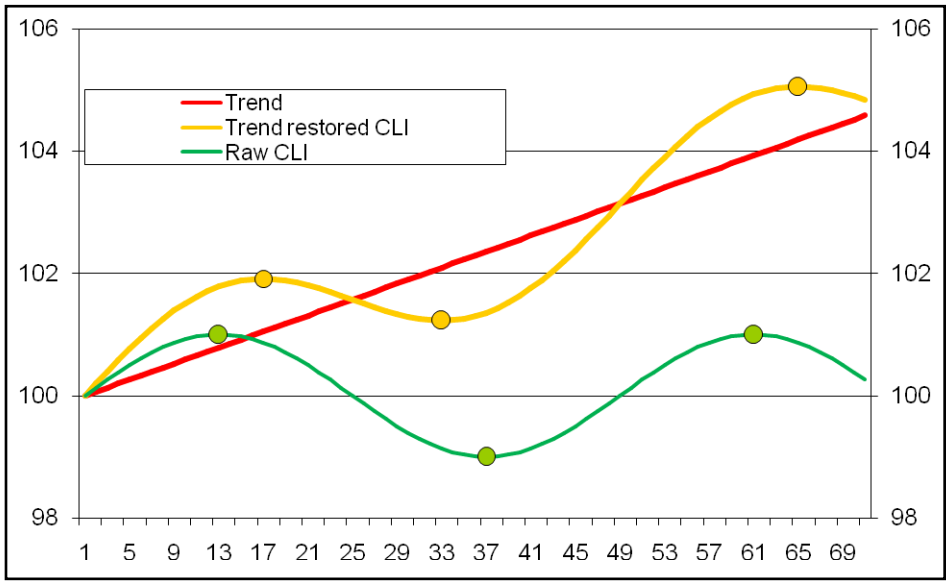
Technical note: Changes to the OECD's Composite Leading Indicator

This document is intended as a technical reference to the information note explaining the OECD's decision to change the focus of presentation for the Composite Leading Indicator (CLI), and therefore needs to be read in conjunction with this note. At present, the OECD presents the trend restored and 6-month rate of change (annualized) forms of the CLI as the headline indicators in the monthly press release. This technical note explains why a single version of the CLI, the ratio to trend amplitude adjusted CLI, should be the preferred headline indicator. This change should enable the OECD to give clear messages on the signal of the CLI in regards to future cyclical developments in economic activity and eliminate the current confusion between considering level and growth series in parallel.

Issues with trend restoration of the CLI

OECD currently uses trend restoration of its CLI series in order to be able to compare the CLIs with their raw reference series. With this operation the two series indeed become comparable; however the operation obscures the cyclical patterns, which should be the key focus of a CLI. This occurs as the trend dominates the cyclical movements, and as a result of this dominance an increase in the trend restored CLI does not necessarily indicate an improvement in cyclical terms. For example, it may be the case that the CLI increases just because the trend growth was larger than the decrease in the raw CLI. As a consequence local minima in the trend restored CLI tend to precede, and local maxima tend to succeed their respective turning points in the raw CLI as seen in the graph below. For correct interpretation of the trend restored CLI one has to be aware of the trend growth rate of each country.

Phase shifts between the trend restored and the raw CLI



Therefore a better approach would be to present the cyclical co-movements among trend removed series, i.e. using the reference series also in its trend removed form. This is more natural for the CLI as it is compiled through aggregation of its component series in their trend-removed form. These trend removed series which have a long-term average = 100 focus only on the cyclical characteristics (deviation from long-term trend), and their interpretation is straightforward. A period starting with a peak and ending in a trough is interpreted as a downswing in the growth cycle[1], a period starting with a trough and ending with a peak is an upswing. Values over 100 may be looked at as a positive output gap, whereas values below 100 a negative output gap[2]. For the purpose of easier interpretation the following classification has been introduced in the CLI press release identifying four phases of the growth cycle:

- Expansion – series is increasing and above 100;
- Downturn – series is decreasing but above 100;
- Slowdown – series is decreasing and below 100;
- Recovery – series is increasing but below 100.

As such, the above classification specifies an upswing in economic activity at a particularly point in time as a recovery or expansion depending on the level of the series with regards to its long-term trend (or long term average in the case of the CLI). Similarly a downswing is specified as either a downturn or slowdown in the same way. Moreover, turning point candidates can be more easily identified by the user, since OECD turning point detection routines themselves use local maxima and minima of the de-trended reference series as turning point candidates. In practice, turning points in industrial production or GDP have been found about six months (on average) after the signals of turning points had been detected in the CLI.

A further problem with trend restoration is that it introduces an extra source of revision in the composite leading indicator, which otherwise would be avoidable. Normally the revisions of the CLI can come from revisions or updates of the component series, but in the case of trend restoration they can also come from revisions of the trend of the reference series. Moreover these trend estimates not only introduce extra volatility in the indicator and yield worse readability but also cause an extra maintenance burden.

Problems with the parallel usage of level and growth rate series

The above discussion justifies why the OECD intends to focus on the trend removed or ratio to trend form of the CLI in preference to the trend restored CLI. The only adjustment made is that this series is altered to ensure that the amplitude of its cycles agrees on average with that of its reference series – which equates to the amplitude adjusted form of the CLI. Given the characteristics of this preferred version of the CLI, the question then remains as to whether there is any advantage for the interpretation of the CLI if a differenced series is also calculated. This is the current approach where the CLI trend restored series and a series of six month rate of change (annualized) are presented in parallel.

The problem with using the level (i.e. trend restored or amplitude adjusted versions of the CLI) and the growth series in parallel comes from the fact that the two series have different cyclical

[1] The relationship between classic cycles, growth cycles and growth rate cycles are illustrated in a paper by Anas/Ferrara included in OECD Journal of Business Cycle Measurement and Analysis Vol. 1 No. 2 2004

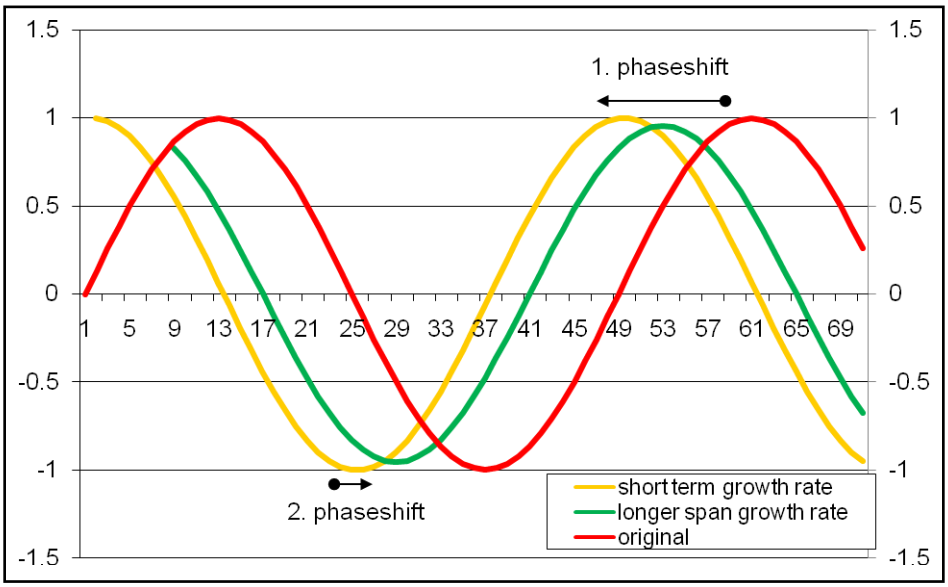
[2] The HP de-trending filter, which is similar to the CLI de-trending method, is frequently used to estimate potential output, see ECO Working paper No. 152, 1995.

patterns, in despite of their apparent similarity. In simple cycles these differences are predictable. However in real life complex cycles the differences become unpredictable, which makes it extremely hard to base a coherent communication of cyclical developments by referring to the two different series.

The case of the simple cycle

The following graph is showing a simple cycle (a sine wave) and the effects of the calculation of a long term growth rate, split into two steps. The 6-month rate of change of the CLI, used by the OECD can be considered as a long term growth rate in this respect. The two steps involved in the calculation of a long term growth rate are the calculation of *short term* growth rates (differencing) and a *moving average* calculation on the short term growth series. Both the calculation of a short term growth rate and the averaging causes a phase-shift compared to the original series. The short term growth rate in the graph below is the month on month growth rate. Its calculation will cause a phase-shift to the left which is equal to a quarter of the cycle length of the original series. The non-central averaging process on the other hand will cause a phase-shift in the opposite direction. The size of this shift depends on the span chosen for averaging, and is independent of the cycle length. In the example below the span of the long term growth rate is 12 months, yielding a 12 month (i.e. year-on-year) rate of change series.

Phase shifts caused by calculating long term growth rates



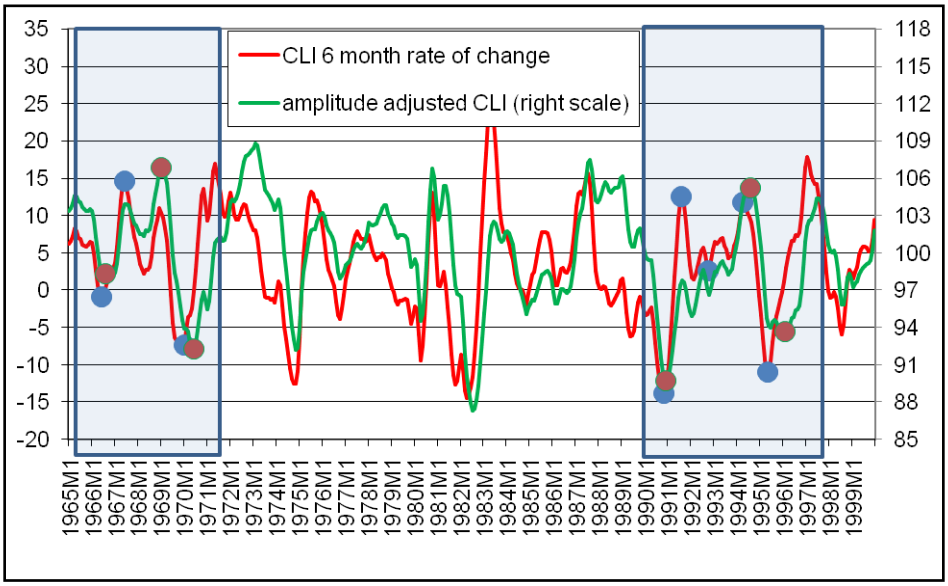
Extension to a real life cycle

If we were to deal with such 'nice' cycles in real life, it would be tempting to choose the differencing option and gain an extra lead of a quarter of a cycle. However the real life case is very different. Real life cycles can be regarded as combinations of ideal cycles of different cycle length. After differencing a complex cycle the relative size of shorter cyclical components

increases and components are phase-shifted to different degrees. Therefore the phase-shifts in a complex cycle are neither stable, nor easily predictable.[3]

In the case of Canada as shown in the graph below, 6 cyclical peaks or troughs match exactly in the raw CLI (amplitude adjusted CLI) and the growth rate series (6 month rate of change, annualized), however the rest of the turning points (approximately 20) are either lagged, missing or extra. In these latter cases the interpretation of the cyclical stance is very complicated and sometimes contradictory. Two periods on the graph are highlighted to illustrate this.

Canada (6 month rate of change and the amplitude adjusted CLI)



In the first highlighted period (from 1966 to 1970) the raw CLI has a long expansionary phase. This upswing starts in July 1966; it has a minor break in the second half of 1967, and reaches its peak in January 1969. At the same time the growth rate series shows a short lived upswing that starts in June 1966, reaches its peak in June 1967, and indicates a downward trend afterwards, with a minor recovery while the raw CLI reaches its peak. Unless a clear distinction between the two series is made, and the relationship of the two series is explained, the message for the period between June 1967 and January 1969 is mixed and confusing. Overall the period is categorized as an upswing by the raw CLI and as a downswing by the 6 month rate of change series. In the

[3] Our complex cyclical function used for illustration could be represented by a weighted sum of i sine waves of varying cycle length:

$$c(y) = \sum_i a_i \sin(k_i y)$$

This may still lack the complexity of a real life cycle; however it is complex enough to highlight the phase shifts which occur at the time of growth rate calculation on a complex cycle. The ideal short term growth rate would be the derivative of the cycle:

$$c'(y) = \sum_i a_i k_i \cos(k_i y)$$

The individual sine waves are shifted to the left a quarter of their original cycle length as the derivatives of the sine waves are cosine waves. The cycle length of each component is governed by k_i. The greater k_i is the shorter is the cycle length. As it can be seen, after the differentiation, the k_i's modify the original weights of the component cycles, giving emphasis to cycles with shorter wave-length.

second highlighted period (from 19 to 1996), the peak of the 6 month rate of change series not only precedes the peak of the raw CLI, but also contains a complete extra cycle and the contradictions between the two series are more apparent even locally.

These phase-shifts between the level (i.e. raw CLI) and growth rate series suggest that the OECD should avoid using them in combination, especially since the CLI press release and the CLI related publications have limited space to clearly elaborate the underlying situation when the indicators go in opposite directions. However each of them, alone, can form the basis of a coherent cyclical analysis framework, for which the relative advantages and disadvantages in the context of cyclical analysis are summarized in the table below.

Assessment of the CLI level and growth rate series for cyclical analysis purposes

	Level series	Growth rate series	Preferred
Story	The patterns in the CLI can be interpreted as expected patterns in the evolution of the output gap.	The series are comparable with official growth rate figures of the reference series (i.e. IIP or GDP), but cannot be considered efficient forecasts of these.	Level
Trend removal	For most of the component series and the reference series trend removal is needed.	The time series differencing already eliminates the majority of the trend	Growth
Implementation	Cyclical indicators are built and tailored to this concept allowing a wide range of component series to be considered (including qualitative series)	To have well behaving (optimal) leading indicators in growth rate terms the whole analysis and production process should be changed, including component selection. This approach is not common in the leading indicator literature.	Level
Information content	Calculating growth rates based on level series is easy	Recovering original level series may be difficult (especially if one calculates growth rates with the current 6 month rate of change technique)	Level
Continuity, stability	Even after a methodological change in detrending and smoothing, the time series patterns and the turning point dating will stay relatively stable	Because of the inherent phase shifts and higher cyclical frequency the turning point dating of growth rate based series may be susceptible to significant revision	Level

Conclusion

In makes sense that the OECD should choose one version of the CLI on which to base a consistent communication of signals for future cyclical developments in economic activity. Considering the advantages and disadvantages of the different measures available in the context of their information content for cyclical analysis, it is clear that the ratio to trend amplitude adjusted form of the CLI is the best option.

OECD Statistics Directorate
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