Analysing and Forecasting Business Cycles with the Aid of Economic Indicators *

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1. Introduction

The measurement and analysis of business cycles has been one of the core research topics in economics throughout the past century. Although the underlying theories have changed, the central questions have remained: What are the causes of fluctuations in economic activity? What role does government policy play in ameliorating (or exacerbating) these fluctuations? In attempting to answer these questions, one soon confronts two others that are even more basic: What do we mean by 'business cycles'? How do we measure 'economic activity'?

The second set of questions is at the heart of economic indicator analysis. The foundations of this analysis were laid by Arthur F. Burns and Wesley C. Mitchell in the first half of this century (see, for example: Mitchell 1913, 1927; Burns and Mitchell 1946). Their seminal work published in 1946 formed the basis of the methods used at the National Bureau of Economic Research (NBER), New York, to compile an official business cycle chronology for the United States. These methods have since been refined and extended by Geoffrey H. Moore, Victor Zarnowitz, and others at the Center for International Business Cycle Research (CIBCR), New York, (now the Foundation for International Business and Economic Research (FIBER)); and also now by Moore and Anirvan Banerji at the Economic Cycle Research Institute (ECRI), New York, to analyse business cycles in countries around the world.

In their analyses of business cycles, proponents of the economic indicator approach distinguish between 'classical cycles' and 'growth cycles.' Classical cycles are, as Pagan (1997b, p. 20) aptly put it, the '… hills and valleys in a plot of the *levels* of the series …' representing the general level of economic activity. Growth cycles, on the other hand, are defined as recurring fluctuations in the *rate of growth* of aggregate activity relative to the long-run trend rate of

growth.[1] A moment's reflection shows that classical cycle recessions may be (and usually are) preceded by growth cycle slowdowns, since activity generally slows before it contracts, but not all growth cycle slowdowns become classical recessions. Further discussions of the definition of business cycles and the background and terminology of the economic indicator approach are contained in section 3 below.

Having settled on what we mean by 'business cycles', it remains to specify some measure of 'economic activity'. This is done in economic indicator analysis through the construction of a *composite coincident index* ('coincident index' for short). This index, as described in more detail in section 6 below, is a combination of several time series that one would expect to contain information about the current state of the economy. Key examples of such series include industrial production, employment and unemployment, real retail sales, real household income, and real gross domestic product (GDP). Likewise, a *composite leading index* is constructed from series such as hours worked, changes in producer prices, building approvals, stock prices, changes in profitability, and price-cost ratios, which contain information anticipating movements in the coincident index. Finally, a lagging index contains series (such as the long-term unemployment rate, level of inventories, labour costs per unit of output, real capital expenditure and interest rates), which habitually reach their turning points later than those in the coincident index. That is, the lagging index confirms the cyclical fluctuations seen first in the leading index and then the coincident.

The major objective in this paper is to highlight the usefulness of economic indicator analysis, through leading and coincident indexes, for economic forecasting and as an aid in policy-making. In the process, we will show that there are theoretical and empirical benefits of

[1] For a stylised illustration of business cycles in terms of classical and growth cycles, see Boehm and Liew (1994,

defining business cycles in terms of both classical and growth cycles. The distinction between classical and growth cycles gains in importance in the light of the changing views regarding the continued existence of business cycles. We discuss these changing views in the next section.

In section 3 the term business cycle as used in this paper is defined more fully, and a brief review is made of the empirical evidence of classical and growth cycles, using for illustration the experiences in Australia and the United States. The expectation that business cycles will continue adds to the merit – for theoretical, forecasting and policy purposes – of distinguishing between classical and growth cycles. However, we note in section 4 that the emphasis in a number of recent theoretical and empirical studies of business cycles has been in terms only of deviations from trend (that is, in terms of growth cycles). Generally there has been little or no attention to turning points (because of the interest in relative volatility and co-movement among variables). Section 5 briefly raises questions of possible weaknesses and limitations of some of the conclusions of these recent studies through using a single series (such as real GDP) to represent the business cycle. Section 6 discusses the development of economic indicator analysis and the construction of leading and coincident indexes. In section 7 we review the merits of using economic indicator analysis for theoretical and policy purposes in order to study the duration of business cycles and to compare the co-movements among key variables during each business cycle. Section 8 describes a way in which economic indicator analysis may be used to identify, distinguish between and forecast both classical and growth cycles. Section 9 provides a summary and conclusion of the analysis.

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p.5). We will use the term ‘business cycles’ in this paper to refer to both classical and growth cycles.

2. Changing views regarding the continued existence of business cycles

In the process of our analysis it will be seen that several major studies have confused, or incorrectly compared classical cycles with growth cycles, or have been silent on the distinction between them. However, a substantial effort has been made recently to understand business cycles, reflecting the considerable revival of interest in this subject from about the beginning of the 1970s. Boehm (1990, p. 27) noted that, after much attention in the 1950s and the first half of the 1960s to the subject of economic fluctuations, interest in and concern about business cycles

> … waned as the experience of the 1960s led an increasing number of economists to raise the question of whether the business cycle was obsolete: witness the conference held in 1967 'on the possible obsolescence of the 10-year business cycle and the various patterns of long- and short-term fluctuations that have characterized capitalistic economic life' (Bronfenbrenner 1969, p. v).

In the past two years, questions about the continuance of the business cycle have again been prompted by the long classical expansions being experienced in the United States and Australia. The classical expansion in the United States has completed its eighth year since March 1991, and in December 1998 became the longest peacetime expansion since World War II. Similarly, the current classical expansion in Australia is in its seventh year since December 1992 (see column 8 in Tables 1 and 2, respectively). These relatively long expansions and the prospects of their continuing have raised the prospect of the 'death of the business cycle' in the minds of a number of commentators. For instance, Colleen Ryan, in the *Australian Financial Review* [*AFR*] (28 January 1997, p. 1), in an article titled 'Has the US fallen off the business cycle?' stated, 'Indeed, so optimistic is the outlook that some economists are suggesting the old boom and bust business cycle has left the US economy for good.' Australia's continuing long expansion led its Federal Treasurer (the Hon. Peter Costello) to suggest (*AFR*, 7 July 1997, p.10), 'We ought to be looking at a cycle that runs in the decades, rather than the experience of the '80s

and '90s which was bursts of growth followed by severe downturns.' A little earlier, the Governor of the Reserve Bank of Australia commented, more realistically:

> Ideally, we should try to eliminate the business cycle (and recessions) altogether, but that would be too utopian an aspiration. The business cycle has been declared dead before, only to re-assert itself. I do believe, however, that if inflation is kept under control, this expansion will be a lot longer than its predecessors and any subsequent downturn kept milder than in the past. (Macfarlane 1997, p. 3)

Similarly, *The Economist*, reflecting in April 1997 on 'the great surge in share prices in America and elsewhere,' (with share prices in the United States '… soaring by around 80% over the past two years…'), also commented:

> Perhaps, said optimists, the business cycle was dead. Perhaps profits and share prices could continue ever upwards…. [B]ut bulls should note that the death of the business cycle was never plausible. All previous expansions have eventually pushed up inflation and hence short-term interest rates. Bond prices then fall, to be followed down by shares before the economy slides into recession. (*The Economist*, 5 April 1997, p. 13)

Weber (1997, p. 65), in his article titled 'The End of the Business Cycle?', suggested warily:

> For both empirical and theoretical reasons, in advanced industrial economies the waves of the business cycle may be becoming more like ripples.
>
> The dampening of the business cycle will change the global economy and undermine assumptions and arguments that political economists use to understand it. 'History counsels caution,' Alan Greenspan warned the [United States] Senate banking committee in February 1997, about 'visions of such 'new eras' that, in the end, have proven to be a mirage.' Greenspan is surely right to warn against too easily accepting that the present is fundamentally different from the past ….

A final piece of evidence on the ubiquitous nature of business cycles comes from two countries at the heart of what was once called the 'Asian Miracle': (South) Korea and Taiwan. ECRI (1998, pp. 24 and 28) shows that both countries had experienced only one classical recession between 1974 and the onset of the Asian financial crisis in mid-1997. However, Korea

Table 1: Phases of Business Cycles, United States, 1948 - 97

Growth Cycles						Classical Cycles					
Turning point dates by month and year (c)		Duration in months				Turning point dates by month and year (d)		Duration in months			
Peak	Trough	Contraction: Peak to trough	Expansion: Trough to peak	Cycle: Peak to peak	Cycle: Trough to trough	Peak	Trough	Contraction: Peak to trough	Expansion: Trough to Peak	Cycle: Peak to peak	Cycle: Trough to trough
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
7/48	10/49	15				11/48	10/49	11			
3/51	7/52	16	17	32	33						
3/53	8/54	17	8	24	25	7/53	5/54	10	45	56	55
2/57	4/58	14	30	47	44	8/57	4/58	8	39	49	47
2/60	2/61	12	22	36	34	4/60	2/61	10	24	32	34
5/62	10/64	29	15	27	44						
6/66	10/67	16	20	49	36						
3/69	11/70	20	17	33	37	12/69	11/70	11	106	116	117
3/73	3/75	24	28	48	52	11/73	3/75	16	36	47	52
12/78						1/80	7/80	6	58	74	64
	12/82	48	45	69	93	7/81	11/82	16	12	18	28
9/84*	1/87*	28	21	69	49						
3/89*	8/92*	41	26	54	67	7/90	3/91	8	92	108	100
12/94*	10/96*	22	28	69	50						
Averages (b):		23	23	46	47			11	51	62	62
Std. Deviations(b):		10	9	16	17			3	30	32	29

Notes:

(a) The last six growth cycle dates marked by asterisks are based on United States' trend-adjusted coincident index only.

(b) The average duration and standard deviations are rounded to full months.

Sources:

(c) CIBCR, *IEI*, January/February 1998, p. 52.

(d) As selected by the NBER and published in CIBCR, *IEI*, January/February 1998, p. 52.

Table 2: Phases of Business Cycles, Australia, 1951 - 97

Growth Cycles						Classical Cycles					
Turning point dates by month and year		Duration in months				Turning point dates by month and year		Duration in months			
Peak	Trough	Contraction:	Expansion:	Cycle		Peak	Trough	Contraction:	Expansion:	Cycle	
		Peak To trough	Trough to peak	Peak to peak	Trough to trough			Peak to trough	Trough to Peak	Peak to peak	Trough to trough
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
4/51	11/52	19				4/51	9/52	17			
8/55	1/58	29	33	52	62	12/55	12/57	24	39	56	63
8/60	9/61	13	31	60	44	9/60	9/61	12	33	57	45
4/65	1/68	33	43	56	76						
1/71	3/72	14	36	69	50						
2/74	10/75	20	23	37	43	7/74	10/75	15	154	166	169
8/76	2/78	18	10	30	28	8/76	10/77	14	10	25	24
9/81	5/83	20	43	61	63	9/81	5/83	20	47	61	67
11/85	3/87	16	30	50	46						
11/89	12/92	37	32	48	69	12/89	12/92	36	79	99	115
8/95	8/97(b)	24	32	69	56						
Averages (a):		22	31	53	54			20	60	77	80
Std. Deviations (a):		7	9	12	14			8	47	45	48

Notes:

(a) The average duration and standard deviations are rounded to full months.

(b) Preliminary.

Sources:

Columns 1, 2, 7 and 8 from Boehm and Moore 1984, pp. 42 and 43, and updated by the authors.

went through six growth cycle recessions that did not become classical contractions; Taiwan experienced seven such slowdowns. The fact that these (and other) countries have had average growth rates well above those of Australia, the United States and the United Kingdom, makes it less likely that a given slowdown will develop into a contraction.

As in the 1970s, so again in the late 1990s and into the next millennium, it is clear that we can expect business cycles to continue to occur in industrialised market economies, although they may well change in some important respects as these economies develop.

3. Definition and characteristics of classical and growth cycles

Mitchell (1927, pp. 468-9) considered 'A Definition of Business Cycles' that would adequately summarise his analysis at the NBER of 'business annals, theoretical hypotheses, and statistical data'. This led to the descriptive definition which was later adopted by Burns and Mitchell (1946, p. 3), and which has since been widely used, at least as a starting point. According to this definition,

> Business cycles are a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic; in duration business cycles vary from more than one to ten or twelve years; they are not divisible into shorter cycles of similar character with amplitudes approximating their own.

This definition applies particularly to classical cycles, which have historically been the main concern of business cycle studies at the NBER. However, Table 1 (columns 7 and 8) reveals that there was no classical contraction in the United States between February 1961 and December 1969, a period of 106 months. This contributed to the growing view among an increasing number of economists and policy-makers in general that the business cycle was

'dead', as noted above. Moreover, Table 2 shows that a classical upswing continued in Australia from September 1961 to July 1974, a period of 154 months. There was also a long classical upswing at the time in Canada. Cross (1982, p. xxvi) records the upswing from February 1961 to May 1974, a period of 159 months; while the CIBCR (1998, p. 53) dates the expansion on recent comprehensive revised data as being even longer, from February 1961 to April 1981, a period of 242 months (see also CIBCR 1997, p. 33). These experiences, particularly in the United States, contributed to a revival of interest in growth cycles. Mintz (1969, 1972, 1974) especially manifested this interest in research work at the NBER. Mintz's allowance for growth cycles as well as classical cycles justified a revision of the Burns-Mitchell definition of business cycles as quoted above, to the extent, as Mintz (1974, pp. 6-7) explains of '… inserting the words "adjusted for their long-run trends" after "economic activities". This version brings out the identity between classical cycles and growth cycles when long-run trends are horizontal'.[2]

Tables 1 and 2 illustrate several important aspects for the purposes of this paper regarding theoretical studies, forecasting and policy-making. One is that, while there was a long classical upswing in the 1960s in both the United States and Australia, nevertheless there were during that time two growth cycles in each country which did not lead on to classical cycles. Another aspect concerns the purpose and usefulness for theoretical, forecasting and policy objectives of distinguishing between classical and growth cycles and identifying the turning points themselves. The use of economic indicator analysis to aid the study of the stylised facts of business cycles, and to identify and forecast both classical and growth cycles, is considered further in sections 7 and 8 of this paper. However, the analyses in recent theoretical and empirical studies of business cycles have been mainly backward-looking exercises in terms of a comparison of the deviations

[2] For an earlier discussion of the definitions of classical and growth cycles, see Mintz 1972, esp. pp. 45-6.

from trend of key economic variables with those of real GDP. It will be appropriate next to review briefly a representative selection of these analyses.

4. A perspective on recent studies emphasising deviations from trend

A central feature of much theoretical and empirical work on business cycles since Lucas's (1977) influential paper on 'Understanding Business Cycles' has been to define business cycles as deviations of 'real GDP' or 'aggregate real output' from trend. The economic setting views the business cycle as occurring in industrial market economies experiencing sustained growth. Furthermore, the pattern of analysis in the 1990s in identifying the stylised facts of business cycles has largely followed the procedure outlined in Kydland and Prescott (1990). In their study of the U.S. cyclical experience, they state (p. 4, italics in original):

> We follow Lucas in defining *business cycles* as the deviations of aggregate real output from trend. We complete his definition by providing an explicit procedure for calculating a time series trend that successfully mimics the smooth curves most business cycle researchers would draw through plots of the data. We also follow Lucas in viewing the business cycle facts as the statistical properties of the comovements of deviations from trend of various economic aggregates with those of real output.

Studies that have largely followed the Kydland-Prescott methodology in analysing the empirical regularities regarding persistence (positive serial correlation) and co-movement (cross-sectional correlation) in key macro-economic variables include Wolf (1991) and Serletis and Krause (1996) for the United States; Backus and Kehoe (1992) for a group of ten countries (Australia, Canada, Denmark, Germany, Italy, Japan, Norway, Sweden, the United Kingdom, and the United States); Blackburn and Ravn (1992) for the United Kingdom; Kim, Buckle and Hall (1994) for New Zealand; Crosby and Otto (1995) and Fisher, Otto and Voss (1996) for

Australia. Brandner and Neusser (1992) examine the stylised facts of business cycles in Austria and Germany, using an analysis similar to Kydland and Prescott's.

The number of specific economic aggregates compared with real GDP (or output) varies from study to study. The variables generally examined include: real expenditure for consumption and investment and components of both for the private and public sectors; exports and imports; production inputs for aspects of labour and capital; and aspects of nominal variables including notably money supply and prices.

There has been little attention to business cycle turning points in the above studies that follow the Kydland-Prescott methodology. Where reference was made to turning points, no distinction was drawn between classical and growth cycle turning points. For instance, brief mention is given to turning points for Austria by Brandner and Neusser (1992, pp. 72-3). But the turns used appear to be for the classical cycle, whereas the growth cycle would have been more relevant for their analysis involving deviation from trend. Similarly, Backus and Kehoe (1992, p. 880) compare their results with those of Friedman and Schwartz (1982) who used the NBER classical cycle reference dates for the United States and the United Kingdom. The more comparable dates for Backus and Kehoe would also have been the growth cycle reference chronology. Kydland and Prescott (1990, p. 17) were explicit in their concluding remarks in stating, 'Let us reemphasize that, unlike Burns and Mitchell [1946], we are not claiming to measure business cycles'. This conclusion reflects the important policy consequence of real business cycle theory that there is no need to pay attention to the timing of turning points, since one leaves any adjustments required during a recession or boom to market forces, thereby not interfering with the 'invisible hand' (see, for instance, Mankiw 1989, p. 83).

It should also be noted that, following Lucas (1977), there had been several influential studies in the 1980s developing the particular methodology, which was further progressed and popularised by Kydland and Prescott (1990), involving various aspects of the auto- and cross-correlations and standard deviations of key economic aggregates. These studies include: Hodrick and Prescott (1980) and their revised version of this paper in Hodrick and Prescott (1997), Lucas (1980), Kydland and Prescott (1982), Long and Plosser (1983), Plosser (1989), and Danthine and Girardin (1989). These earlier studies should justifiably be taken into account and their contributions assessed in a more comprehensive review of the attempts to explain business cycles than undertaken in this paper. Stadler (1994), Cooley (1995), and King and Rebelo (1998) are examples of such reviews.

5. Using a single series to represent the business cycle

5.1. The need for a monthly measure of aggregate economic activity

A general objective of the studies listed in the first paragraph of the previous section (and which follow the Kydland-Prescott methodology) was to see whether the selected key variables have remained consistently pro-, counter-, or acyclical with respect to output (i.e., real GDP). It clearly may be very useful to know for theoretical and empirical studies the cyclical behaviour of specific key variables during business cycles. Several studies also compare their results for a particular country with the results reported in one or more of the earlier studies listed above. Comparisons are also made in some cases with the results of studies before the 1990s on the stylised facts of business cycles, notably the findings of Friedman and Schwartz (1963, 1982). But generally, more consideration could have been given in the recent studies to possible reasons

for any conflicting or contrasting conclusions with the results of earlier researchers for other countries, or for changes identified during the selected period for the specific country under review.

A question being raised in this paper is whether the use of a single data series such as real GDP is the most appropriate way to provide a proxy for the business cycle. One important reason probably contributing to the contrasting or conflicting conclusions drawn concerning the pro-, counter-, or acyclical movements of key variables could be the relatively poor or varying quality of an economic variable. There may also be important differences due to the use of a single series such as real GDP to represent the business cycle. Moreover, that series itself has been subject to more or less important revisions, as discussed below.

Ideally what is required, as discussed in Boehm (1987, 1998), is a precise and accurate measure of the aggregate economic activity of a nation as soon as possible after the event. We could define the *ideal* measure of the aggregate economic activity as monthly real GDP.[3] Though no such series is available, it is nevertheless worth pondering what it would mean to have a series which accurately, and without requiring later revisions, measures total economic activity and which would therefore clearly reflect business fluctuations.

An important reason for looking to GDP for possibly providing the required ideal measure is because it is the most comprehensive of the official statistical series that approximates aggregate economic activity. Moreover, as Harding and Pagan (1999) point out, one of the main motivating factors in Burns and Mitchell's development of economic indicators was the lack, at

[3] For countries such as Australia, a better measure of monthly economic activity would be real GNFP (gross non-farm product), which allows for irregular weather influences on the harvest. We will continue to use the term 'monthly real GDP' in the remainder of this section, with the understanding that GNFP would be used in some cases.

that time, of a reliable *quarterly* measure of GDP. In fact, Burns and Mitchell (1946, pp72-73) state:

> Aggregate [economic] activity can be given a definite meaning and made conceptually measurable by identifying it with gross national product …. Unfortunately, no satisfactory series of any of these types is available by months or quarters for periods approximating those we seek to cover.

If we had this ideal measure of aggregate economic activity, we could then compare our theoretical and empirical studies of the stylised facts of business cycles (concerning persistence and co-movements of key macroeconomic variables) with those of the ideal measure. The ideal measure of monthly real GDP could also be used to provide the basis for identifying reference cycle chronologies and, hence, phases of the business cycle. All other economic indicators, including the leading and lagging indicators, could then be related to this reference series. We would still be interested in statistical indicators whose cyclical patterns are roughly coincident with monthly real GDP. This interest would be essentially because of the importance to business cycle analysis and economic forecasting of key areas reflecting aspects of the current state of economic activity, such as industrial production, household income, retail trade, employment, and unemployment. However, if we already had the ideal measure, we would not be concerned with using these roughly coincident indicators to obtain a measure of the general course and the level of aggregate economic activity.

In reality, of course, 'no single time series measures [aggregate economic activity] … adequately; however, a variety of statistical series measure some of its major aspects' (U.S. Department of Commerce 1984, p. 65). This applies equally to other countries. Thus, in the absence of the ideal measure of monthly real GDP, we select roughly coincident indicators that will, when combined in a composite index, give a reasonably accurate picture of aggregate

economic activity. We discuss the selection of these indicators and the construction of leading and coincident indexes in section 6 below. Similarly, Stock and Watson (1991, pp. 63-64), in considering the question of 'What do the leading indicators lead?', explain their construction of 'a probability model of the coincident economic indicators'. Their model

> … is based on the notion that the comovements in many macroeconomic variables have a common element that can be captured by a single underlying, unobserved variable. In the abstract, this variable represents the general 'state of the economy.' The problem is to estimate the current state of the economy, that is, this common element in the fluctuations of key aggregate time-series variables.

In support of their development of the coincident indicator model, Stock and Watson (1991, p. 65) recognise that

> Individual series measure more or less well-defined concepts, such as the value of all goods and services produced in a quarter or the total number of individuals working for pay. But these series measure only various facets of the overall state of economic activity; none measure the state of the economy [in Burns and Mitchell's (1946) terminology, the 'reference cycle'] directly. Moreover, even the concepts that the series purport to measure are measured with error.

Oppenländer (1994, p. 718) agreed that '… the indicators [used in the construction of the coincident composite index] implicitly define a variable that can be thought of as the 'overall state of the economy' (Stock and Watson 1988, p. 1) …'.

5.2. Cyclical changes in real GDP following revisions to National Accounts data

Measurement errors mean that the estimates of the real GDP and GNFP series that are available, for instance, for Australia, fall a long way short of the ideal series envisaged above. This is not only because the estimates of GDP and GNFP are not available monthly. The available quarterly series are subject to significant revisions for varying reasons, especially for recent quarters, but also extending back to earlier quarters (see Lim 1985). Nor does any other

single statistical series individually satisfy our requirements for analysis of the overall state of economic activity.

It is instructive to note the extent of the cyclical changes in estimates of real GDP for Australia that have resulted from attempts to remove measurement error and from other revisions of the data published earlier.[4] Revisions might reasonably be expected to occur with the most recent quarterly estimates of GDP or GNFP until the data on which the estimates are based become more fully available. Revisions to earlier estimates may arise when the constant price series is re-based on a more recent year. Revisions may also arise from the more regular updates of seasonal adjustment factors and of benchmarks used from surveys or censuses. When measurement error is eliminated as far as possible and revisions are made, the turning points should then be expected to settle down. The statistical evidence shows that this is not always the case.

Table 3 reports the turning points identified in the estimates of GDP(I) (that is, the income-based measure of GDP). The first two columns of the table repeat the growth cycle chronology from Table 2. The remaining columns show the chronology one obtains from using GDP(I) instead of the coincident index, based on the data available at each of several dates (noted in Table 3) from the June Quarter 1981 to the June Quarter 1998.

Chart 1 illustrates these two growth cycle chronologies as of the June Quarter 1998. The top section shows the (annualised) six-month smoothed growth rate of the coincident index, with

[4] It is helpful to note here that the Australian Bureau of Statistics (ABS) has regularly produced four real GDP and GNFP series during the 1990s: namely, income-based, GDP(I); expenditure-based, GDP(E); production-based, GDP(P); and the average of these three, GDP(A). As explained in Boehm (1998), GDP(A) appears to be the best of these series for economic indicator analysis. During the development of the Westpac – Melbourne Institute indicator project in the late 1970s and early 1980s, only GDP(E) and GDP(I) were available. It seemed clear at

the contraction phases of the growth cycle chronology from Table 2 overlaid as shaded bars. The bottom section shows the (annualised) smoothed growth rate of real GDP(I), and the shaded areas the contraction phases of its growth cycle chronology (from columns 11 and 12 of Table 3).[5]

Table 3 reveals that, in addition to the more or less expected revisions to recent quarters, there have also been important and continuing revisions with earlier turning points. For instance, the table shows that the peak in 11/76 (that is, November 1976), as identified in both June 1981 and May 1984, moved to 5/76 in the data available at March 1986. It appears[6] to have remained there through to the data available at January 1993, but in May 1995 this peak had returned to 11/76 and appears to have remained there since. Table 3 shows that other shifts in the earlier turning points for GDP(I) also occurred; for instance, a peak in 11/68, as originally identified for the data available at June 1981, had moved to 5/70 in May 1984, then to 8/71 for March 1986 and April 1988, but back to 5/70 in January 1993. This peak appears to have returned to 8/71 since May 1995. Another example concerns the trough in 2/72, as identified in June 1981 and moving to 8/72 in May 1984, then back to 2/72 in April 1988, and returning to 8/72 in May 1995.

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that time that the latter series was preferable; hence we have available an historical analysis only of GDP(I), as reported in Tables 3 and 4.

[5] The six-month smoothed growth rates in Chart 1 are obtained by computing the ratio of the current month's index to the average of the preceding twelve months. Since the interval from the current month to the middle of this twelve-month average is 6.5 months, the ratio is raised to the 12/6.5 power to put it on an annual rate basis. The six-month smoothed growth rate is discussed in more detail in section 8.

[6] It is appropriate to say 'appears' in this context, since the turning point analysis of the national account series has not been run at the times of every quarterly update when revisions of earlier data during the period under consideration would also have been reported.

The importance of these shifts can partly be assessed in the light of the extent to which they lengthen or shorten the respective duration of the specific fluctuation in GDP in relation to the corresponding growth cycle fluctuation. To put it another way, what influences or distortions do shifts in the turning points of GDP have on the correlation between the variables under examination? For instance, the six-month shift of the peak from 11/76 to 5/76 occurred during a growth cycle slowdown lasting from 8/76 to 2/78, a duration of 18 months. It seems clear that this growth cycle peak in GDP(I) occurred within three months of the peaks in the growth cycle chronology (see Table 3, column1) and in the coincident index (see Boehm, 1998, Table 10, column 11); therefore this shift would probably not lead to very important differences in the two chronologies. A much more significant shift was that of the peak in GDP(I) from 11/68 to 5/70 and then to 8/71. The corresponding contraction in the growth cycle chronology was only about 14 months, from 1/71 to 3/72 (see Table 3, columns 1 and 2).[7] This implies that the GDP(I) peak occurred either 26 months before, eight months before, or seven months after, both the growth cycle and the coincident index peaks. These shifts could lead to different and conflicting results of correlation analyses using GDP(I) in relation to other series.

We should note that there have at times also been some revisions in the growth cycle chronology at the selected dates shown in Table 3 (columns 1 and 2), but in general only for the most recent turns. This is reflected in the fact that it is generally necessary to view the latest identified turn as preliminary. We discuss the identification of turning points in more detail below.

There is also the problem of the varying experience of one or two extra cycles in real GDP(I), which do not correspond with the latest growth cycle chronology for the selected dates

[7] The turning points for this growth cycle contraction correspond to those in the coincident index, as shown in

Table 3: Australian Growth Cycle Chronology and Turning Points of Real GDP(I), at Selected Dates, 1971-98

Growth cycle Chronology		Chronologies in GDP(I) identified in deviations from trend for data available at: June 1981		May 1984		March 1986		April 1988		Jan. 1993	
P	T	P	T	P	T	P	T	P	T	P	T
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1/71	3/72	11/68	2/72	5/70	8/72	8/71	8/72	8/71	2/72	5/70	2/72
2/74	10/75	11/73	11/75	11/73	11/75	11/73	11/75	11/73	11/75	8/73	11/75
8/76	2/78	11/76	11/77	11/76	11/77	5/76	11/77	5/76	11/77	5/76	11/77
9/81	5/83			8/81	5/83	5/81	5/83	5/81	5/83	5/81	5/83
11/85	3/87							8/85	5/86	8/85	5/86
11/89										5/89	
Extra cycles:					5/74		5/74				
				5/75		5/75					
		2/79		2/79	2/80	2/79	8/79	2/79	8/79	2/79	8/79

		May 1995		Feb. 1996		July 1997		Dec. 1997		June 1998	
P	T	P	T	P	T	P	T	P	T	P	T
1/71	3/72	8/71	8/72	8/71	8/72	8/71	8/72	8/71	8/72	8/71	8/72
2/74	10/75	11/73	11/75	11/73	11/75	11/73	11/75	11/73	11/75	11/73	11/75
8/76	2/78	11/76	11/77	11/76	11/77	11/76	11/77	11/76	11/77	11/76	11/77
9/81	5/83	8/81	2/83	8/81	2/83	8/81	2/83	8/81	2/83	8/81	2/83
11/85	3/87	8/85	5/86	8/85	5/86	8/85	8/86	8/85	8/86	8/85	8/86
11/89	12/92	5/89	5/92	5/89	8/91	5/89	5/92	5/89(b)	5/92(c)	5/89	5/92
8/95	8/97(a)					2/96(a)		8/96 (c)		8/95	2/97
Extra cycles:			5/74		5/74		5/74		5/74		5/74
		5/75		5/75		5/75		5/75		5/75	
		2/79	5/80	2/79	5/80	2/79	5/80	2/79	5/80	2/79	5/80

Notes:

(a) Preliminary.

(b) Recorded as 8/89 in October 1997.

(c) A minor cycle.

Sources:

Columns 1and 2 from Table 2, columns 1 and 2; other columns computed from seasonally adjusted data in ABS 1998, Cat. no. 5206.0, June Quarter, and earlier issues.

Boehm (1998, Table 10, columns 11 and 12).

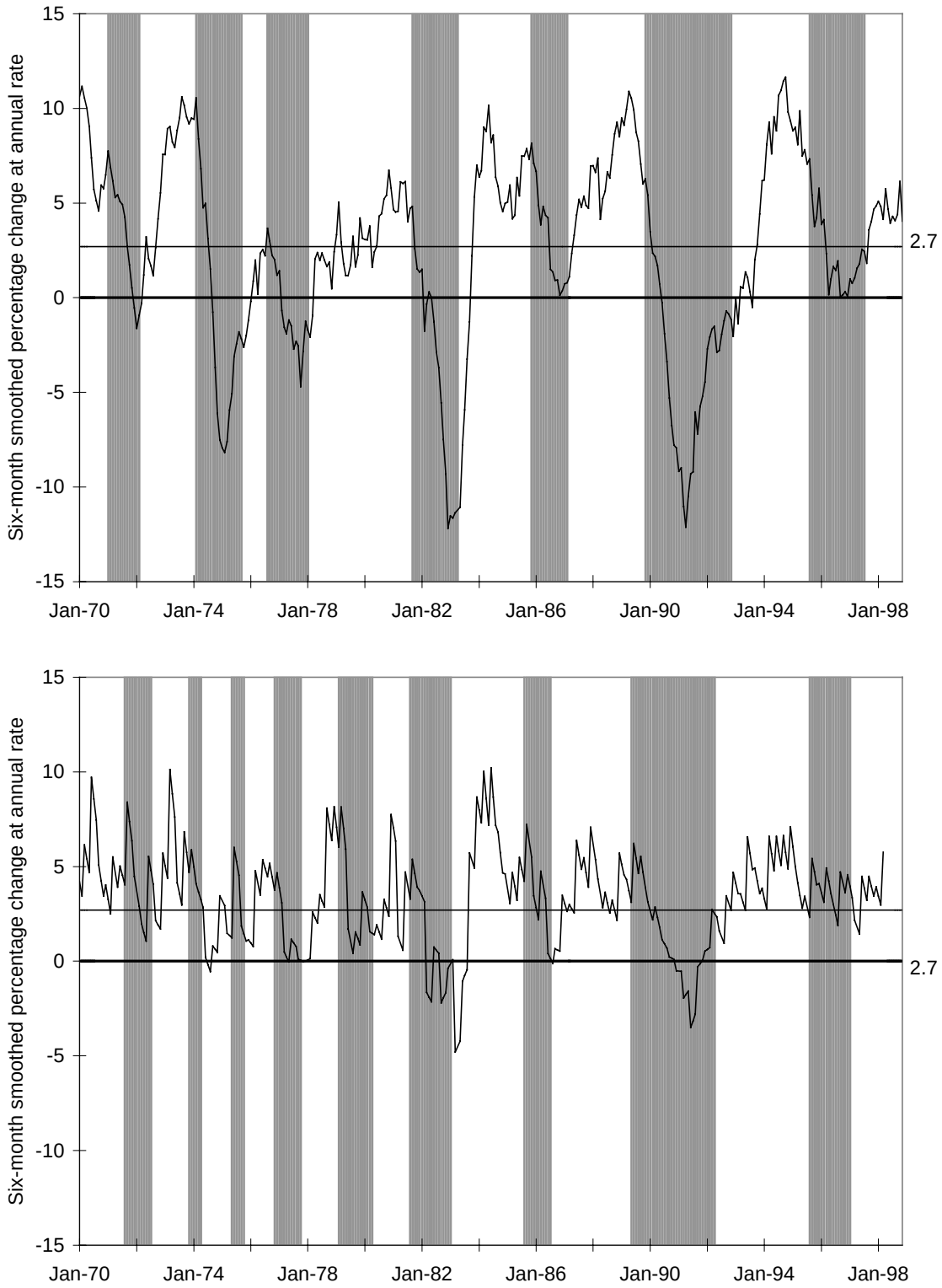


Chart 1. Growth cycle contractions (shaded areas) in Australian composite coincident index (top) and GDP(I) (bottom).
Source: Melbourne Institute of Applied Economic and Social Research

shown in Table 3. The two extra cycles shown in Table 3 (columns 11 and 12) for the data available at June 1998 are identified in the lower section of Chart 1.

An important factor contributing to the extra cycles in GDP(I) is the greater number of classical and growth cycles in the farm sector. Boehm (1998, pp. 19-21 and 52) shows that, during the period 1960 to early 1997, Australia's farm sector experienced eleven classical cycles compared with only five in the total economy. There were about the same number of growth cycles in Australia's farm sector as classical cycles, with some differences in the timing of turning points. The classical cycle in the farm sector had an average duration (from peak to peak or trough to trough) of just over three years, compared with about seven years in the total economy. Furthermore, while the average classical expansion phase in the farm sector has been only about two years compared with an average contraction phase of just over a year, by contrast in the total economy since 1960 the classical expansion phase has averaged nearly five and a half years while the average contraction phase averaged just over one and a half years. The farm sector in the United States has also experienced more classical cycles (and more growth cycles) than the total economy. However, the United States has not done so to the same extent as Australia, the U.S. classical cycle in the farm sector since 1960 displaying an average duration of just over four years compared with five and a half years in the total economy. The evidence for Australia supports strongly a preference for the GNFP series of the national accounts, especially the average, income and production series in studies of Australia's cyclical experiences. On the other hand, the total economy experienced much greater variability in the duration of individual phases and cycles than did the farm sector.

However, the farm sector has declined fairly rapidly in relative importance as a share of GDP in industrialised market economies. This has meant that the marked instability of the farm

sector has been one important factor contributing to the decline in the volatility of GDP, as observed for the United States by DeLong and Summers (1986, p. 685). The share of Australia's real gross farm product as a proportion of its real GDP has declined from 5.9 per cent in 1960 to 3.9 per cent in 1997. Boehm (1993, pp. 8-9) shows that the share of GDP at factor cost for agriculture, forestry, fishing and hunting (predominantly agriculture) as a proportion of total Australian GDP has declined substantially from an average of just above 20 per cent in the first four decades of the twentieth century to about 16 per cent in the mid-1950s, 13 per cent in the early 1960s, to 7 per cent around 1980 and just above 4 per cent in the early 1990s. As Calomiris and Hanes (1998, p. 18) observed, the general independence of fluctuations in the farm sector from the main business cycle in industrialised economies has received inadequate attention in macroeconomic history and economic analysis.

The experience of important shifts in the turning points for real GDP(I) has also applied to estimates of Australia's real GNFP(I), but not always at the same time or to the same extent for corresponding turns (as discussed in Boehm 1998, pp. 15-16). However, in both series a trough was identified in 5/83 in the data as available at March 1986 to January 1993, and as reported for GDP(I) in Table 3. Then this trough for both series moved to 2/83 for the data available at May 1995 and at all dates since. By contrast, 5/83 has consistently appeared as a trough in both Australia's coincident composite index and growth cycle chronology. In fact, 5/83 has been one of the easiest turning points to fix.

Revisions in the National Accounts have also changed the quarterly pattern of peaks and troughs in Australia's classical cycle experience in real GDP(I) for the dates reported in Table 4 from June 1981 onwards. Chart 2 illustrates the classical cycle findings for the Australian economy at June 1998, in relation to the levels of Australia's coincident index (in the top section) and real

GDP(I) (expressed as an index in the bottom section). The chart reveals that there were two classical contraction phases in Australia's coincident index in the 1970s (top section) that were not recorded in Australia's level of GDP(I) (bottom section).

An interesting question for further research is the contrasting extra cycle experiences in the total economy and GDP(I) in respect to growth cycles and classical cycles. Chart 1 reveals that Australia's GDP(I) growth rate contained two extra cycles, compared with the composite coincident index for the total economy, for the period 1970-98. On the other hand Chart 2 shows that there were two extra classical cycles in Australia's coincident index in the 1970s, which were not recorded in the level of GDP(I).

The data available at June 1981 for Table 4 show a classical cycle peak in real GDP(I) at 11/60, followed by a trough in 8/61. But there were no corresponding classical turning points in real GDP for the classical reference peak for Australia in 7/74 and trough in 10/75. A (relatively minor) peak and trough in real GDP in 5/77 and 11/77, respectively, were identified at June 1981. However, neither of these turns was identified in the updated estimates of real GDP thereafter for the dates shown in Table 4. The classical trough in real GDP in 8/61 at June 1981 had moved to 5/61 at April 1988, but had returned to 8/61 at January 1993 and appears to have remained there since. The peak recorded in GDP in 11/60 at June 1981 had moved to 8/60 in May 1984 and has remained there. In our analyses in May 1984 and March 1986, a minor classical cycle was found in real GDP with a peak in 11/73 and a trough in 5/74. But in the national accounts data reported from April 1988 on, no corresponding classical turns have been found in real GDP in the 1970s for the two classical reference cycles shown in Table 4 (columns 1 and 2); that is, after a classical trough in real GDP in 5/61 at April 1988 and thereafter with this trough returning to 8/61 from January 1993 and on, the next turning point in real GDP appears

Table 4: Australian Classical Cycle Chronology and Turning Points of Real GDP(I), at Selected Dates, 1971-98

Classical cycle Chronology		Chronologies in GDP(I) identified in raw data available at:									
		June 1981		May 1984		March 1986		April 1988		Jan. 1993	
P	T	P	T	P	T	P	T	P	T	P	T
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
9/60	9/61	11/60	8/61	8/60	8/61	8/60	8/61	8/60	5/61	8/60	8/61
7/74	10/75	nt	nt	11/73(a)	5/74(a)	11/73(a)	5/74(a)	nt	nt	nt	nt
8/76	10/77	5/77(a)	11/77(a)	nt	nt	nt	nt	nt	nt	nt	nt
9/81	5/83			5/82	5/83	8/82	5/83	5/82	5/83	8/81	5/83
12/89	12/92									2/90	8/91
		May 1995		Feb. 1996		July 1997		Dec. 1997		June 1998	
P	T	P	T	P	T	P	T	P	T	P	T
9/60	9/61	8/60	8/61	8/60	8/61	8/60	8/61	8/60	8/61	8/60	8/61
7/74	10/75	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
8/76	10/77	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
9/81	5/83	11/81	2/83	11/81	2/83	11/81	2/83	11/81	2/83	11/81	2/83
12/89	12/92	2/90	5/91	2/90	5/91	2/90	5/91	2/90	5/91	2/90	5/91

Notes:
(a) A minor cycle.
(b) nt: no corresponding turn.

Sources:
Columns 1 and 2 from Table 2, columns 7 and 8; other columns computed from seasonally adjusted data in ABS 1998, Cat. no. 5206.0, June Quarter, and earlier issues.

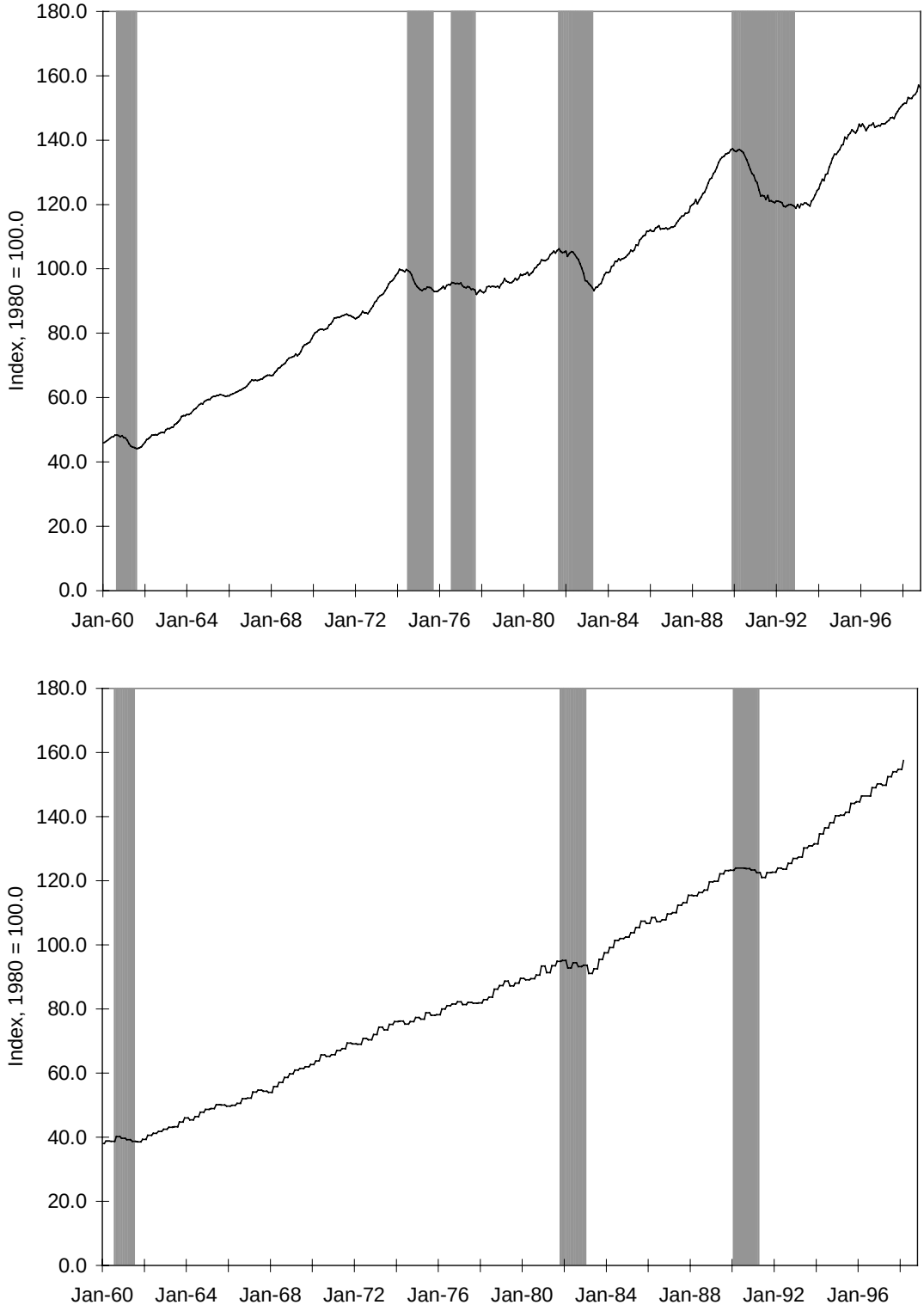


Chart 2. Classical cycle contractions (shaded areas) in Australian composite coincident index (top) and GDP(I) (bottom).

Source: Melbourne Institute of Applied Economic and Social Research

not to have occurred until a classical peak in 5/82 with the data available at April 1988. This peak moved to 8/81 at January 1993 and then to 11/81 at May 1995 and on. A classical trough in 5/83 from May 1984 to January 1993 moved to 2/83 from May 1995 on, as also occurred with the growth cycle in real GDP, as shown in Table 3.

The analysis and problems reported above and encountered in using a single series to represent the reference cycle clearly still affirm in 1999 the position adopted by the NBER and Mintz (1974, p. 9) when she commented:

> Another familiar objection to the NBER cycle concept suggests that a single indicator, the GNP or the GNP gap, is preferable to the NBER indicator list. The definition of growth cycles as cycles in the trend-adjusted GNP is rejected here for the same reasons for which the NBER has rejected the definition of classical business cycles as cycles in the GNP. These reasons are that investigations have shown how uncertainties in the measurement of GNP and the necessarily very frequent revisions (which often reach back a number of years) increase the likelihood of selecting the wrong turns. [See note below *.] Moreover, GNP data are not available monthly, whereas a monthly reference chronology is required.

* In a footnote at this point, Mintz stated (p. 107):

> For the definitive investigation of GNP revisions and their effects on GNP turning points, see Rosanne Cole, *Errors in Provisional Estimates of Gross National Product* (New York: NBER, 1969) especially pp. 73-81. For an excellent study of the effects of dating reference cycles by GNP cycles, see two articles by Victor Zarnowitz, 'On the Dating of Business Cycles,' *Journal of Business of the University of Chicago,* April 1963, and 'Cloos on Reference Dates and Leading Indicators: A Comment,' *ibid.,* October 1963. For a striking example of repeated back-and-forth shifts of a trough through GNP revisions, see Rendigs Fels and C. Elton Hinshaw, *Forecasting and Recognizing Business Cycle Turning Points* (New York: NBER, 1968), p. 29. For general arguments against reliance upon a single measure, see Mitchell, *What Happens During Business Cycles*, p. 11, and Geoffrey H. Moore, 'What is a Recession?', *American Statistician*, October 1967. For a contrary view, see George W. Cloos, 'How Good are the National Bureau's Reference Dates?' *Journal of Business*, January 1963[a; and see also Cloos, 1963b].

Lim (1985, p. 27), in reviewing the 'discrepancies and revisions' in 'GDP growth rates', supported the NBER approach in concluding

> … that forecasters and policy makers should not rely solely on published estimates of GDP growth as indicators of economic activity since these estimates (quite apart from publication lags) do not necessarily reflect underlying conditions. A range of variables, such as embodied in the indicator approach (see Boehm and Moore 1984) should be monitored and used to ascertain the state of economic activity.

It seems reasonable to suggest that Burns and Mitchell themselves, in learning from the evidence available since 1946, would support the conclusion reached by Mintz, Lim and us. Thus, we suggest in section 7 below that a solution to the problems highlighted above (in respect to a single series such as real GDP) would be to use a coincident composite index (such as the Melbourne Institute's) as a much more robust proxy for the business cycle. Before turning our attention to this issue, it will be appropriate to describe more fully the key aspects of economic indicator analysis and the construction of leading and coincident composite indexes.

6. The development of economic indicator analysis

Our discussion so far has made brief references to particular aspects of economic indicator analysis. It is appropriate here to discuss the development and usefulness of this analysis in more detail.

The indicator approach contributes to an understanding of the ever-changing variety of business-cycle experiences through the model of the economy furnished by classifying selected indicators as leading, roughly coincident, and lagging. A cross-classification – by economic process and cyclical timing – of the indicators included in the original Westpac-Melbourne Institute indexes is provided in Boehm and Moore (1984, Table 2) and Boehm (1987, Table 1).

The criteria used in selecting component series for use in the composite indexes can be summarised as follows. A suitable indicator: 1) is a significant economic variable; 2) is statistically adequate; 3) is not subject to significant revisions; 4) reveals a consistent relationship

(leading, coincident, or lagging) over time with business cycle peaks and troughs; 5) (related to 4) conforms to the general cyclical movements between peaks and troughs; 6) is not dominated by irregular, erratic and non-cyclical influences; and 7) is promptly and regularly available, preferably monthly but at least quarterly.[8] It is important to undertake periodic reviews of each selected indicator to ensure that it continues to perform consistently as expected.

The leading indicators include measures, reflections or assessments of commitments currently being made that will affect the pace and level of economic activity in the coming months. The coincident indicators identify the current phase of the business cycle and the timing of the changes in the direction of activity as they occur (see Tables 1 and 2). The lagging indicators habitually reach their turning points later than the corresponding turns revealed by the coincident indicators. The indicators generally represent a diverse range of economic information, which is synthesized in the composite leading, coincident and lagging indexes. A further feature of the coincident index is that it fills a major gap in our economic information by providing a monthly index of 'aggregate economic activity'. Thus, as discussed in section 5.1 above, the coincident index constitutes a reliable substitute for the 'ideal measure' of monthly real GDP. The Australian coincident index is presently constructed from six series, three being quarterly, namely: real GNFP(A), real household income and an index of industrial production; and three monthly series: real retail turnover, total employed labour force and the unemployment rate (inverted). The inclusion of the three monthly series, which are available in advance of the national account series, means that the coincident index is more up-to-date than it would be if it relied only on a quarterly series such as GDP or GNFP. The monthly series generally identify

[8] For more detailed discussion of these criteria, see Zarnowitz and Boschan (1977a,b); U.S. Department of Commerce (1984, p. 70, n. 1); and Boehm (1987, pp. 8-10).

well the approximate state of the economy. A detailed description of the construction of Australia's coincident index is provided in Boehm and Moore (1984).

The process of fixing the business cycle chronologies reported, for instance, in Table 2 for Australia, involves viewing the turning points (with the aid of computer programs) in three parts: first, the turns of the coincident index itself; secondly, the cyclical turning points of the components of the coincident index, which tend to occur in clusters (and for Australia including in this cluster the turning points of real GDP); and thirdly, the median of each cluster. The clusters can generally be identified fairly easily. The further rules that are taken into account in fixing the turning points are described in Boehm and Moore (1984, esp. pp. 38 and 40-2). The business cycle chronologies are important dates of reference for purposes of identifying and explaining the current level of business activity and (as explained in section 8 below) in forecasting what course the general level of activity may be expected to take in the coming months. The chronologies also assist in our understanding of the specific cycles in key economic time series.

The analysis of business cycles using composite leading, coincident and lagging indexes has been a recognised success in the United States for more than fifty years (see, for instance, Auerbach 1982). In recognition of the international manifestations of business cycles, a research strategy of the 'International Economic Indicator' project at the CIBCR and ECRI has been to examine to what extent the indicators that have been successful in monitoring the U.S. economy do likewise in other market-oriented countries. However, no series is included in a country's composite index simply because it appears to be similar to a series in the U.S. index. The selection of component series for a country's indexes is driven by *a priori* knowledge of the economy, theoretical concerns, and their evaluation in terms of the criteria referred to above.

Nevertheless, it is the case that a number of the indicators chosen as component series in Australia, the United Kingdom and other countries parallel quite closely those used in the United States. This is fortunate, as it enhances the comparisons that we can make of the business cycle in each country.

After selection of the individual leading, coincident and lagging indicators, the various composite indexes were initially computed for the United States as weighted averages. A detailed weighting scheme, which scored each indicator according to its characteristics in terms of the seven criteria listed above, was developed for the United States (see Zarnowitz and Boschan 1977a, pp. 171-73; and U.S. Department of Commerce 1984, pp. 65-70). However, Auerbach (1982, p. 594) concluded that '… the extensive effort devoted to assigning and updating weights for the series included has essentially no effect on the resulting index; it is indistinguishable from one with equal weights'. Hence in both the International Economic Indicator project generally, and the Westpac-Melbourne Institute indexes in particular, there is empirical justification for each indicator entering the index with unit weight. The dynamic factor model approach to composite indexes developed by Stock and Watson (1989, 1991) uses a different approach to weighting the component series.

In order to account for the fact that the various component series possess different underlying volatilities, it is customary to standardise the individual indicators prior to combining them into the index. This is achieved by first computing the month-to-month percentage changes for each series, or the month-to-month differences for series (such as the unemployment rate), which are already in percentage or ratio form. These percentage changes (or differences) are then divided by the mean absolute deviation of that series, computed over a selected long-run period. This standardisation procedure ensures that series typically exhibiting large percentage changes

do not have an unduly large influence on the composite index. Thus, standardisation itself serves as a form of weighting.[9]

7. Advantages of using a composite coincident index as a proxy for the business cycle

In section 5.2 above, we noted that two important problems arise when there is reliance on a single series, such as real GDP, as a proxy for the business cycle. The problems are, first, the shifting of turning points over time. The second concerns the 'extra cycles' that are not found in a comprehensive economic indicator analysis. Both problems raise important questions about the appropriateness of using a single series for the purpose of following Lucas (1977) and Kydland and Prescott (1990) in identifying as accurately as possible the experiences of persistence and the co-movements of deviations from trend of other key variables with those of the single series. These studies of the stylised facts of business cycles appear not to have considered to what extent their use of a single series to represent the business cycle could account for some of the conflicting or contrasting conclusions drawn concerning the pro-, counter- or acyclical movements of key variables. However, it has not been our aim to examine this aspect or to discuss the conflicting or contrasting conclusions themselves.

Nevertheless, it appears that a more appropriate and helpful methodology than using a single series for the reference cycle would be to use, if available, a series that is not only less subject to revisions but also represents or indicates more closely and accurately the general course and level of economic activity. One such series would be the country's coincident composite index that is a major product of economic indicator analysis. Coincident indexes are now available for most major industrialised market economies.

[9] For a more detailed discussion of the construction of the composite indexes, see U.S. Department of Commerce

The Organization for Economic Co-operation and Development (OECD) has developed leading composite indexes since the mid-1970s for its member countries and has recognised the usefulness of having a 'reference series' around which its indicator system is built (see OECD 1987, esp. Chs 1 to 4). An increasing weakness of the OECD's economic indicator system, however, is its reliance on a 'total industrial production index' in each country for the reference series. The OECD recognises (see OECD 1987, pp. 24-7) that while a series for industrial production is a real series, is closely related to, but more promptly available than real GDP, and there is a high degree of comparability and consistency in its measurement by member countries, nevertheless, the share of industrial production in total economic activity has been declining significantly. The OECD (1987, p. 12) noted: 'The production industries may account for only 35 per cent of total OECD GDP in 1983 as opposed to 40 per cent in 1960 …'. This decline has continued. The OECD explains further that it settled in favour of industrial production as '… a single readily available variable, essentially identical for all countries …' whereas GDP estimates were '… available on a quarterly basis for only about half of the [24] OECD Member countries and annually for the others …'. There would be considerable merit in the OECD developing a comprehensive coincident index for each member country, or employing the internationally comparable coincident indexes now developed by other institutions (for instance, those developed at the CIBCR and now reported by FIBER, for 14 countries, or ECRI for 13 countries,) for use in conjunction with the OECD's leading index in monitoring and forecasting the course and level of business activity in its member countries. The use of a coincident index as an essential part of a 'reference series' would be consistent with the course that the NBER and Mintz would follow, as explained above.

(1984, pp. 65-70).

One important strength of the coincident index itself is that it is much less subject to revisions or changes than is a single series (and notably the national accounts). This is partly because the combination of the six components reduces the effects of measurement problems relating to errors or later revisions of a series, especially where the early estimates of a series are based on preliminary information. It particularly means that the coincident index generally exhibits a more accurate and stable reading of the course of each phase of the business cycle and of the turning points than would a single series.

Some economists have questioned the inclusion of the two labour market series in the coincident index (see, for instance, Pagan 1996, p. 13, n. 11). One argument in favour of their inclusion is that the labour market situation (in terms of both the level of employment and the unemployment rate) generally manifests important political, social and economic evidence on the current state of an economy. Retail turnover also furnishes helpful information on the current state of business activity. Fundamentally, in the absence of the 'ideal' monthly measure of 'aggregate economic activity', as discussed in section 5.1 above, what is defined as the current state of business activity reflects what economists, policy-makers, business people and the community in general believe needs to be taken into account to describe accurately (for economic, political and social purposes) the current health of an economy on both micro and macro bases. In brief, the combination of the key variables in the coincident index involving production, income, trade and the labour market does this well by capturing important and different aspects of the overall current state of economic activity. We are thereby provided with a more comprehensive, timely and reliable reading of the current state of business activity than could be obtained from a single series. Similarly, the leading index (combining series that have a proven record of generally anticipating well the future course of business activity) has also been

found to provide more robust forecasts than any single component of the index on its own. For instance, Auerbach (1982, see esp. pp. 594-5) concluded that the exclusion from the U.S. leading index of series that do not individually appear to be performing well for forecasting purposes actually worsened the performance of the index in out-of-sample predictions.

It is worth commenting further here on the popular and frequently quoted (but crude and often misleading) rule that a classical recession occurs if and when there are two consecutive quarters of negative growth in real GDP (see, for instance: ABS 1993, p. v; Crosby and Otto 1995, pp. 55 and 68, n. 1; Pagan 1997a, p. 1; and van Wel 1998, p. 1). This has not been a consistently reliable rule for either the United States or Australia. For instance, for the United States one would have missed the classical recession in the early 1960s, as shown in Table 1, columns 7 and 8, since there was only a single quarter of negative GDP growth. This applies to both the former real GDP series constructed on a fixed-base year method (see U.S. Department of Commerce 1994, p. 42) and the recently introduced GDP series measured on a chain-weighted method (see U.S. Department of Commerce 1997, p. 15). Other recessions in the United States would have been believed to be shorter and to have a different timing and duration than shown in Table 1 (columns 7 to 9). For Australia, using GDP(A) and GNFP(A), one would not have missed any recessions, but their duration and timing would have been significantly different from the results in Table 2. In particular, some recessions would have lagged by up to about a year and been of shorter duration than shown in Table 2, column 9. Alternatively, if one had used for Australia the income-, expenditure- or production- based estimates of either GDP or GNFP, one would have found recessions not only of shorter duration but also some ‘false alarms’; that is, there were instances of two consecutive quarters of negative growth when other evidence exhibits no classical recession.

It was noted above that van Wel (1998) identified the recession phases of Australia's classical cycle by using the definition of two consecutive quarters of negative growth. Though van Wel's results are not surprising, it is nevertheless difficult to see how she concluded (p. 2) that this resulted in phases 'very similar' to those determined by Boehm and Liew (1994) (see also Table 2, columns 7 to 12, of this paper). For instance, if we assign the peaks and troughs identified by van Wel in the middle month of the corresponding quarter, then the peak she identifies in 11/73 leads the corresponding peak in Boehm and Liew's paper (dated at 7/74) by 8 months (see Table 2, column 7). Similarly, van Wel's trough in 8/74 leads Boehm and Liew's in 10/75 by 14 months, while the next peak she identifies (in 5/77) lags Boehm and Liew's (in 8/76) by 9 months. Finally, van Wel's peak in 5/82 lags Boehm and Liew's in 6/81 by 11 months. Moreover, van Wel (1998, p. 2) is incorrect in stating that Boehm and Liew used only a 'coincident index' to identify Australia's turning points. These were determined as stated in the sources of Table 2 in this paper.

8. Forecasting business cycles with leading and coincident indexes

The coincident composite index is not only useful as a more reliable proxy of the business cycle than a single series such as real GDP. It can also be used for purposes of economic policy-making – along with a leading composite index – to furnish reliable short-term forecasts of the likely course of economic activity in both classical and growth cycle contexts. A reliable reading of the classical cycle can, of course, be made simply from the *level* of the coincident index, a feature of economic indicator analysis that appears not to be always recognised or understood. It is the raw data reporting the level of the coincident index or, more particularly, the peaks and troughs of this index which contribute to the fixing of the classical

cycle chronology. Moreover, it can convey at a glance a great deal of information about the current state of the economy, including the direction and level of economic activity. Much additional information about the current state of the economy and its future prospects may also be obtained from analyses of the growth rates and deviations from trend of the leading and coincident indexes.

One of the most helpful, consistently reliable and straightforward techniques so far developed for monitoring and forecasting jointly both classical and growth cycles is the six-month smoothed growth rates of the leading and coincident indexes, respectively, as presented in Chart 3.[10] The smoothed growth rate method, as described in footnote 5 above, has been found more suitable and generally less volatile than others, such as taking the per cent change on the corresponding month of the previous year.[11] Nevertheless, it should be allowed that the annual growth rates of the indexes fluctuate month by month, as can be seen in Chart 3. Furthermore, the growth rate in the leading index in a particular month does not mean that the economy is (necessarily) going to grow at that rate at any time in the future. What it does mean is that when there are, for instance, periods of above (or below) trend growth in the leading index, the economy is likely to experience similar growth also in the coincident index (that is, in the current economic performance) in the months ahead. The composite indexes themselves are made useful

[10] For a detailed description of a system of monitoring business cycles with the aid of the smoothed rates of growth in the composite indexes of leading and coincident indicators, see Zarnowitz and Moore (1982); and Moore (1983, Ch. 4). There has been extensive and successful use of the six-month smoothed growth rate method since 1983 in CIBCR's (and now FIBER's) monthly *International Economic Indicators*, and since 1996 in ECRI's monthly *International Cyclical Outlook* and other publications.

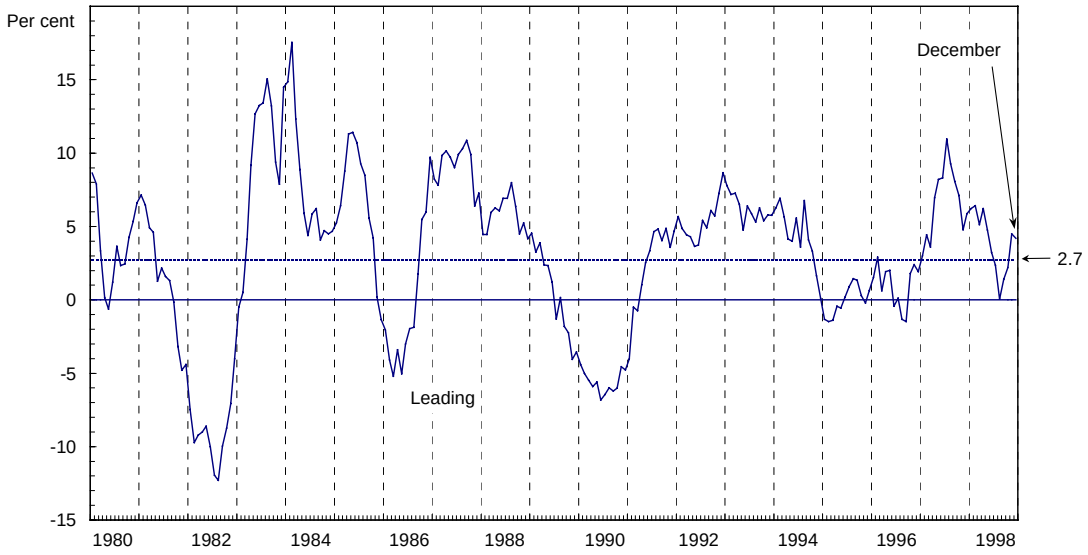
[11] It is important to remember that both of these methods of computing growth rates are methods of filtering the data, and that from a statistical perspective, these (and other) filters have differing effects when applied to a given data series. Although it is beyond the scope of this paper to discuss the specific effects of various filters, the fact that they will generally differ needs to be borne in mind.

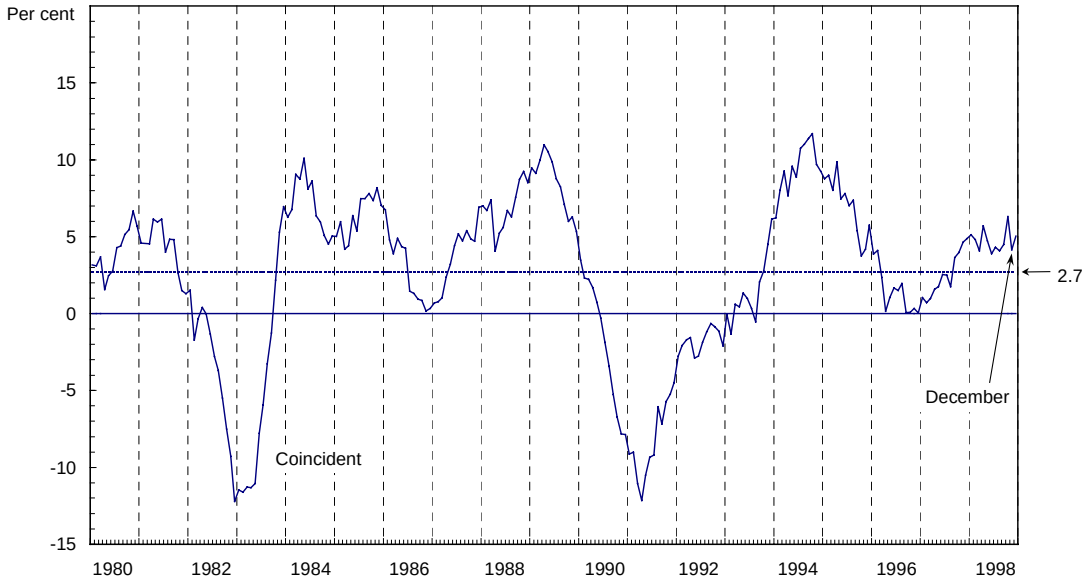
as indicators of changes in the general *level* of economic activity by adjusting each index so that its rate of growth is equal to the annual long-term trend rate of growth of real GDP. In Australia's case, this long-term trend is currently equal to 2.7 per cent per annum (or 0.223 per cent per month), as computed over the period 1985-95. This procedure is consistent with the neo-classical growth model developed by Solow (1970, see esp. p. 2) in which a key growth fact is that real GDP grows at a roughly constant rate over relatively long periods of time. Hence, with the trend rate of growth of each index equal to the rate of growth of the economy as a whole, any differences in the growth rates of the indexes month by month are due to short-run factors. It means that we can conclude, for instance, that the Australian economy is growing faster (slower) than its annual trend rate of growth when the rate of increase in the coincident index is above (below) 2.7 per cent.

One of the first signs that an expansion phase of the business cycle may be coming to an end is a decline in the smoothed growth rate of the leading index.[12] This change would be more clearly foreshadowed when the leading index growth rate moves below the trend rate of 2.7 per cent. The trend rate is shown by the dotted line in both panels of Chart 3. This chart is very helpful in distinguishing between a growth slowdown (or recession) and a real (classical) recession. When it is only a growth slowdown, the actual growth rate of the coincident index falls below the trend rate of growth but the rate generally remains positive. It is possible that, during a growth slowdown, the growth rate of the leading index may briefly become negative, reflecting some short-term volatility in the index. But it is generally unlikely to do so for more

[12] In Chart 3 the smoothed growth rate is placed in the current month; for instance, when the rate is computed using the January value and the average of the preceding twelve months, the result is assigned to January. However, in comparison with the business cycle turning points and in forecasting turning points, the growth rate needs to be shifted back three months. For example, the value computed using January data is assigned to October. This is done in order to centre the growth rate, on statistical grounds, with the corresponding turning point.

Chart 3: Growth Rates in Leading and Coincident Indexes
Australia, 1980 - 1998
(Six-month smoothed percentage change at annual rate)





Note: The broken lines at 2.7 per cent indicate the annual average rate of change, 1985 - 95, in the indexes.
Source: Melbourne Institute of Applied Economic and Social Research

than a month or so without the coincident index growth rate within a short time doing so as well. If the coincident rate becomes negative and remains so for at least six months (see Boehm and Moore 1984, p. 41; and Boehm 1987, p. 16 on NBER rules), this probably indicates a real recession. Other criteria used in fixing the turning points of business cycles also apply in fixing the cyclical chronology relevant to the period. The peak of the growth cycle occurs about the time that the coincident index growth rate (centred, as described in footnote 12) moves below the trend rate. If a real recession occurs, the classical cycle peak is experienced approximately when the (centred) coincident index growth rate becomes negative (sometimes with a short lag after the growth cycle peak; see Tables 1 and 2).

The beginning of a recovery phase of the classical cycle from a recession is foreshadowed when the (centred) leading index growth rate rises above zero while the coincident rate is probably still negative. The classical trough occurs approximately when the (centred) coincident growth rate becomes positive. This may lead by a month or so or be coincident with the growth cycle trough (Tables 1 and 2). The growth cycle trough takes place when the (centred) coincident growth rate exceeds the trend rate of growth.

Thus the growth rates of the leading and coincident indexes can be very useful to economic policy-makers through the respective readings that they promptly provide of the current state of, and future prospects for, the economy. The leading index furnishes a fairly reliable forecast of, on average, six to nine months ahead of what can be expected to be seen in the coincident index.

Chart 3 highlights at a glance the two classical recessions in 1981-83 and 1989-92. These were clearly anticipated by the leading index. The chart also demonstrates the two growth slowdowns in 1985-87 and 1995-97. Again, both slowdowns were foreshadowed by the leading

index and, as the leading index also generally anticipated, neither slowdown was followed by a classical recession. It is worth observing here that in the latter half of the 1980s when the Melbourne Institute was establishing its indicator project and offering its monthly report on it to potential subscribers in government, business and community circles in general, Chart 3 proved to be one of the more successful means in promoting the project, including to non-economists.

Boschan and Ebanks (1978) developed the phase-average trend method involving the concept of a non-linear trend in attempting to improve the NBER's trend-fitting methodology following the apparent significant slowdown in the long-term trend rate of growth in the first half of the1970s. An objective is to identify the trend so that it would itself be free as far as possible from the short-term effects of cycles. Nevertheless, their method is consistent with the fact that the trend and cycle may be intricately related. The method works well historically, but it has difficulties and uncertainties in measuring the deviation from trend over the last few months of the series being studied, and may react misleadingly – sometimes considerably from one recent month to another when updates of the series are made – if series included in an index are volatile in one month alone, especially the latest month. The OECD (1987, p. 12) records the problems it has experienced with the phase-average trend method, notably in '… calculating trend estimates over the most recent period, particularly the most recent uncompleted cyclical phase'. Similar problems arise in using other deviation from trend methodologies. This has, of course, made the reading of the current state of the economy and short-term economic forecasting with the deviations from trend approach uncertain and hazardous, and often misleading from one month to another with, for instance, the economy appearing 'clearly' to be in an expansion in one month, a contraction the next, but back to an expansion the next. For these purposes the per cent change six-month smoothed growth rate technique, as used for Chart 3, has proven to be

superior. Layton and Moore (1989, p. 380) came to the same conclusion favouring the analysis of growth rates directly rather than looking at deviations from trend. The deviation from trend analysis is an area of economic indicator analysis that warrants further detailed research and development if it is to aid consistently the reading of the current state of the economy and short-term economic forecasting.

9. Summary and conclusions

Much recent theoretical and empirical interest in business cycles has been concentrated on certain stylised facts, relating especially to the corresponding cyclical timing characteristics of key economic variables. The analyses have particularly involved the regularities and irregularities in terms of auto- and cross-correlations and standard deviations of macroeconomic variables in relation to the movements of real GDP as a proxy of the business cycle. Explanations of business cycles in terms of the timing of turning points, the durations of the upswing and downswing phases, and the amplitude of each phase appear to have attracted less interest. However, it is the timing, duration and amplitude of the phases of business cycles as well as the nature of the co-movements of key variables, with which policy-makers (in both government and business circles) are essentially concerned. The timing and mix of economic policies may also benefit considerably from the distinction made in economic indicator analysis between classical and growth cycles, thereby aiding an understanding of the amplitude of the fluctuations occurring in the level of business activity. For instance, it is particularly important for economic policy-makers to know if a growth slowdown foreshadowed by the leading index and occurring in the coincident index is likely to lead also to a classical (real) recession and then how deep and prolonged the recession appears likely to be. This contrasts with modern business

cycle theory, which offers little theoretical explanation of the amplitude of economic fluctuations (see also Collard 1996, esp. p. 923).

The recent major interest in the stylised facts of business cycles involving the cyclical behaviour of key economic variables in terms of deviations from trend may be seen as more of a backward-looking analysis than a forward-looking exercise. By contrast, both these tasks are performed well by the six-month smoothed growth rates of the leading and coincident composite indexes, thereby both monitoring and forecasting the course of expansions and contractions in business activity. In the process the technique facilitates the identification of turning points as an aid to economic forecasting and the choice of economic policies to fit the anticipated cyclical fluctuations. Nevertheless, the knowledge furnished by the backward-looking cyclical experiences involving particularly the cyclical nature of the co-movements of key variables during business cycles would also be instructive for policy-makers.

The results of a number of recent studies reporting the cyclical experiences concerning persistence and the co-movements of key variables in respect to real GDP (or output) have probably been weakened by their use of GDP as a proxy for the business cycle. This use generally appears not to have been questioned or justified. The contributors to business cycle analysis in terms of ‘deviations from trend’ (some of whom are listed in section 4 above) have been silent on the attention given by Mintz (1974, esp. pp. 9-10) to the weaknesses inherent in using a single series such as real GDP as a proxy for the business cycle. The analysts reporting the co-movements of key variables with those of real GDP (or output) need to justify this methodology and to consider what effect data revisions and the occurrence of extra cycles may have on the results that they have reported. It would also be of special interest to know whether more robust, reliable and permanent results from a long-term point of view would be provided by

studying cyclical persistence and the co-movements of key variables with the aid of a coincident composite index. This index should furnish a more reliable proxy of the business cycle and be much less subject to revisions than tends to be the case for a single series such as real GDP. Inter-country comparisons of the cyclical experiences of key variables obtained from using a coincident index should also provide more consistent and useful results, especially where the coincident indexes are constructed, as far as feasible, on a comparable international basis. This applies, for instance, to the Westpac-Melbourne Institute's index which is largely comparable with the coincident indexes constructed by FIBER (formerly CIBCR) and by ECRI (see also Boehm and Moore 1984).

Thus a subject for further research highlighted by this paper is the need for a comparative study of the empirical results from using alternatively real GDP (or real GNFP in the case of Australia) on the one hand and a coincident index on the other. This study could compare the respective cyclical experiences regarding persistence and the co-movements of key variables during the business cycle on national and international bases. Such a study could also investigate whether consistent or variable patterns occur over different periods both nationally and internationally. The statistical results on turning points presented in this paper clearly suggest that more reliable evidence on cyclical experiences regarding persistence and the co-movements of key variables should be obtained from using a more comprehensive series such as a coincident index to represent the business cycle, rather than a single series such as real GDP.

Finally, since many economists justifiably view the estimates of real GDP as the most comprehensive (readily available) single measure of aggregate economic activity, an additional subject for further research is why real GDP spawns 'extra cycles'; that is, extra to the cycles that are identified via a comprehensive economic indicator analysis that follows the NBER business

cycle methodology. This analysis would generally involve a short list of key selected roughly coincident series including real personal (or household) income, real GDP (or GNFP), industrial production, employment, unemployment and real retail trade, together with a composite index of those series.

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