STATISTICS BRIEF

OECD

Predicting the Business Cycle

How good are early estimates of OECD Composite Leading Indicators?

By Ronny Nilsson and Emmanuelle Guidetti

For good economic policy making and many other economic agents' decisions it is necessary to correctly assess the current and, especially, the future economic situation. Over the last 50 years several leading indicators have been developed to signal the movements, up and down, of future economic activity before they occur, as well as to provide some indication of the magnitude of those movements. One of the most well known (and carefully followed by financial analysts) composite indicators worldwide has been developed by the OECD. Published every month, the set of OECD Composite Leading Indicators (CLIs) covers not only the OECD member countries, but also the most important non-members (China, Russia, etc.). This *Statistics Brief* describes the purpose they serve, how they are constructed and their performance and reliability, measured through a careful analysis of their revisions.

Purpose and characteristics of the OECD's Composite Leading Indicators

The "leading indicator" approach is based on the view that market-oriented economies experience repetitive but non-periodic fluctuations in economic activity. The OECD system of leading indicators is based on the "growth cycle" approach, which measures deviations from the long-term trend. A contractionary phase signals a decline in the rate of growth of the reference series though not necessarily an absolute decline in economic activity. This is distinct from classical cycles which are defined as a succession of periods of absolute growth and decline in economic activity. The peaks and troughs of growth cycles tend to appear earlier in time than those of classical cycles.

Figure 1. **OECD area Composite Leading indicator (CLI) and economic activity** (long-term trend = 1)

Organisation for Economic Co-operation and Development
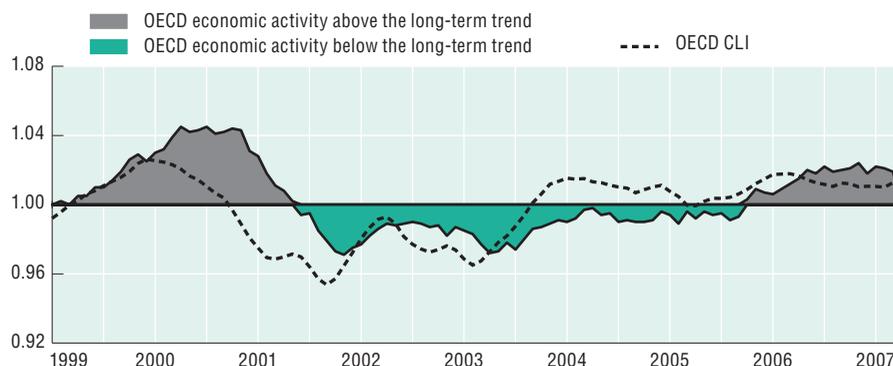
In particular, OECD CLIs are constructed to predict cycles in a reference series chosen as a proxy measure for the aggregate economy. By looking at Figure 1, one can see that the CLI for the OECD area is strongly correlated with the indicator of economic activity, but with the turning points of the CLI preceding those of the economic activity. The index of industrial production (IIP) is used as the reference series for aggregate economic activity because besides constituting the most cyclical subset of the aggregate economy, it is available promptly and on a monthly basis for most OECD countries. In addition, the cyclical profiles of IIP and gross domestic product (GDP) in OECD countries have been found to be closely related, so that the CLIs also serve as leading indicators of the GDP cycle.
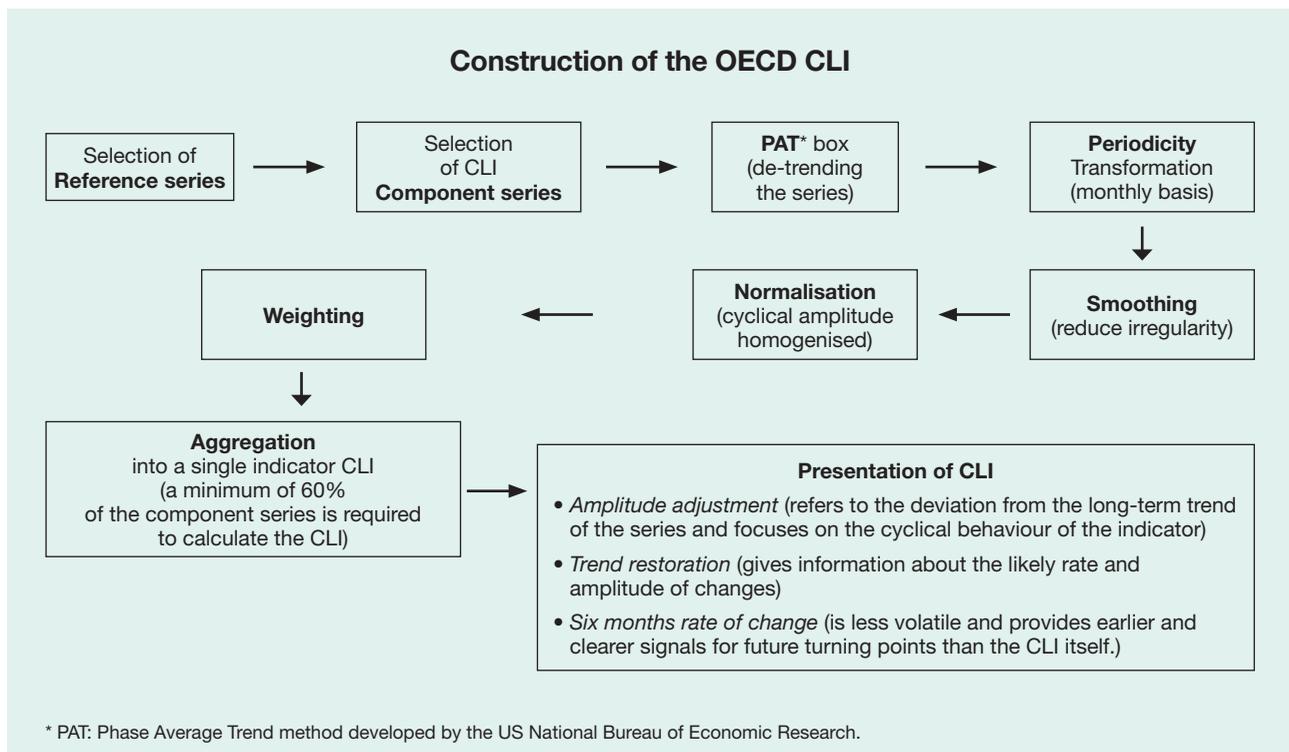
OECD CLIs are calculated by combining component series in order to cover, as far as possible, the key sectors of the economy. These component series cover a wide range of short-term indicators such as observations or opinions about economic activity, housing permits, financial and monetary data, etc. For each country, these component series are selected according to the following criteria:

- economic significance;
- cyclical behaviour; and
- data quality.

The final set of component series is selected in order to maximise the performance of the CLI with respect to the reference series, which is evaluated in terms of missing or extra cycles, homogeneity of leads at turning points and cross-correlation. The number of series used for the compilation of the OECD CLIs varies for each country, but ranges between five to eleven series, and averages eight.

The aggregation of component series to form the CLI reduces the risk of "false signals", which are defined as changes in the indicator due to irregular movements that do not correspond to any later developments in the reference series. The component series need to be transformed and "standardised" in various ways before they can be combined into one single composite indicator. This entails:

- *De-trending*: the growth cycles (*i.e.* the deviations from the long-term trend) of each component series are derived.

Construction of the OECD CLI

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│   Selection of   │ ───▶ │    Selection     │ ───▶ │    PAT* box      │ ───▶ │   Periodicity    │
│ Reference series │      │     of CLI       │      │  (de-trending    │      │ Transformation   │
│                  │      │ Component series │      │   the series)    │      │ (monthly basis)  │
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│                  │ ◀─── │  Normalisation   │ ◀─── │                  │      │    Smoothing     │
│    Weighting     │      │(cyclical amplitude│      │                  │      │(reduce irregularity)│
│                  │      │  homogenised)    │      │                  │      └──────────────────┘
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│      Aggregation         │      │              Presentation of CLI                   │
│ into a single indicator CLI│ ──▶ │ • Amplitude adjustment (refers to the deviation from the long-term trend │
│  (a minimum of 60%       │      │   of the series and focuses on the cyclical behaviour of the indicator) │
│ of the component series is required│  │ • Trend restoration (gives information about the likely rate and │
│   to calculate the CLI)  │      │   amplitude of changes)                            │
└──────────────────────────┘      │ • Six months rate of change (is less volatile and provides earlier and │
                                  │   clearer signals for future turning points than the CLI itself.)  │
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* PAT: Phase Average Trend method developed by the US National Bureau of Economic Research.

- *Periodicity*: all component series are transformed to monthly periodicity.

- *Smoothing*: in order to reduce the irregularity of the final composite indicator, component series are smoothed using well established statistical techniques.

- *Normalisation*: the cyclical movements are expressed in a comparable form, and so the cyclical amplitude is homogenised.

Interpretation of trend restored and amplitude adjusted forms of the CLI

The OECD uses trend restoration of the CLI series to compare them with their reference series by multiplying the raw CLI, which fluctuates around 100, by the trend of the reference series. Trend restoration enables the two series to become quantitatively comparable but the operation obscures the cyclical patterns, which are the main focus of the CLI. Because long-term trend growth dominates the cyclical movements, an increase in the trend-restored CLI does not necessarily indicate an improvement in cyclical terms. For correct interpretation of the trend-restored CLI one has to be aware of the trend growth rate of the reference series for each country. Trend restoration has the additional disadvantage of introducing an extra source of revision and volatility in the CLI. Normally the CLI revisions come from revisions or updates to their component series, but in the case of trend restoration they can also come from revisions of the trend of the reference series.

A better approach is to focus the analysis on the cyclical co-movements of the CLI and its reference series from *trend-removed* series. This is more natural for the CLI as it is compiled through aggregation of its component series in their trend-removed form. The only adjustment made is that the CLI 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. Comparison with the reference series also in its trend-removed form is then straightforward. Using this approach, the quality of the CLI in regards to its consistency in leading the cycle of the reference series is more evident and turning points can be easily identified.

- *Weighting*: in general, for each country, component series of the CLI have equal weights.

Improving the performance of the OECD CLIs

As for most statistical indicators, CLIs are subject to revisions. Although revisions are necessary, they are not very much appreciated by users, especially when signals provided by indicators about the cyclical situation change over time. The following factors give rise to CLI revisions:

- *Timeliness/availability*: CLI data for a given month "*t*" are published at the beginning of month "*t*+2". But many components are not sufficiently timely and so the CLI is subsequently revised when they become available.

- *Frequency*: CLIs are calculated with monthly frequency, but some of their components are of quarterly frequency, such as business tendency survey indicators for some countries. The current method to convert quarterly series into monthly series is linear interpolation, and so revisions are made as new data become available.

- *Smoothness*: In order to aggregate the component series to a country CLI, it is necessary to ensure that they have equal "smoothness", *i.e.* month-to-month changes in the composite indicator are not unduly influenced by irregular movements in any indicator series. The OECD uses the "Months for Cyclical Dominance" (MCD[1]) moving averages, a procedure that ensures approximately equal smoothness between series and also ensures that the month-to-month changes in each series are more likely to be due to cyclical than to irregular movements. The data lost at the end of the series due to the moving average are restored with an extrapolation by regression over the end of the series. And so this procedure introduces revisions to the end of the series depending on the length of the moving average (given by the MCD value) needed to smooth the series. Indicators with small

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1. MCD (Months for Cyclical Dominance) is defined as the shortest span of months for which the I/C ratio is less than unity. I and C are the average month-to-month changes without regard to sign of the irregular and trend cycle components of the series, respectively.

Table 1. Component characteristics of OECD Composite Leading Indicators (CLI) before and after the 2002 CLI review

Country	CLI before 2002 review						CLI after 2002 review					
	Total number of components	Non-revised components survey (S) or financial (F)		Monthly components	Timeliness: latest data available at $t+2$ or earlier	Smoothness: components with MCD < 4	Total number of components	Non-revised components survey (S) or financial (F)		Monthly components	Timeliness: latest data available at $t+2$ or earlier	Smoothness: components with MCD < 4
		% of total number of components						% of total number of components				
		F	S					F	S			
Canada	10	20	30	70	40	80	8	37	37	75	63	75
Mexico							7	43	43	100	86	42
United States	8	25	12	100	87	75	7	28	28	100	100	100
Australia	8	25	50	50	37	100	7	28	43	57	43	100
Japan	9	22	22	78	44	89	7	28	0	100	86	57
Austria	6	17	33	67	17	100	6	17	67	100	100	100
Belgium	7	0	57	100	57	29	6	0	83	100	83	50
Denmark	9	22	22	67	55	55	8	25	37	87	75	50
Finland	10	30	50	50	10	90	9	22	44	67	55	100
France	12	42	33	100	92	75	10	30	40	100	90	70
Germany	6	17	67	100	100	83	6	17	67	100	100	83
Greece*	9	11	33	100	67	44						
Ireland	9	33	33	89	55	55	8	25	50	100	75	37
Italy**	7	29	43	100	83	50	6	17	50	100	83	50
Netherlands	9	22	55	100	55	44	6	17	83	100	100	67
Norway	6	33	50	50	33	83	6	33	33	67	67	83
Portugal	6	0	50	50	33	33	6	17	50	100	100	83
Spain**	7	0	86	57	43	43	5	20	60	100	100	60
Sweden	11	36	36	64	36	72	9	22	44	55	50	67
Switzerland*	7	43	43	100	100	71						
United Kingdom	9	0	67	78	78	89	7	0	57	86	86	86
Total		23	42	76	56	70		24	47	89	80	73

* No revision undertaken in 2002.
** CLI review undertaken in 2001.

MCD values are preferred in order to minimise the length of the moving average when performing smoothing. Monthly component series with MCD values above 4 are very irregular and will imply revisions to the series when the next data become available.

- *Other factors*: These include revisions to the source data, including revisions to the seasonal factors, and revisions arising from homogenisation of the cyclical amplitude of components.

In 2002 the OECD undertook a major review of its CLIs with the objective of minimising revisions and maximising their predictive capability. In particular, series included in CLIs were carefully analysed to replace untimely components series, component series no longer published and quarterly component series with monthly ones. After the 2002 CLI review, the share of timely components increased by 24%, which is partly explained by the increase of 13% in the share of monthly component series. Business and consumer tendency survey series are the most frequently used CLI component series which are never or rarely revised. Their share increased by 5% after the 2002 CLI review. A second group of never or rarely revised series includes financial series. The share of such components remained at about the same level after the 2002 CLI review. Table 1 summarises the component characteristics that are important for understanding and explaining revisions to the CLIs.

If the share is above a certain threshold value for at least three of the following four criteria then country CLIs are classified to a "low revision group":

1. *Timeliness/Availability:* the share of latest data available at t+2 or earlier is above 80 per cent.

2. *Frequency:* the share of monthly components is above 80 per cent.

3. *Smoothness:* the share of components with MCD less than 4 or QCD less than 2 is above 80 per cent.

4. *Non-revised series:* the share of business/consumer tendency surveys and financial and monetary components is above 60 per cent.

The results for the period after the 2002 CLI review show a widespread improvement with the share of country CLIs that would be expected to be exposed to major revisions falling by half to reach 40 per cent. The countries for which the CLIs would still be expected to show major revisions are Canada, Australia, Japan, Denmark, Finland, Ireland, Norway and Sweden. In all cases, timeliness or smoothness or both factors together explain the existence of high expected revisions for these countries. The weak timeliness occurring in half of these countries is explained by the fact that quarterly business tendency survey indicators are used as components (Canada, Australia, Norway and Sweden).

How have the OECD Composite Leading Indicators performed in practice?

The historical performance of the composite leading indicators for member countries covered by the OECD system is set out in Table 2.[2] The results refer to the latest revision undertaken by the OECD. To check their historical performance at turning points the table shows the number of extra and missing cycles in the indicators, and the median leads at peaks, troughs and at all turning points, together with the absolute mean deviation from the median. The median, rather than mean, is usually used in this kind of analysis because there are relatively few observations for some countries. These measures can be relied upon to give a true picture if the cycles are clear and irregular variation is not a problem. However, for example, with a twin-peaked pattern, the choice of one date rather than another can alter these measures significantly. Furthermore, an extra cycle in the composite indicator is not penalised, but a missing cycle is penalised twice – once for the peak and once for the trough. Hence, these figures should be treated with caution.

Ideally, the absolute mean deviation from the median should not be too great itself and should not be too great in comparison with the median. However, the mean deviation exceeds the median lead for nine countries: Canada, Mexico, Australia, Denmark, Germany, Greece, Netherlands, Portugal and Switzerland.

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2. Click on the following link to find more information on historical data and methodological information: *www.oecd.org/documentprint/0,3455,en_2649_34349_39438112_1_1_1_1,00.html.*

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

From Table 2 it can be seen that, in general, the historical record of the composite indicators both with respect to turning points and closeness of fit has been rather good. The average lead of the composite indicator, as measured by the lag at which the closest correlation occurs, should not be too different from the median lag at all turning points if the composite indicator is to give reliable information both about approaching turning points as well as during the evolution of the reference series. This difference has been eight months for Portugal, five months for both Finland and Spain, four months for Denmark and Ireland, three months for Austria and Germany but for other countries two months or less. For most countries, the composite indicators have in the past

Table 2. **Historical performance of OECD Composite Leading Indicators**									
				Turning point analysis Median lag (-) in months at				*Cross-correlation*	
Country	Date of revision of Composite Leading Indicators	Number of turning points	Extra (x) or missing (m) cycles	Peak	Trough	All turning points	Mean absolute deviation around median	Months Lag (-)	Peak value
Canada	2002	19	1x	4	4	4	8.0	6	0.66
Mexico	2006	13	2x, 1m	4	9	4	5.0	5	0.77
United States	2002	19	1x	7	4	6	3.6	5	0.77
Australia	2002	17		4	6	5	6.3	7	0.52
Japan	2002	19	1x	9	5	8	5.4	6	0.84
Austria	2002	19		4	9	7	6.3	4	0.85
Belgium	2002	17		6	5	6	6.0	6	0.58
Denmark	2002	11	1x	10	7	8	9.0	4	0.66
Finland	2002	15	1x	12	9	9	6.5	4	0.59
France	2002	15		7	7	7	5.7	7	0.69
Germany	2002	19	1x	7	2	3	4.3	6	0.72
Greece	2006	23	1x, 1m	2	7	3	7.4	4	0.49
Ireland	2002	21	2x	7	5	7	6.0	3	0.54
Italy	2001	25	1x	9	5	7	5.7	6	0.76
Netherlands	2002	19	4x	7	9	8	8.9	6	0.75
Norway	2002	14	2x	6	2	3	2.6	2	0.65
Portugal	2002	09	1x	1	3	1	3.0	9	0.50
Spain	2001	21	2x	12	8	9	5.2	4	0.73
Sweden	2002	17	1x	4	6	6	4.9	8	0.78
Switzerland	2006	21	1x, 2m	2	6	6	9.4	7	0.60
United Kingdom	2002	21	3x	7	6	7	5.0	8	0.66

led the reference series by at least five months, taking both measures into account.

Is the first estimate of the CLIs able to provide early signals of turning points in economic activity?

The aim of the revision analysis is to evaluate the quality of the CLIs when they are first released. The historical performance of OECD CLIs is examined regularly and the results are published frequently. However, these results may give a somewhat favourable picture of the historical performance of the CLI in regards to signalling fluctuations in the growth cycle of the reference series as they are generally evaluated after series have been revised. It is therefore important to examine the performance of the CLI in "real-time", using successive monthly

	Number of turning points over common sample period	Extra (x)/missing (m) turning points between estimates		Median lag (-) and standard deviation (std) at all turning points between estimates			
				Lag(-)	std	Lag(-)	std
		1st and 2nd estimate	2nd and 3rd estimate	1st and 2nd estimate		2nd and 3rd estimate	
Canada*	6	0	0	0	1.6	-1	3.1
Mexico	3	0	2 m	-1	2.6	0	2.0
United States*	4	0	0	0	1.5	0	0.0
Australia	3	0	0	-1	1.0	0	0.6
Japan*	4	0	0	0	0.8	-1	0.6
Austria	3	0	0	0	0.6	0	0.0
Belgium	5	0	0	0	0.4	0	0.7
Denmark	4	0	0	-1	2.5	0	0.5
Finland	4	0	0	1	1.7	-1	0.6
France*	6	0	0	-1	0.5	0	0.7
Germany*	6	0	0	0	0.4	0	0.5
Greece	5	0	0	0	0.8	0	0.7
Ireland	3	0	2 m	0	0.6	0	0.5
Italy*	6	0	0	-1	0.8	-1	2.0
Netherlands	5	0	0	0	0.9	0	0.4
Norway	4	0	0	0	0.8	0	0.0
Portugal	3	0	0	0	0.0	0	0.0
Spain	4	0	0	0	1.0	0	0.0
Sweden	3	0	0	0	0.0	0	0.0
Switzerland	3	0	0	0	1.5	0	0.6
United Kingdom*	6	0	0	-1	0.5	0	0.4
OECD area	6	0	0	0	0.0	0	0.4
Major 7 countries	7	0	0	0	0.6	0	0.4
Euro area	6	0	0	0	0.5	0	0.4

Table 3. **Revisions to early signals of cyclical turning points**

* For Major seven countries: sample period is January 1999 to June 2006; for all other countries sample period is January 2001 to June 2006.

snapshots of the indicator which have been saved over time.[3] The analysis presented below is restricted to the 21 OECD member countries listed in Table 1 for which CLIs are available for the time period December 1998/August 2000 to August 2006.[4] The analysis concerns the performance of the CLIs over this period and two sub-periods – one before and one after the major review undertaken in 2002.

The size of a revision for a month is measured by the difference between the first and second releases of the growth rate for the month and also between the second and third releases of the growth rate for the month. A positive sign for the revision indicates an underestimation of the growth rate by the earlier estimate. The mean absolute revision is an indicator of the overall magnitude of change to the first release or in other words an indicator of the uncertainty of the first release. Table 3 gives the cyclical characteristics of first and second releases against second and third

releases respectively, as a guide to their performance with regard to turning points (median lag), smoothness (MCD) and closeness of fit (correlation).

The first and second releases give reliable signals of approaching turning points. The median lag is zero or at the most one month for all countries and no false signals in terms of extra or missing turning points are recorded for any countries or zone aggregates, except Mexico and Ireland. The ability to indicate approaching turning points and to confirm them is secured by the relative smoothness of the CLI for all countries except Mexico and Ireland.

The charts in Figure 2 show the evolution of the year-on-year growth rate of the first and second releases of the CLI for the OECD area and the United States as examples of CLIs with very reliable performance and Ireland and Mexico as examples of country CLIs with very poor performance.

Figure 2. **Evolution of the year-on-year growth rate of the first and second releases**

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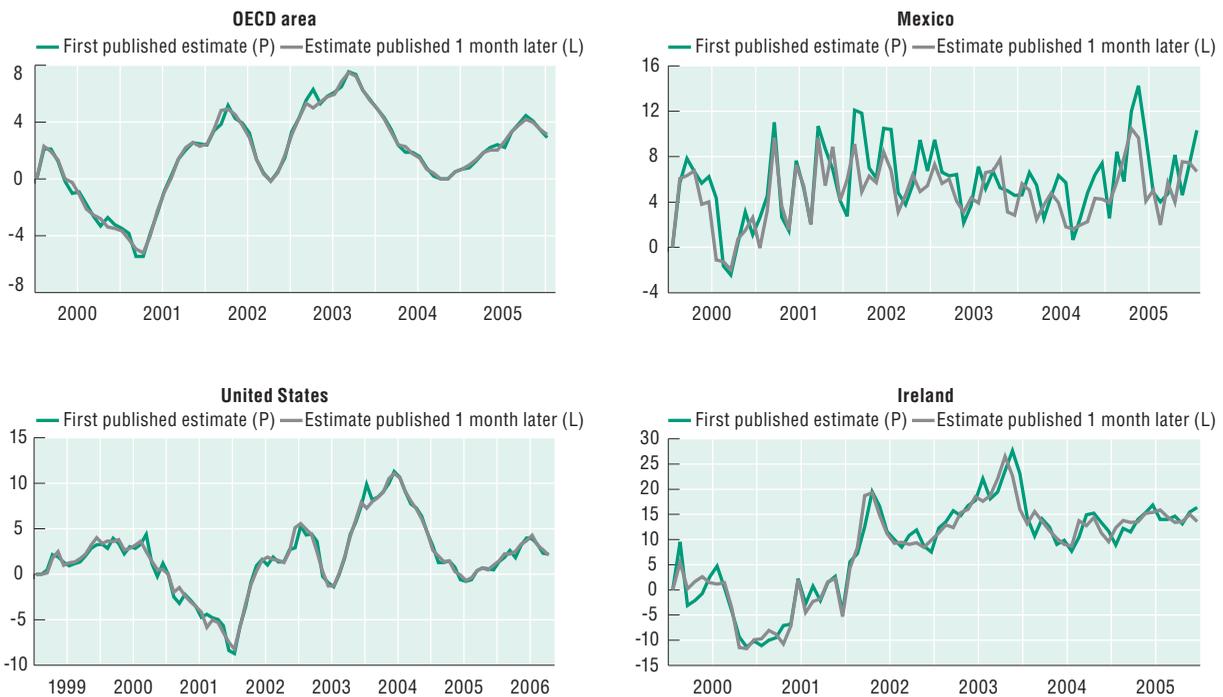
3. The successive monthly snapshots of the OECD CLI are available in the OECD Original Release Data and Revisions Database at http://stats.oecd.org/mei/default.asp?rev=1.

4. The starting date of the analysis is determined by the availability of all CLI revision versions. This date is December 1998 for all major seven OECD member countries (Canada, United States, Japan, France, Germany, Italy and the United Kingdom) and August 2000 for other countries included in the analysis.

How large are CLI revisions?

Figure 3 shows a comparison of the mean absolute revisions across countries for year-on-year growth rates for the CLI. The mean absolute revision of year-on-year[5] growth rates between first release and the second release (*i.e.* those published one month later) for the period December 1998 to August 2006 are large (greater than 1.5%) for two countries (Mexico and Ireland) and rather large (greater than 0.6%) for four additional countries (Canada, Denmark, Norway and Portugal), but for all other countries the revisions are rather small (less than 0.6% or 0.4% on average). For Denmark, Mexico, Ireland and Portugal the size of the revisions is mainly explained by the high share of very irregular components which introduce revisions to the calculation of the CLI due to the smoothing process. For Canada and Norway, the size of the revisions might be explained by the lack of availability of timely components related to the high share of quarterly components. The mean absolute revision between the second and third releases is lower in magnitude for all countries (except for Finland) than the one between the first and second releases. This suggests there is an improvement in the reliability of the second release compared with the first release.

When comparing the size of the revisions for the periods before and after the 2002 CLI review (Figure 4) the results are mixed. For Canada, Mexico, Japan, Ireland, Norway and Switzerland the results show an increase in the mean absolute revisions between the first and the second period. The poor results for the second sub-period for these countries may be explained by the increase in the number of less smooth components in the revised CLI for most of these countries and problems with the timeliness of newly introduced components for a few countries. For all other countries the mean absolute revisions decreased in the second period, which suggests an improvement in the reliability of the first estimates.

Another important statistic to consider in the revision analysis is mean revision, which is an indicator of bias in the first released figure. In Figure 5, only Mexico stands out as having a very high mean revision. This is confirmed by testing the statistical significance of the mean revision from zero. The first release of Mexico's CLI growth rate was revised down on average by 1 percentage point between the first and second releases, and by a further 0.9 of a percentage point between the second and third releases. The mean revisions to year-on-year growth rates were found

Figure 3. **Mean absolute revision between the first and second, and second and third releases of year-on-year growth rates for CLIs over the period December 1988/August 2000 to August 2006**

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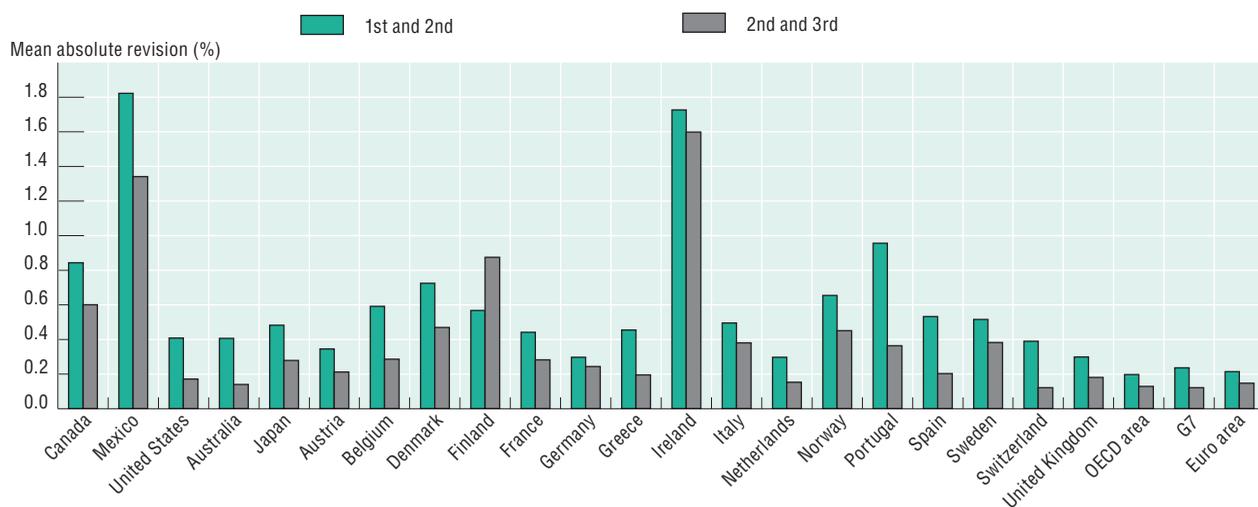
5. The year-on-year growth rate is computed as follows $((M_t/M_{t-12})-1)*100$. Please see the OECD working paper "Current period performance of OECD Composite Leading Indicators (CLIs)", for more details.

to be statistically significantly different from zero for Denmark and Switzerland between the second and third releases for the entire period. For all other countries and zone aggregate, there is no evidence of bias. The mean revisions are fairly small and negative values appear as often as positive ones. They also tend to diminish in size from the second to the third release compared with the first to the second release.

Are the first estimates of the CLIs able to quantify the size of short-term movements?

The OECD CLI aims to provide qualitative information on short-term economic movements rather than quantitative information. Therefore, movements in the CLI point to the direction of future movements in the reference series up or down, more so than the size of the movement. For almost all of the 21 countries considered in this analysis, around 90 per cent of the time the sign of the initial release of year-on-year growth rates is the same as those published one month later. Turning points in industrial production or GDP have been found to lag by about six months (on average) the signals of turning points detected in the CLI (see Table 2). So the initial release can be considered to be a good indicator of whether economic activity will move up or down in the near future.

A measure relating revisions to the cyclical movements in economic activity that is more appropriate than the sign test is the acceleration/deceleration measure. This measure captures the cyclical dynamic or direction in the growth rates. For twelve countries, for more than 20% of the time, the second release of year-on-year growth rates signals a difference in direction than the first release. For only one country is it less than 10%. An improved picture emerges when second and third releases are considered, where the difference in direction is less than 10% for seven countries (United States, Australia, Austria, Belgium, Germany, Switzerland and United Kingdom) and more than 20% for only six countries (Canada, Mexico, Denmark, Finland, Ireland and Italy). These results indicate, however, that it could be dangerous to draw conclusions on the size of growth rates from one- or two-months figures for a large number of countries.

Conclusions

The results show that first releases of CLIs are revised frequently but the size of revisions is rather small for most countries and almost negligible for zone aggregates. There is no evidence of substantial bias, except for Mexico, where the mean absolute

Figure 4. **Mean absolute revisions between first and second release of year-on-year growth rates for CLI both for the entire period (December 1998/August 2000 to August 2006) and for two sub-periods**[1]
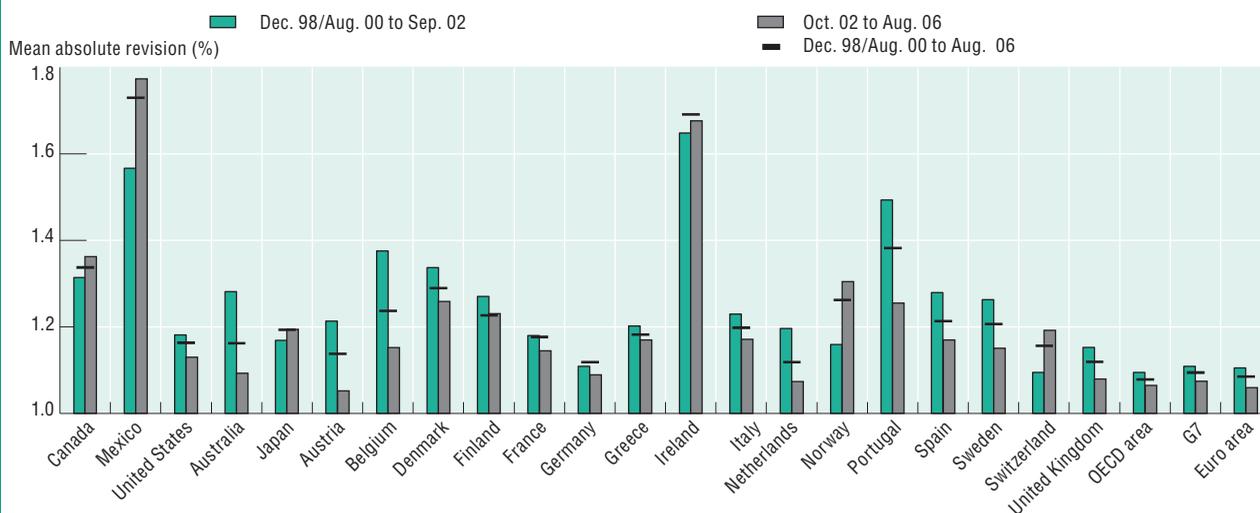
1. The split into two sub-periods has been done on the raw data, and as data triangles have been used for calculating the growth rates of the revisions, the last data point of the first sub-period does not have any revision. This explains why the mean absolute revision of the entire period may be higher or lower than the mean absolute revision of both of the two sub-periods.

revisions between first and second estimates and between second and third estimates are very large. The mean revisions to year-on-year growth rates were also found to be statistically significantly different from zero for Denmark and Switzerland between the second and third estimates for the entire period, but they are nevertheless relatively small. The results also indicate that there is an improvement in the reliability of the second estimates.

Forecasting turning points is one of the main objectives of the leading indicator technique, but predicting the timing of cyclical turning points is one of the most difficult activities in economic forecasting. The results of the study provide evidence that first and second estimates of year-on-year growth rates give reliable signals of approaching cyclical turning points. The median lag between first and second estimates and between second and third estimates is zero or at the most one month for all countries and no false signals in terms of extra or missing turning points are recorded for any countries or zones except Mexico and Ireland. The ability to indicate approaching turning points and to confirm them is secured by the relative smoothness of the CLI for all countries except Mexico and Ireland.

The importance of smoothness of components in the calculation of first and second estimates of the CLI and the overall smoothness of the CLI itself is noted in the findings. This further reinforces the argument that smoothness is probably the most important factor explaining revisions to the OECD CLI. However, timeliness is also important, but only on condition that the timely components are smooth.

Overall, this study has shown that whilst it could be dangerous to draw conclusions on the directions up or down in growth rates from one or two months figures for several countries, the first and second estimates of the CLIs give early signals of approaching turning points that in most cases are not revised later. This capacity of the CLIs to predict turning points is very important and one of the main objectives of the leading indicator technique. However, the findings also highlight the importance of smoothness of components in the calculation of first and second estimates of the CLI. This is an area for further investigation where the quality of the CLIs may be improved by either replacing very irregular components with smoother ones or by introducing a more efficient smoothing technique. ■

Figure 5. **Mean revision between first and second releases of the CLI and between the second and third releases for year-on-year growth rates over the period December 1998/August 2000 to August 2006**
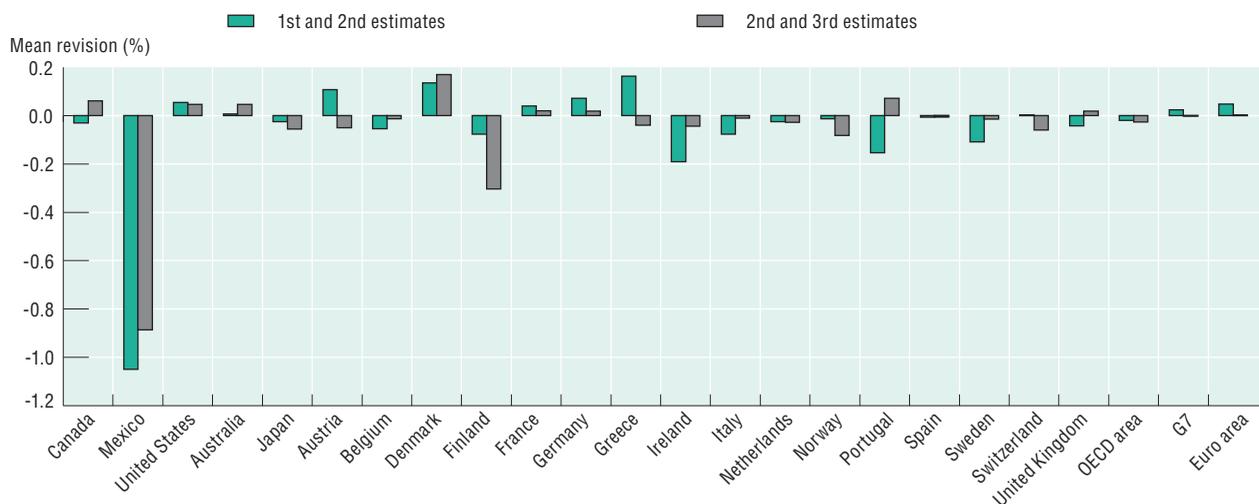
Further information

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