2	71.8	21.7	6.5
Netherlands	1971-Aug 1986	0.1	97.9	2.1	0.0
Switzerland	1967-Jun 1986	0.1	88.3	11.7	0.0
United Kingdom	1977-Aug 1986	0.3	43.9	40.3	15.8
OECD-Europe	1967-Aug 1986	0.1	96.6	3.0	0.4
North America	1955-Sept 1986	0.2	72.8	21.4	5.8
OECD-Total	1963-Aug 1986	0.1	96.4	3.2	0.4

Table 7. Frequency of change in signs in growth rate[1] between final and incomplete composite indicator

	Period covered	Frequency of change in sign at					
		All differences		Major differences at percentage points			
				above ± 1		above ± 2	
		Absolute	Per cent	Absolute	Per cent	Absolute	Per cent
United States	1959-Sept 1986	16	4.9	13	4.0	7	2.1
Japan	1960-Sept 1986	24	7.6	70	6.3	13	4.1
Belgium	1966-Jul 1986	26	10.7	21	8.6	8	3.3
France	1967-Aug 1986	10	4.2	3	1.3	0	0.0
Germany	1963-Aug 1986	18	6.5	9	3.2	1	0.4
Italy	1963-Jul 1986	14	5.1	10	3.6	7	2.5
Netherlands	1971-Aug 1986	7	3.7	0	0.0	0	0.0
Switzerland	1967-Jun 1986	13	5.6	10	4.3	7	3.0
United Kingdom	1977-Aug 1986	18	16.7	14	13.0	9	8.3
OECD-Europe	1967-Aug 1986	15	6.5	7	3.0	3	1.3
North America	1955-Sept 1986	17	5.2	14	4.3	8	2.4
OECD-Total	1963-Aug 1986	8	2.8	1	0.4	0	0.0

1. Measured by 6-month changes at annual rate.

and OECD-Total are close to zero, with only 0.4 per cent of the revisions above 0.5 percentage points.

Table 7 shows the frequency of change in sign in growth rate, measured by six-month changes at an annual rate, between final and incomplete composite indicators. The change in sign is given both for all differences and for major differences. Two limits are used to define major differences: one counting changes in sign only in cases of differences above (above ± 1 percentage point between final and incomplete composite indicators, the other set at ± 2 percentage points.

The frequency of change in sign of all differences is in the range of **3** to 6.5 per cent for all zones and countries with the exception of Japan, Belgium and the United Kingdom. Japan is slightly outside this range with 7.6 per cent, and Belgium has a relatively high figure of 10.7 per cent. The only extreme figure, 16.7 per cent, is that for the United Kingdom. This figure can, however, be explained by the same reasons as above concerning the size of the average revision for the United Kingdom. A better performance is obtained at differences above ± 1 percentage point. The frequency drops by around 1 to **3** percentage points for all countries and zones. The frequency of differences above ± 2 percentage points gives a much improved performance, with figures in the range of 0 to 4 per cent for all countries and zones with the exception of the United Kingdom. France, the Netherlands and OECD-Total have zero frequencies, and Germany is close to zero at 0.4 per cent.

This exercise shows that the first-published incomplete indicators give information which in most cases is not revised later. This holds both for the timing of turning points and the evolution over the whole cycle.

C. Predicting turning points

The above review of the historical and current performance of the composite leading indicators is reasonably reassuring, although the fact remains that it is imprudent to read too much into one or two months' figures. This section considers how the composite indicators can be used to predict a turning point. The measures calculated for the composite indicators concerning average lead and variability of lead give only a broad guide to this question. It is difficult to detect a turning point in advance with only the help of the composite indicator itself, and several derived measures are usually used for this purpose. The following derived measures are considered:

- The one-month percentage change of the amplitude-adjusted composite leading indicator;

- The six-month percentage change at annual rate of the amplitude-adjusted composite leading indicator and the reference series itself;
- The so-called "straight pressure ratio", which is the simple ratio of the composite leading indicator to the reference series;
- The "percentage change pressure ratio", which is calculated by expressing the six-month percentage changes of the composite leading indicator and reference series as differences from **100** per cent (to take care of problems of discontinuities caused by sign changes and division by zero) and taking the ratio.

All these measures give advance warning of impending approaching cyclical turning points. The percentage change series display turning points about six months ahead in the case of regular well-behaved symmetrical cycles, but may not do so when the original series has skewed cycles and sub-cycles. The straight pressure ratio adds about 50 per cent to the lead time of the composite indicator, and is a measure of the extent to which the composite leading indicator has out-stripped the reference series. The percentage change pressure ratio is a measure that combines the effect of the percentage change series and the straight pressure ratio.

Charts N to Q illustrate the evolution of these measures (except the one-month change) for the major OECD zones and Japan, which is treated as a zone in itself. The detrended composite leading indicators and the reference series are also shown.

The usual method of deciding if a peak (trough) in the reference series has occurred is to examine the composite index to see if it has been above (below) its previous high (low) for a specified number of months. This approach will work well if the composite index is smooth and not subject to large revisions. Revisions and random movements do, however, affect the composite index. To take care of this as far as possible, the following rules have been adopted for the calculations of growth cycle signals based on the above measures. For the six-month percentage change series, as well as the pressure ratios, a peak signal is indicated when the change or ratio goes below minus **1** per cent, and a trough signal when the change or ratio goes above plus **1** per cent. **For** the one-month percentage change series a three-month rule is applied, that is, a peak (trough) signal is indicated when the change is below (above) zero for the third consecutive month. In practice, over the period from **1960** to **1983,** all these derived measures, except the straight pressure ratio, have succesfully predicted all cyclical turning points, although as noted below, they have also provided a number of false signals – indications of approaching peaks and troughs that in the event did not materialize.

The results presented in Table 8 show the median lead at cyclical turning points in the reference series for all derived measures during the period, normally starting

CHART N

OECD TOTAL

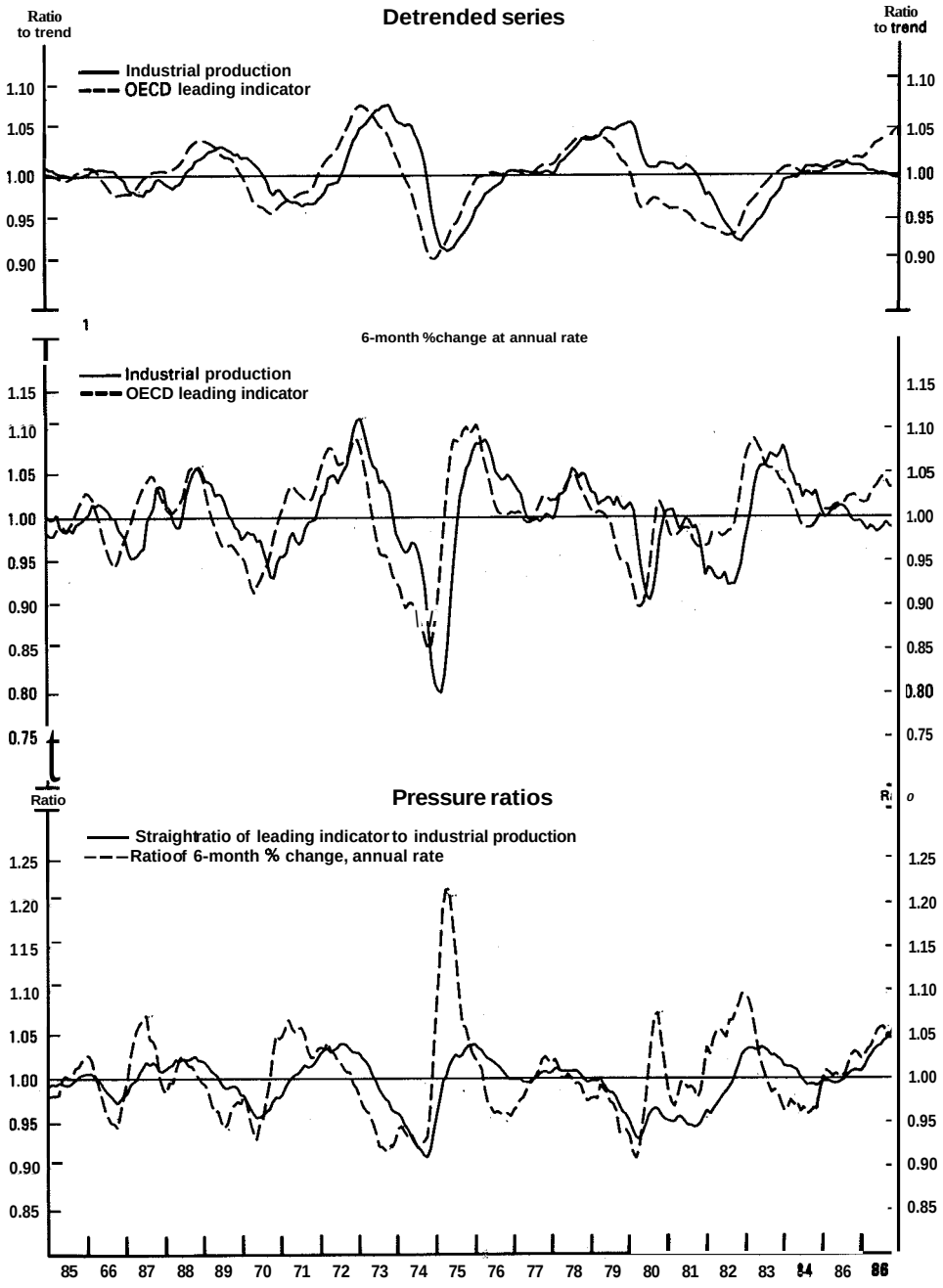


CHART θ

OECD EUROPE

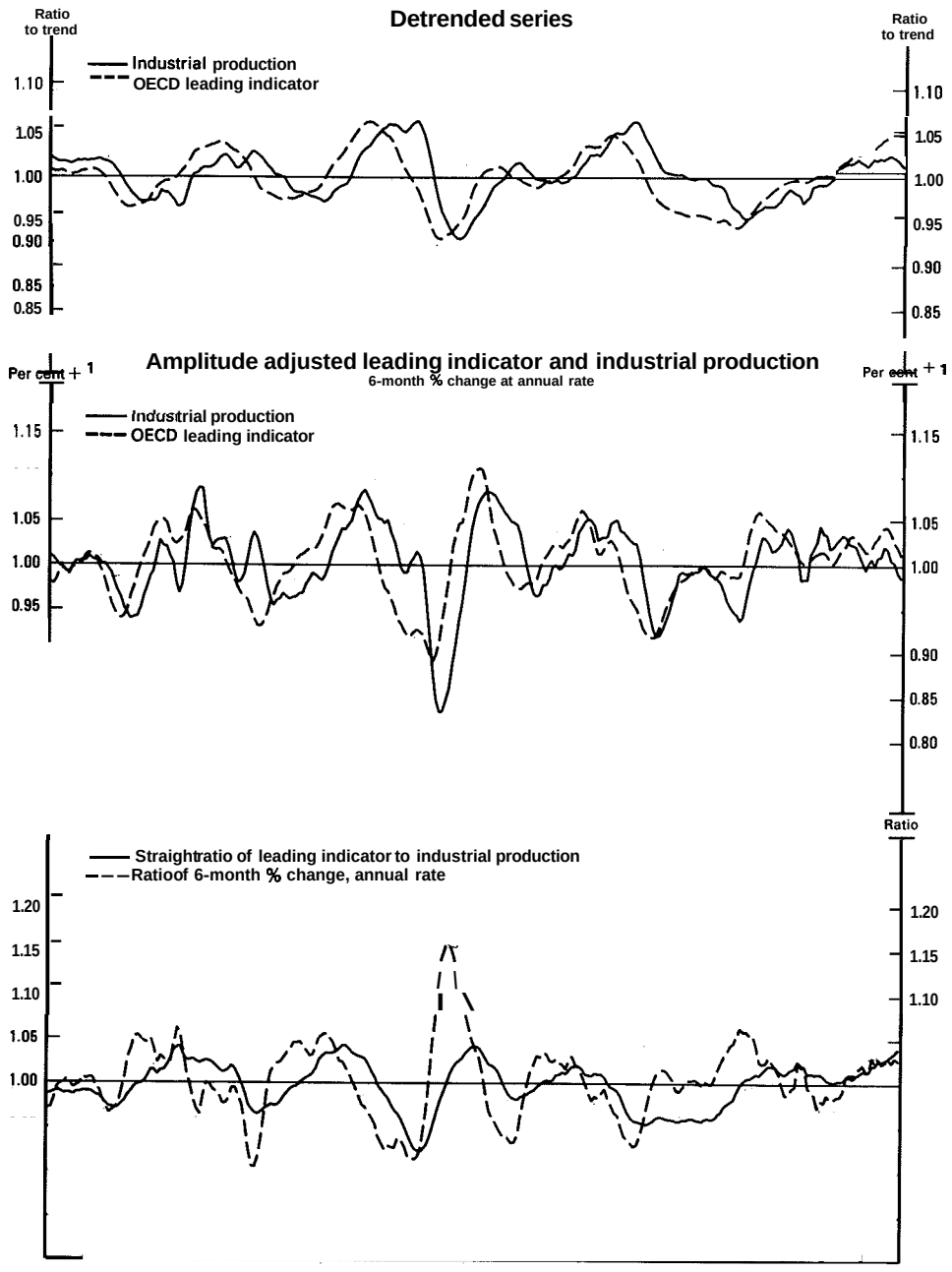


CHART P

NORTH AMERICA

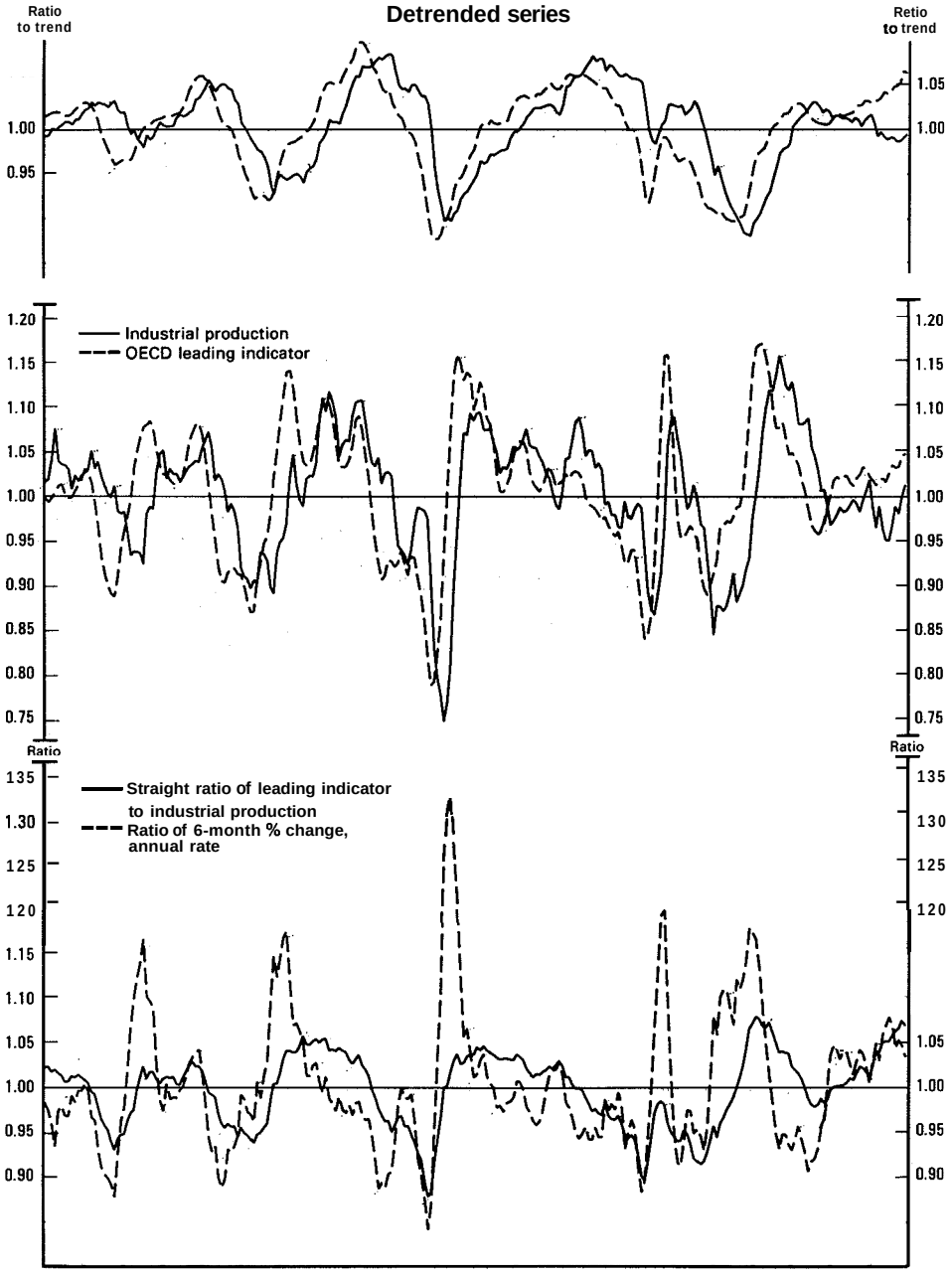


CHART a

JAPAN

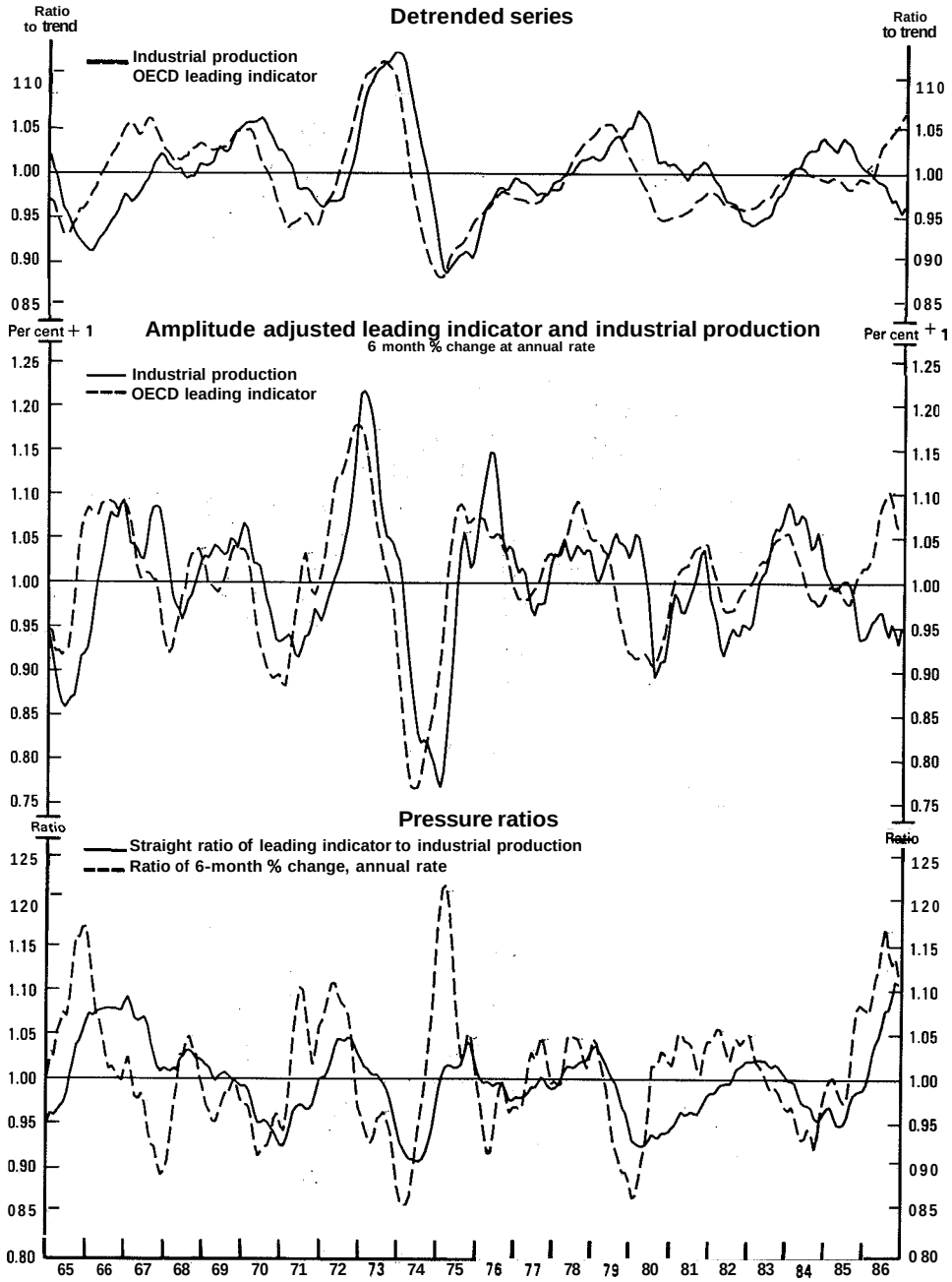


Table 8. Median lag, in months, of derived measures for leading indicators (LI) and industrial production (IP) used to signal cyclical peaks and troughs

	Period Covered	Peaks signals Median lag (+)					Trough signals Median lag (+)				
		1-month % changes in LI	6-month % changes in LI[1]	Straight pressure ratio[2]	Percentage change pressure ratio3	6-month % changes in IP[1]	1-month % changes in LI	6-month % changes in LI[1]	Straight pressure ratio[2]	Percentage change pressure ratio3	6-month % changes in IP[1]
Canada	1959-1982	-3	-1	-1	-8	t5	-3	-4	-2	-8	t3
United States	1960-1982	-5	-4	-3	-6	t2	-1	0	-1	-2	t4
Japan	1962-1983	-2	-1	-3	-8	t4	-2	tl	-1	-4	t4
Australia	1966-1983	t3	+2	+1	-7	0	-1	0	-4	0	t5
Austria	1965-1982	-3	-3	-1	-9	t4	-1	0	t4	-5	t4
Belgium	1967-1982	-1	-1	-1	-5	t4	-6	-4	-1	-8	t4
Luxembourg	1963-1982	-3	-3	+1	-2	t2	-1	-1	-3	-4	t5
Denmark	1970-1982	-7	-7	-1	-5	t5	-2	0	-1	-3	t5
Finland	1962-1982	-7	-5	-2	-6	t3	-3	-4	+1	-4	t4
France	1963-1982	-2	0	+1	-8	t5	-3	-1	t5	-5	t5
Germany	1963-1982	-3	-2	-1	-10	t5	-2	0	0	-8	t4
Greece	1965-1983	-5	-4	-1	-9	t5	-6	-5	-2	-6	t4
Ireland	1966-1982	-3	-2	-1	-4	t4	-2	0	-4	-3	+2
Italy	1965-1983	t2	+1	+1	-7	t6	-3	-1	t2	-6	t4
Netherlands	1963-1982	0	0	0	-11	t4	-4	-3	0	-5	t4
Norway	1974-1982	-5	-4	-2	-6	+3	-2	-1	+1	-3	t5
Portugal	1969-1982	t2	t2	-3	t2	t4	t2	t3	-5	-3	t4
Spain	1965-1982	-3	-4	0	-7	t4	-5	-3	-2	-7	t4
Sweden	1961-1982	0	+1	t2	-7	t4	-6	-7	-1	-9	t5
Switzerland	1968-1982	-6	-6	-3	-10	t5	-9	-9	-2	-10	t5
United Kingdom	1960-1981	-2	-7	-6	-15	t3	-7	-6	-2	-12	t3
Yugoslavia	1962-1984	t4	-5	-1	-8	t5	-2	+1	-1	-8	t3
OECD-Europe	1964-1982	-3	-4	-2	-12	t4	-2	0	+1	-8	t5
North America	1960-1982	-3	-2	-1	-6	t5	+1	0	-1	-2	+4
OECD-Total	1961-1982	-2	0	t3	-5	t5	-2	0	-1	-4	t5

1. 6-month percentage change at annual rate in amplitude adjusted series.
2. Straight ratio of leading indicator to industrial production.
3. Ratio of 6-month percentage change, annual rate.

Table 9. Number of extra (x) or missing(m) growth cycle signals in leading indicators (LI) and industrial production (IP)

	Peak signals										Through signals									
	1-month % changes in LI		6-month % changes in LI[1]		Straight pressure ratio[2]		% change pressure ratio[3]		6-month % changes in IP[1]		Number of reference turning points[4]	1-month % changes in LI		6-month % changes in LI[1]		Straight pressure ratio2		% change pressure ratio)		6-month % changes in IP[1]		Number of reference turning points[4]
	x	m	x	m	x	m	x	m	x	m		x	m	x	m	x	m	x	m	x	m	
Canada,						2	2		3		8						2	2		3		8
United States				1		3	2	1	1		8				1		2	2	1	1		8
Japan						2		1			8						2		1			8
Australia						1	3		3		6						1	3		3		6
Austria						1	3		4		5							3		4		5
Belgium			2				2		1		4			2				2		1		5
Luxembourg			1		3		10		3		5			1		3		10		3		6
Denmark		1	1		1	1	3		3		5		1	1		1	1	3		3		5
Finland					3		6		4		6					3		6		4		6
France							1				6							1				7
Germany						1	1				5						1	1				6
Greece							5		4		5							5		4		6
Iceland		1	1		2	1	6		4		4			1		2	1	6		4		5
Italy			1				3		4		5			1				3		4		6
Netherland			1		1		2				5			1		1		2		1		6
Norway							1				4							1				4
Portugal			3		2	1	4		5		4			3		3	2	4		5		5
Spain			1			2	4		5		6			1			2	4		5		6
Sweden			1			1	2		4		6			1			1	2		4		6
Switzerland					1	1	4		3		4					1	1	4		3		5
United Kingdom			1		1		4		1		5			1		1		4		1		5
Yugoslavia			6			1	7		3		5			6		1	3	7		3		6
OECD-Europe							1				5							1				5
North America		1		1		2	2				8				1		3	2				8
OECD-Total				1		3	1			1	8						2	1			1	9

x = Extra signals
m = Missing signals.
1. 6-month percentage change at annual rate in amplitude adjusted series.
2. Straight ratio of leading indicator to industrial production.
3. Ratio of 6-month percentage change, annual rate.
4. Growth cycle turning points in industrial production.

between 1960 and 1965 and ending in 1982 or 1983 for most countries and zones. The median lead is reasonably long for the percentage change pressure ratio, and fairly good for the other three measures for most of the countries and zones. Even if the median leads do not seem to be very long or are actually lags in some cases, they should be compared with the median lead for the six-month percentage change in the reference series, because this series shows the earliest confirming signal for a turning point. In the case of Italy, for example, the one-month percentage change series actually lagged the peak turning points in industrial production by two months on average throughout the period, but the signals produced by this measure were, on average, still available four months before the turning point could have been confirmed from the behaviour of the industrial production index itself.

Table 8 provides evidence of the ability of the derived measures to indicate approaching turning points and to confirm them. The measures did, however, produce a number of extra or missing turning points over the same period, as can be seen from Table 9. Missing turning points are most frequent in the straight pressure ratio, which is the most stable measure and signals only major cyclical changes. None of the other measures failed to signal any major turning point. A more frequent problem is the number of extra turning points. The percentage change pressure ratio indicates the most number of extra turning points, closely followed by the one-month percentage change series. The reference series itself, on a six-month basis, indicates also a large number of extra turning points, which underscores the difficulty in obtaining reliable current confirmation of turning point signals. The best record concerning extra turning points is shown by the six months percentage change measure. This measure did not indicate any extra turning points for the zones or for most of the major countries.

Given the problems with extra and missing signals, all derived measures must be used with care. They all give, however, some information about approaching or current turning points, and in combination they can be used to monitor the cyclical development.

D. Using the indicators

The results suggest the following guidelines as to how the measures can be used to signal approaching and current turning points. In a normal case, the signals will appear sequentially in the following order: the first signal will turn up in the percentage change pressure ratio, followed by a second signal in the leading indicator, on a six-month basis and/or in the leading indicator on a one-month basis. A third signal will then turn up in the straight pressure ratio, and finally, the turning point will be confirmed by a signal in the reference series, on a six-month basis.

SIGNALS FOR THE 1982 TROUGH FOR THE UNITED STATES

CHART R

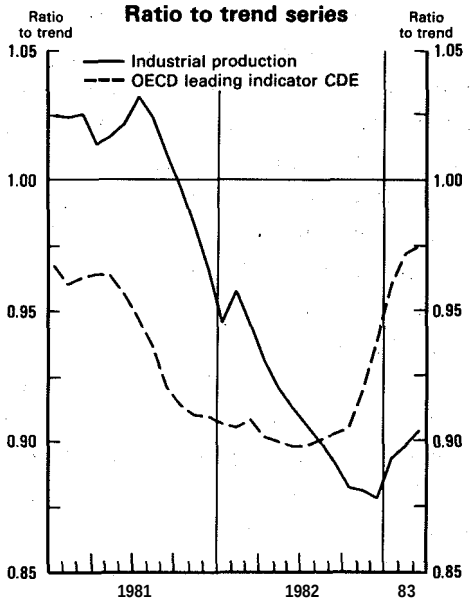


CHART T

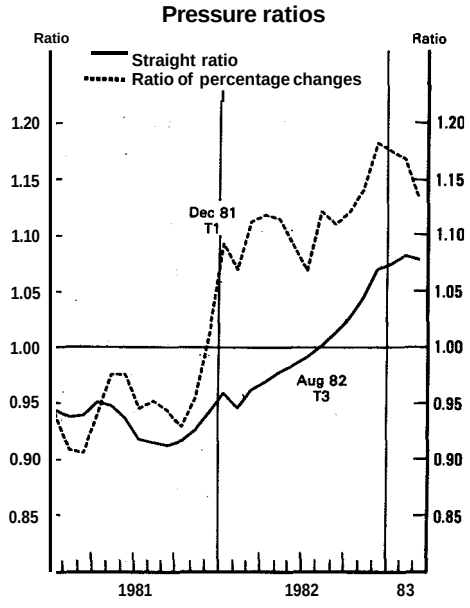


CHART S

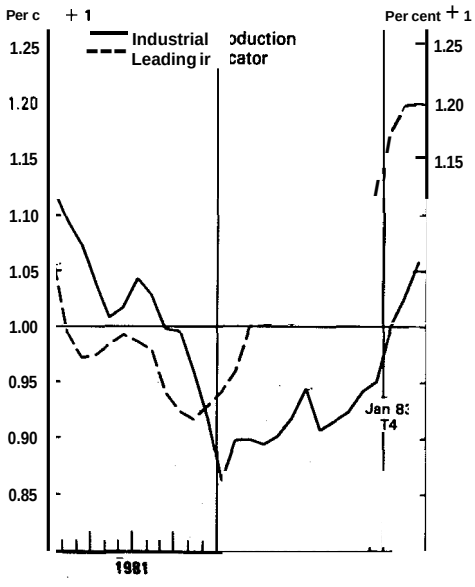
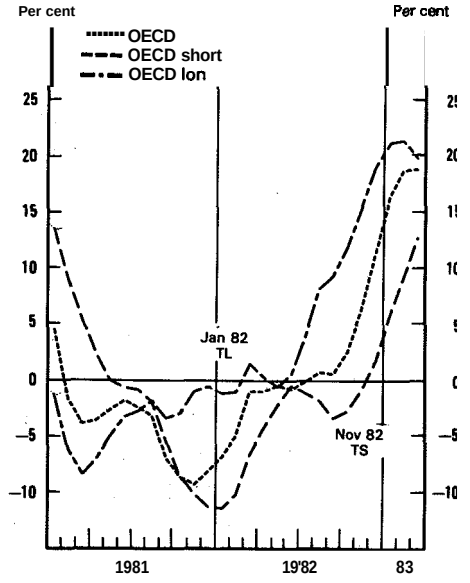


CHART U



If the first signal turns up in the percentage change pressure ratio, it should, however, not be considered as a definitive signal until it is followed by a second signal in the leading indicator, on a six-month basis. This rule should be used for a majority of the countries, especially the smaller ones.

The same rule as above will govern the second signal, if it first turns up in the leading indicator on a one-month basis. This signal should not be taken as definitive unless it is closely followed, within one to two months, by a signal in the leading indicator on a six-month basis.

If the second signal, announced by the leading indicator on a six-month basis, is followed by a third signal in the straight pressure ratio, then it is almost certain that a major turning point is coming.

Charts R to U illustrate how the system worked for the last trough in November 1982 for the United States. The first signal (T1) appeared in the percentage change pressure ratio in December 1981, a lead of eleven months (Chart U). A second signal (T2) turned up in the leading indicator on a six-month basis in June 1982, a lead of five months (Chart S). The third signal (T3) showed up in the straight pressure ratio in August 1982, a lead of three months (Chart T). Finally, the trough was confirmed by a signal (T4) in the reference series in January 1983, a lag of two months (Chart S).

In all, the system gave a sequence of turning point signals ranging from eleven to three months in advance of the trough in November 1982 (Chart R), which was confirmed by the reference series in January 1983.

In the case of the United States, additional signals could have been obtained from the "longer-leading" and "shorter-leading" composite indicator versions. The longer-leading indicator showed a trough signal (TL) in January 1982, a lead of ten months (Chart U). The shorter-leading indicator (TS) confirmed the trough in November 1982, coinciding with the later defined trough at that date (Chart U).

E. Forecasting short-term changes

The main objective of the OECD leading indicators system is, as noted above, to predict cyclical turning points, but the system was designed also to forecast changes in the reference series at all stages of the cycle. To test the performance of the leading indicators in this latter role, two forecast simulations have been carried out, and the results are presented in this section.

The first simulation uses the percentage change in the annual level of the composite leading indicators to forecast the change in the index of industrial production in the following six months. This forecast is based on the values of the composite leading indicators up to June each year, which are then used to forecast

the change in the index of industrial production from July to December. In other words, the average level of the leading indicator series is calculated for the two consecutive twelve-month period, July $(n-1)$ to June (n) and July (n) to June $(n+1)$. The growth rate between the average levels in the two periods is then used to forecast the change in the industrial production index from July to December $(n+1)$.

This is a fair test in so far as the OECD leading indicators are designed to lead the reference series by about six months on average, but it is also an unrealistic one. In practice, at a given moment – such as the middle of June – the leading indicator series will be available for most countries only up to March or April. An alternative and more realistic simulation has, therefore, also been carried out in which the data actually available at a given date – in this case mid-December – are used to forecast the change in industrial production for the coming twelve months. Specifically, the change between year $n-1$ and year n in the average level of the composite indices in the three months July to September is used to forecast industrial production in year $n+1$. This is a much more ambitious test than the previous one, and it is also an unfair one in the sense that the changes in the level of the composite index between July/September of successive years can legitimately be used to predict changes only in industrial production in the first quarter of the succeeding year, and not in the whole year as is attempted here. Not unnaturally, the composite indicators perform better in the first test than in the second, but in both they perform substantially better than a naive forecasting model, used as the bench-mark, which simply extrapolates the past growth rates of industrial production into the future.

The simulations are restricted to the major OECD contries and zones which, except for the United Kingdom, all have an average lead of approximately six months. In the case of the United Kingdom, whose indicators lead by twelve months, only the second simulation has been attempted.

Table 10 shows the mean absolute error for these two forecasts and for the forecast based on the naive model. The first forecast, with a six-month horizon, produces a mean absolute error in the range of 0.7 to 1.4 percentage points for the zones and below 2 percentage points for all major countries except Italy and Japan. The second forecast, which gives an estimate for the future twelve months, has higher mean absolute errors, but they are still below 2 percentage points for all zones except North America, and there are no errors above 2 percentage points for any major country. The naive model produces forecast errors that are substantially larger.

The correlation between forecasts and actual changes are also shown in Table 10. The size of the correlation coefficents indicates that the forecasts based on the composite indicators have been predicting the evolution of the reference

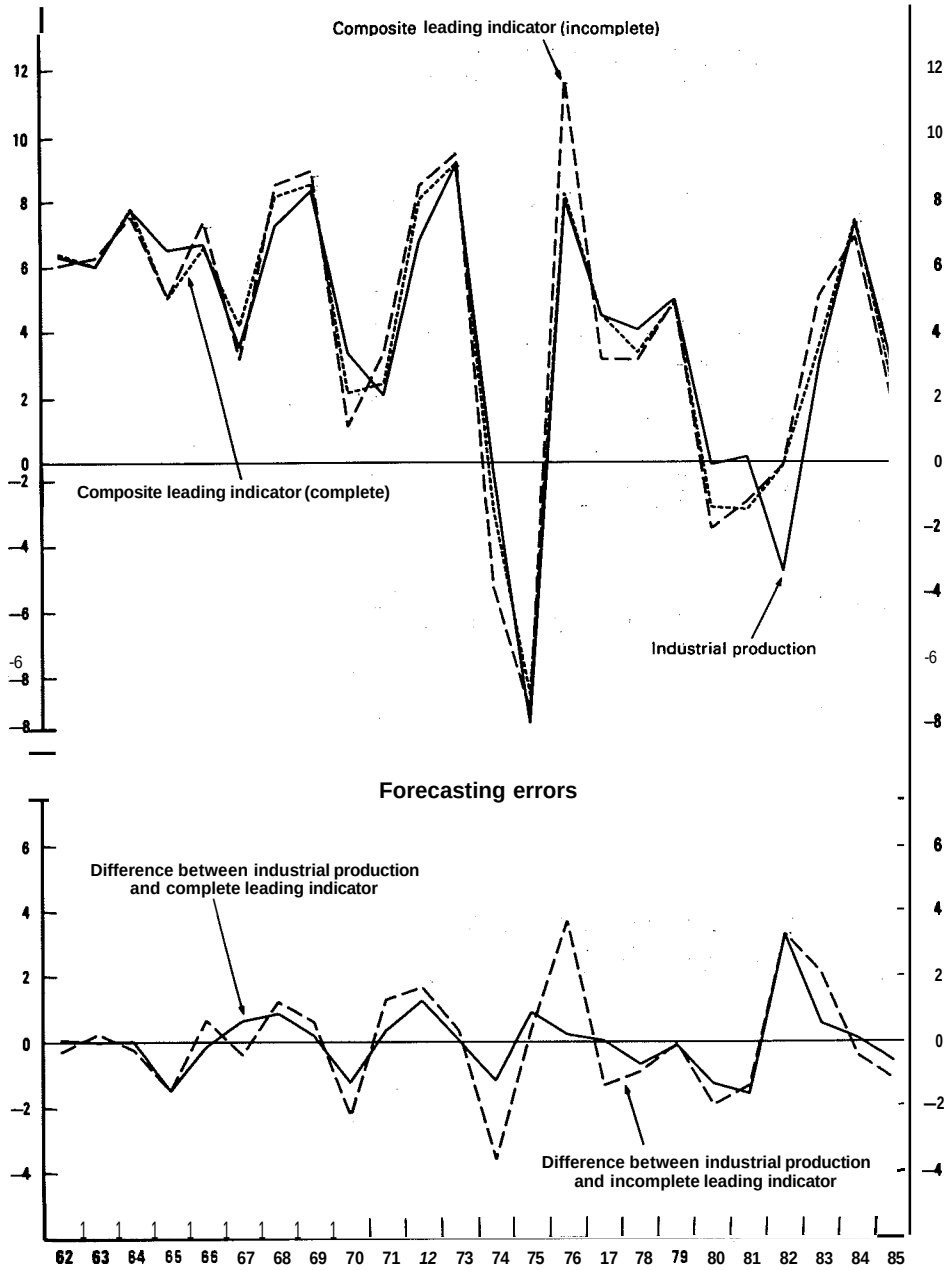
Table 10. Forecasts of annual percentage changes in industrial production (IP)

	Period covered	Mean absolute error			Correlation coefficient, forecast and actual change			Standard deviation industrial production growth rate
		First simulation June and complete data[1]	Second simulation December and incomplete data[2]	Naive extrapolation of IP	First simulation June and complete data	Second simulation December and incomplete data	Naïve extrapolation	
Canada	1975-1985	1.19	1.97	4.87	0.94	0.91	0.13	4.56
United States	1957-1985	1.41	2.46	6.05	0.95	0.89	0.01	5.54
Japan	1962-1985	2.11	2.71	6.46	0.93	0.90	0.31	6.96
France	1964-1985	1.89	2.84	4.15	0.90	0.81	0.07	4.37
Germany	1964-1985	1.38	2.08	4.54	0.94	0.91	0.23	4.61
Italy	1965-1985	2.67	3.00	5.27	0.86	0.87	0.00	5.17
United Kingdom	1961-1985	..	1.58	3.28	..	0.82	0.12	3.65
North America	1957-1985	1.35	2.38	5.89	0.95	0.89	0.02	5.40
Major European	1965-1985	1.14	1.77	3.77	0.93	0.87	0.12	3.79
Major Seven	1962-1985	0.75	1.37	3.83	0.97	0.93	0.17	4.24
EEC	1964-1985	1.04	1.61	3.62	0.94	0.89	0.18	3.84
OECD-Europe	1964-1985	1.01	1.58	3.48	0.94	0.89	0.21	3.72
OECD-Total	1962-1985	0.72	1.34	3.65	0.97	0.93	0.19	4.08

1. The change between year $n-1$ and year n in the average level of the composite indicator in the three months July to September is used to forecast industrial production in year $n+1$.
2. The growth rate between the average levels in two consecutive twelve-month periods, July to June $(n+1)$ is used to forecast the change in industrial production from July to December $(n+1)$.

CHART V

FORECASTED AND ACTUAL YEARLY CHANGES IN INDUSTRIAL PRODUCTION FOR OECD TOTAL



series successfully. By contrast, the correlation coefficient for the naive model is very low.

Actual and forecast changes for the whole OECD area are plotted in the upper panel of Chart V; and the forecasting errors in the lower panel. The forecasts track the changes fairly well, considering the variation in the series, as measured by the standard deviations given in the last column of Table 10. The first forecast, based on a complete set of data, shows only one major forecasting error – in 1982. This error is due presumably to the fact that the composite index remained constant instead of decreasing during the period 1981 to mid-1982. The second forecast, giving an estimate for the coming year, produced three major forecasting errors – in 1974, 1976 and 1982. The first two of these errors are explained by the events following the first oil shock.

NOTES

1. The method is described in Boschan and Ebanks (1978).
2. Described in Boschan and Bry (1971).
3. Months for Cyclical Dominance. MCD is defined as the shortest span of months for which the I/C ratio is less than unity. I and C are the average month-to-month changes without regard to sign of the irregular and trend-cycle component of the series, respectively. Although I remains approximately constant as the span of months increases, C should increase, hence the I/C ratio, itself a measure of smoothness, should decline, and eventually become less than unity. In practice, there are some series for which the I/C ratio at first declines as the span in months increases, and then starts to increase again without ever having dropped as low as 1. Hence, there is a convention that the maximum value of MCD should be six. For quarterly series there is an analogous measure, Quarters for Cyclical Dominance (QCD), which has a maximum value conventionally defined as 2.

Annex: Table A. Reference Gross domestic

	P	T	P	T	P	T	P	T	P
Canada			1/60	(1/61	1/62)	2/63			1/66
United States			1/60	(1/61	1/62)	1/63	(1/64	4/64)	1/66
Japan				2/60	4/61	4/62	2/64	4/65	
Australia			3/60	3/61			4/64	(2/66	1/67)
New Zealand				1/62					3/66
Austria			1/61			1/63	4/64	(2/65	1/66)
Belgium					62)	63	64		
Luxembourg					61)	63	64		
Denmark					62	63	64		
Finland					61	63	65		
France					(62	1/63)	3/63	1/65	3/66
Germany			1/61	(3/61	1/62)	1/63			1/66
Greece					61	62			65
Iceland				61					66
Ireland					(61	621	64	66	
Italy				4/60)	(4/61	1/63)	1/64	1/66	
Netherlands			2/60			1/63	1/65		
Norway*	(73	741			61	63	(65	66)	67
Portugal				61	(62	63)	65	66	68
Spain					63			(65	66)
Sweden			(61	621			64		
Switzerland							64		
Turkey				61			63	65	66
United Kingdom					1/61	1/63	4/64	3/66	
Big Four Europe				2/60	1/61	1/63	2/64		
Major Seven				(4/60	4/61)	1/63	(1/64	4/64)	1/66
EEC				2/60	1/61	1/63	2/64		
OECD-Europe				2/60	1/61	1/63	2/64		
North America	4/55	1/58	1/60	(1/61	1/62)	1/63	(1/64	4/64)	1/66
OECD-Total			1/60	(4/60	4/61)	1/63	(1/64	3/65)	1/66

P = Growth cycle peak.
T = Growth cycle trough.
0 = Turning points of minor cycles.

chronologies 1960-84
product

T	P	T	P	T	P	T	P	T	P	T
1/68	1/69	4/70	1/74	2/75	(2/76	2/77)	(3/79	3/80)	2/81	4/82
2/67	1/69	4/70	1/73	1/75			4/78	(3/80	1/81)	4/82
	4/69	4/71	1/73	1/75			1/80			1/83
4/67	4/68	3/72	4/73	(4/75	4/76)	4/77	(1/79	1/80)	3/81	2/83
3/68	4/69	2/71	4/73	(1/76	3/76)	1/78	(1/79	3/80)	(3/81	2/82)
1/69	3/70	4/71	1/74	2/75	(2/77	1/78)	1/80			1/83
68	70	71	74	75	(76	77)	80			83
67	69	71	74	(75	76)	77	80			83
68	69	71	73	75	(77	78)	79			81
68	4/70	4/71	4/73	(1/76	4/76)	3/78	3/80			1/83
4/67	3/68	1/71	1/73	2/75	(1/77	4/77)	3/79	(1/81	4/81)	2/84
3/67	4/69	4/71	1/73	1/75	(1/77	3/77)	1/80			2/84
68	69	71	73	3/74	(4/76	2/77)	2/79			
69			74	76			80			
	69	71	74	76			78			83
	2/69	3/72	1/74	2/75	(1/77	4/77)	1/80			2/83
2/67	4/70	3/72	2/74	1/75			1/80			4/83
(68	69)	70	72*	75	(76	771	80			
69			73	75	(77	781	80	(81	82)	
67	69	71	74	75	(78	79)	80	(81	831	
1/68	4/70	2/72	1/75			3/78	3/80			1/82
4/67			2/74	1/76	(3/77	3/78)	1/80			4/83
(67	68)	70	71	73	76			80		
	4/68	1/71	1/73	3/75			2/79			3/81
3/67	4/68	3/72	3/73	3/75	(4/76	3/77)	1/80			2/84
2/67	4/68	4/71	1/73	1/75			1/80			4/82
3/67	4/68	4/71	1/73	3/75	(4/76	3/77)	1/80			2/84
3/67	3/69	4/71	1/73	3/75	(4/76	3/77)	1/80			4/82
2/67	1/69	4/70	1/73	1/75			4/78	(3/80	1/81)	4/82
4/67	4/68	4/71	1/73	1/75			1/80			4/82

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