Report: The Economic Climate Tracer

A tool to visualise the cyclical stance of the economy using survey data

Christian Gayer[*]

Abstract

Business and consumer surveys are a popular tool for business cycle analysis. A standard way of using survey results is plotting the answers to specific questions, or combined indicators thereof, against time. An example of a slightly more sophisticated way of data presentation is the Ifo institute's "Konjunktur-Uhr", visualising the interaction between managers' business assessment and expectations. For internal use, DG ECFIN has been producing a similar graphical representation, helping to visualise the cyclical stance in the euro area and selected Member States. Such graphical representations should ideally describe a circular movement through the phases of the business cycle. However, in practice the approach can suffer from two drawbacks. First, the cyclical information can be superposed by a considerable amount of short-term variation, leading to erratic movements from month to month. Second, even filtering out the short-term variation does not necessarily result in the desired clockwise rotation through the quadrants of the graph, depending on the length and stability of the lead of the expectations component over the current assessments component. In the case of DG ECFIN's "Survey Watch", the relatively minor mean lead basically resulted in movements up and down the graph's main diagonal.

We propose an alternative tool to visualise and analyse the state of the economy using sectoral climate indicators derived from the Joint Harmonised EU Programme of Business and Consumer Surveys. The "Economic Climate Tracer" is based on smoothed climate indicators and plots their levels against their month-on-month changes, resulting in circular, counter-clockwise movements through the four quadrants of the graph. The latter directly correspond to a turning-point oriented definition of the business cycle phases. A time-series view and a cross-section view of the Economic Climate Tracer can be produced. While the first focuses on the development of a particular indicator over time, the second displays several sectoral indicators jointly for the most recent observation, allowing for both the "overall picture" and a comparative sector-wise analysis of the state of the economy. In summary, the Economic Climate Tracer seems to be a useful and efficient tool for the description and analysis of the business cycle in the euro area and its Member States. It offers a both reliable and differentiated representation of the current state of the economy and helps to detect major turning points in the business cycle.

---

1. Introduction

This report outlines a relatively new graphical device used within DG ECFIN to give more value added to the basic survey data collected in the framework of the Joint Harmonised EU Programme of Business and Consumer Surveys. Before turning to the description and demonstration of the new visualising tool, termed the "Economic Climate Tracer", we briefly review another graphical device formerly used to enhance the service to internal users (the "Survey Watch"). The discussion of some practical weaknesses of the Survey Watch in Section 2 will serve to motivate the development and use of the Economic Climate Tracer, presented in Section 3. Section 4 briefly discusses the crucial trade-off between smoothness and absence of revisions in graphical representations, drawing on a short revision analysis in the annex. Section 5 summarises and concludes.

2. Visualising BCS results: the "Survey Watch" revisited

Inspired by the German Ifo-institute's "Konjunktur-Uhr",[2] the business survey unit of DG ECFIN has for several years produced a graphical representation of survey results called the "Survey Watch". This graph has plotted manufacturers' current business perceptions against their production expectations over the next three months. The current business perceptions have been computed as the first principal component (PC) of four balance series inferring managers' current economic assessment (production trends, order books, export order books, stocks). Theoretically, since (rational) expectations should lead subsequent realisations of the business situation, one should see a circular movement through the four quadrants of the graph over time. Starting from a boom period, with further improving assessments of the current situation, expectations should start to decrease at some point, leading the economy to the downswing phase of the business cycle, where current perceptions start to and expectations continue to worsen. In the recessionary phase, marked by further deteriorating current business perceptions, expectations for the future should eventually become brighter again. As soon as the current business situation starts to improve accompanied by further improving expectations, the economy enters the upswing phase of the cycle. This ideal movement should take about 3 to 5 years in line with the common duration of one growth cycle. However, in reality, there are two problems that can substantially dilute this ideal picture.

First, there is the problem of short-term volatility in the survey data, i.e. measurement errors due to sampling uncertainty, non-response bias, misreporting etc. This short-term volatility can hide or dominate cyclical movements over several months, such that a change of direction of cyclical forces (actual or expected or both) might only be spotted in the survey data with a lag. Consequently, the scatter plot of assessments and expectations might display rather erratic movements that are subsequently revised or even completely reversed.

Second, there is the general problem of limited predictability of the future path of the economy, mirrored by usually rather short horizons of reliable forecasts and, thus, expectations. In the industry survey, managers are asked to report their production expectations over the next three months. Analysing the mean relationship between industrialists' expectations and subsequent realisations of current production assessments, one finds that the correlation between the two series is quite high at around 0.94 (euro area, 1991-2006). However, this best congruency between the two series is achieved when

---

[2]   The Ifo Konjunktur-Uhr (Business Cycle Clock) plots manufacturers' assessment of the current business situation against their business expectations over the coming six months, see http://www.cesifo-group.de/portal/page?_pageid=36,1899103&_dad=portal&_schema=PORTAL

expectations of period t are matched with assessments for period t+1 or t+2, i.e. the mean lead of managers' expectations over their assessments is between one and two months only. Furthermore, the coincident correlation between the two series is not significantly lower, at around 0.93 (0.90 at the intended 3-month lead, below 0.40 from 9 months onwards).

As to the first issue of short-term volatility, the so-called "months for cyclical dominance" (MCD) can help to disentangle the relative importance of truly cyclical and short-term irregular movements in a given series.[3] The MCD is based on a decomposition of the seasonally adjusted series into a trend/cycle and an irregular component. It indicates the fewest number of months needed for the movement in the trend/cycle component to dominate, on average over the sample, changes in the irregular component. It can thus help to gauge how long one has to wait before a change of direction in the series can be attributed to cyclical factors, rather than idiosyncratic noise.

While the MCD is low at two months for the aggregate euro-area and the German expectation series, it is equal to three months for Italy and France and even five months for Spanish industrialists' expectations. The relative irregularity of this series is thus particular high (Table 1). The volatility of the second component of the Survey Watch, i.e. the composite current business perceptions, is markedly lower, partly as a consequence of averaging across the four coincident input series. The MCD over the sample 1990-2006 is between 1 (euro area, France) and 2 (Germany, Spain, Italy) months only.

TABLE 1: Months for cyclical dominance

	EA	DE	FR	IT	ES
Expectations	2	2	3	3	5
Current situation	1	2	1	2	2

Source: own calculations

The following graphs display the scatter plots between the index of current business perceptions (x-axis) and business expectations (y-axis) for the euro area and two of the big euro-area countries from 1990 to 2006.

GRAPH 1: Survey watch for the euro area (left), France (centre) and Spain (right), 1990-06
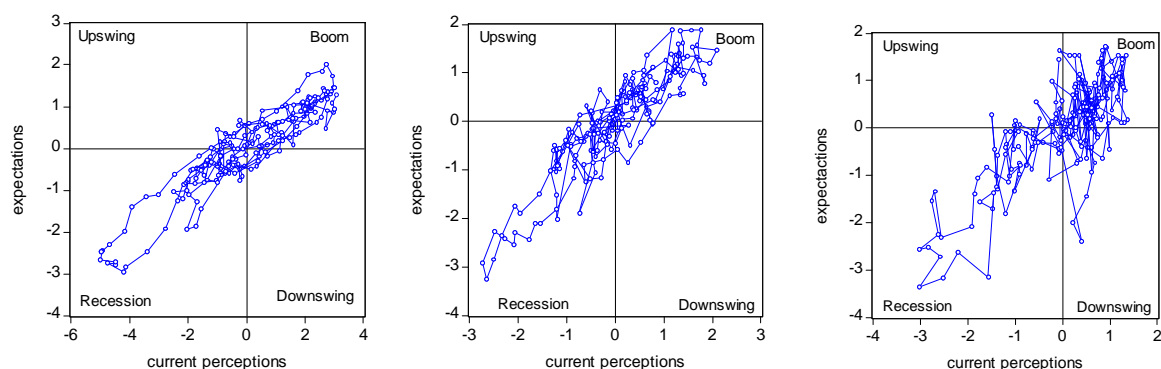
Over the plotted sample, one should expect three or four more or less clockwise rotations through the quadrants. Obviously, especially for Spain, the erratic short-term movements from month to month make it impossible to identify such a pattern. The observations oscillate rather widely within and between the quadrants through the business cycle. An

---

[3] For more information on the MCD see e.g. the OECD glossary at http://stats.oecd.org/glossary/detail.asp?ID=1688 or the UK Office for National Statistics at http://www.statistics.gov.uk/articles/economic_trends/ET636MethodNote.pdf.

obvious solution to cope with the problem of short term volatility is to smooth the series. The following graphs display the same scatter plots as above, but on the basis of smoothed current assessments and expectations.[4]

GRAPH 2: Survey watch using smoothed data (euro area (left), France and Spain (1990-06)
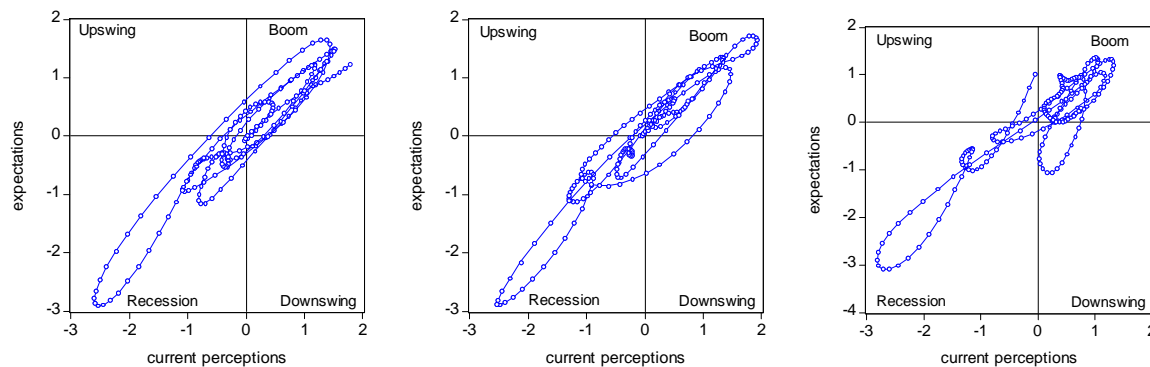
On the basis of the filtered series, one can now detect systematic movements through the quadrants of the graphs. However, the cross-plots basically describe movements along the main diagonal of the graph, thus, the points are concentrated in the upper right (boom) and lower-left (recession) quadrant. This leads to the above-mentioned second drawback of this type of graphical representation.

For an ideal rotation of the Survey Watch through the four quadrants, the expectations need to lead the current perceptions by exactly one quarter of a cycle length, i.e. expectations of period t should be fully congruent with the cyclical assessment one business cycle phase later. This would translate into a required lead of 12 months in the case of an assumed 4-year growth cycle. In the case of the surveyed expectations and current assessments, the lead of the first series with respect to the second should notionally be equal to three months; in practice it has been found to be even more limited. Therefore, the two series are basically at the same time at very high or very low levels; put the other way round, it rarely happens that the expectations in period t are below their long-term average when the current assessments are still above their long-term average or vice versa. As a consequence, the scatter plot is basically limited to two of the quadrants only, i.e. the boom quadrant (both components above average) or the recession quadrant (both below average). The information content of the Survey Watch is therefore mainly restricted to whether expectations and current assessments are at a high or low level compared to their historical averages and whether they improve (developments away from the origin) or deteriorate (development towards the origin) compared to the previous period. However, as said before, particularly this latter part of information can be superposed by a considerable amount of short-term volatility.

All in all, the Survey Watch cannot fully live up to its promise of visualising the business cycle by tracking current assessments and expectations through the four conjunctural phases. A further weakness is that the quadrants of the graph are set on an ad hoc basis and do not properly match the business cycle's phases as conventionally defined by its turning points.[5]

---

[4] The smoothing was performed using a Hodrick-Prescott low-pass filter with a smoothing parameter (lambda) of 69. This corresponds to filtering out all movements of a period of less than 18 months. The filtered series does thus retain all swings that are commonly associated with cyclical and trend movements. The drawbacks of using filters in real-time applications (revisions, end-point problem) will be discussed later in Section 3 and in more detail in the annex.

[5] See Abberger (2005) for a related critical review of the phases indicated by the Ifo Business Cycle Clock.

Formally, e.g. the downswing begins just after the upper turning point of the cycle has been passed, i.e. once the cyclical indicator starts to deteriorate in positive territory. By contrast, the definition of the quadrants of the survey watch is solely based on the series' position compared to their long-term averages. Thus, the graph remains in the "boom" quadrant even when the cyclical situation has started to deteriorate. In short, there is a systematic shift with respect to the conventional business cycle phases by roughly half a phase length.

3.   A new visualizing tool: the Economic Climate Tracer

As an alternative tool to visualize the cyclical stance of the economy and the direction of its movement we propose a diagram in which the (standardised) level of one or several cyclical indicators on the vertical axis is plotted against the period-on-period changes on the horizontal axis.[6] This immediately shows (1) whether and (2) by how much an indicator is performing above or below its average and (3) whether and (4) by how much the short-term development is pointing up or down. Two types of graphs are possible, the first focusing on the development of a given indicator over time (time-series view), and the second displaying several indicators jointly for the most recent data point (cross-section view).

### 3.1   *Time-series view of the Economic Climate Tracer*

This type of presentation concentrates on the evolution over time of the level and the changes of one single indicator per graph. The information content of such a graph, applied to e.g. the industry climate indicator, is broadly similar to that of the above-described Survey Watch using industrialists' expectations and assessments. One important visual attraction is, however, that plotting the levels against the first differences of a cyclical series automatically generates a circular movement through the four quadrants of the graph, corresponding to the four business cycle phases (Graph 3). These phases, crossed in a counter-clockwise rotation, can be characterised as follows: above average and increasing (upper-right, "Boom"), above average but decreasing after having reached the peak (upper-left, "Downswing"), below average and decreasing (lower-left, "Recession") and below average but increasing after having passed the trough (lower-right, "Upswing"). This classification follows the conventional notion of the business cycle phases and offers a simple and clear method to characterise the development of economic indicators throughout the cycle.

The main reason for plotting the levels on the y-axis and the changes on the x-axis - which together implies the counter-clockwise movement through the graph - is that thereby the movements along the y-axis directly correspond to the standard plot of the underlying series against time, i.e. a high time series value of the series can be identified as a correspondingly high observation in the Economic Climate Tracer. Furthermore, in line with intuition, business cycle peaks emerge as positions in the upper centre of the graph, while troughs are positioned in the lower centre. Similar tools like e.g. Morgan Stanley's "the Compass" are structured accordingly.[7]

---

[6]   A similar graphical device was introduced in 2006 by the Statistics Netherlands (CBS). The "Statistics Netherlands' Business Cycle Tracer" is, however, based on a selection of both qualitative and quantitative cyclical indicators. See van Ruth, Schouten and Wekker (2005) for details.

[7]   "The Compass" is featured in Morgan Stanley's monthly "Euroland Business Cycle Watch" (subscribers only). It plots the level of a (survey-based) manufacturing indicator on the y-axis against the so-called "surprise gap" on the x-axis, the latter being the difference between current production assessments and production expectations three months earlier. Given that the empirical lead of the expectations series is actually rather 2 than the nominal 3 months, the surprise gap should be rather close to the first difference

GRAPH 3: Diagram of the Economic Climate Tracer over time
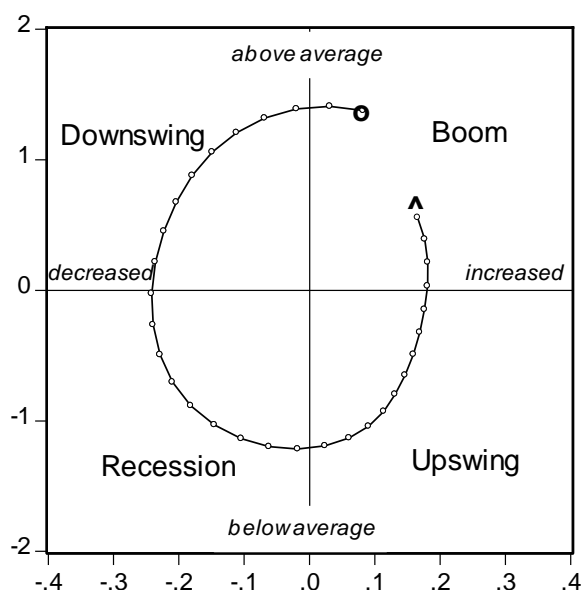
Graph 4 illustrates these cyclical movements using the Economic Climate Indicator (ECI) and the five sector climate indicators for the euro area over the sample from January 2000 to September 2007.[8] All indicators are smoothed using the HP filter in order to eliminate short-term fluctuations of a period of less than 18 months. The smoothed series are then standardised to a common mean of zero and standard deviation of one. The resulting series are plotted against their first differences.

The charts show a similar picture across sectors. Starting from the boom in early 2000, all indicators reached their peak in the middle of that year, crossing the border into the downswing quadrant at about the same time. The rather continuous movements through the downswing and the recession quadrants were followed by the mini-cycles that marked the period from 2002 to 2005, where in particular the industry series showed transitory signs of decline before actually recovering to a "sufficiently" high level. Driven by uninterrupted increases in all (smoothed) series since mid-2005, all climate indicators moved back to the boom quadrant in the course of 2006.

In the course of 2007, all indicators except the consumer index have moved over to the downswing quadrant. The industry indicator entered the downswing quadrant around the first quarter of this year, while the services indicator entered it more recently, around the

---

of production assessments, i.e. our indicator of acceleration. The considerable amount of uncertainty due to the use of unsmoothed series is faced by defining a "grey zone" within which the signals from the two components are considered as indecisive/not reliable. Actually, however, 5 out of the total 9 quadrants of the Compass represent situations where at least one component delivers no reliable signal.

[8] The Climate Indicators are based on principal component (PC) analyses of balance series (s.a.) from the surveys conducted in industry, services, building, retail trade and among consumers. For the industry sector, five of the monthly industry survey questions are used as input variables (employment and selling-price expectations are excluded). The respective numbers of input series for the other sectors are: services: all five monthly questions; consumers: nine questions (price-related questions and the question inquiring the current financial situation are excluded); retail: all five monthly questions; building: all four monthly questions. In the euro area case, the first principal component explains between 65% (retail) and 92% (industry) of the variance of the input balance series in question. The Economic Climate Indicator (ECI) is a weighted average of the five PC-based sector Climate Indicators. For details see Gayer and Genet (2006).

second quarter. The building and the retail trade indicators have been in the downswing quadrant since the beginning of the year. The consumer indicator is still hovering around the border between the boom and the downswing areas. Altogether, the charts suggest that the peak of the current business cycle has been reached in early 2007.

GRAPH 4: The Economic Climate Tracer across sectors, euro area, Jan 2000 to Sep 2007
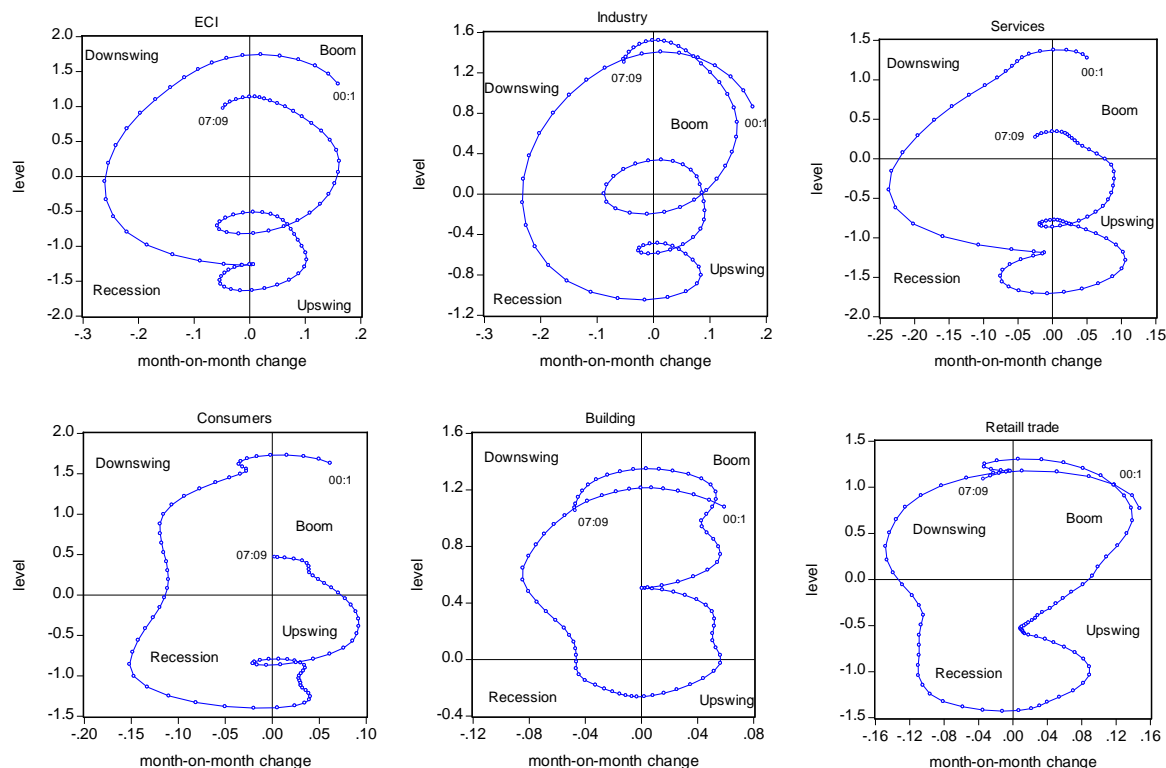
It is noteworthy that the definition of the long-term average of the indicators is based on the whole available sample, usually from 1985 onwards.[9] The - according to historical standards - high average level of the building climate indicator since 2000 explains why the scatter plot displays only few points in the lower two quadrants of the graph.[10]

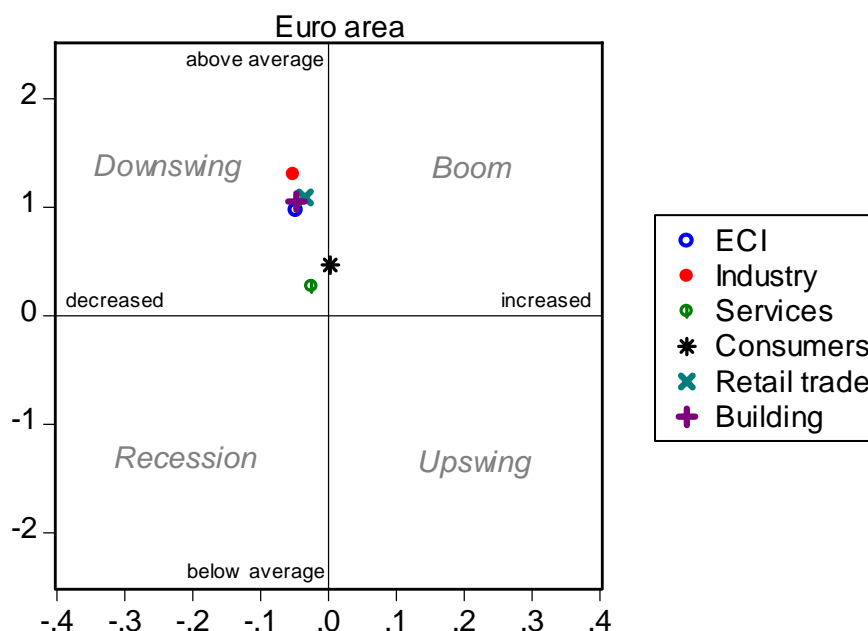### 3.2   *Cross-section view of the Economic Climate Tracer*

An alternative way of showing cross-plots between levels and period-on-period changes is to display several indicators in one graph at a time, focusing on the most recent data point of each indicator. Each individual point reveals information on both the level and the change compared to the previous period of the sector indicator in question. Jointly displaying these combinations for several sectors creates a system which can act as a coincident indicator of the overall business cycle. At the same time, the disaggregated approach enables a comparative sector-wise analysis of the state of the economy, where the position of each individual indicator can be directly gauged against its own historical average (horizontal zero-line) and against the position of the other sector indicators.

---

[9]   The samples for the services climate indicator and the composite ECI start only in 1997 due to the later inauguration of the harmonised EU-wide services survey.

[10]   A prior de-trending of the input series, e.g. using the standard HP low-pass filter could be a feasible way to stabilise the centre of the Tracer over time at the origin. However, given that the survey indicators are stationary by their nature, there is no theoretical justification for trend-elimination.

Graph 5 displays such a "cross-section Economic Climate Tracer" on the basis of the levels and changes of the five sectoral climate indicators and the aggregate ECI in September 2007.

GRAPH 5: The cross-section Economic Climate Tracer for the euro area in September 2007

The graph provides a helpful synopsis of the cyclical stance in the five sectors covered by the surveys and, therefore, in the overall economy. The ECI data point serves to summarise the current position of Economic Climate across sectors. As was mentioned above, (smoothed) business climate has passed the peak and started to decline across all business sectors. Smoothed consumer climate is on the borderline between boom and downswing and is thus just marking the peak of the confidence cycle. In terms of levels, the building, retail and particularly the industry sectors can be seen to still stand at fairly high levels.[11] The level of consumer and services climate, however, is at relatively low levels, not far above the historical average indicated by the zero line. This indicates that the cyclical peak has been reached before confidence in the services sector and among consumers has fully recovered from the low levels posted during the stretched-out period of cyclical weakness in 2003-2005.

All in all, the Economic Climate Tracer as a monthly cross-sectional view of the business cycle seems to be a rather efficient tool to summarize the cyclical stance of the economy according to business and consumer surveys in just one graph. The following graphs show the Economic Climate Tracer for the four big euro-area Member States.

In Germany, the industry, services and building sectors are currently located in the downswing area. The industry and retail trade indicators entered this quadrant only a few months ago, with the level of the industry indicator still being exceptionally high. Having entered the downswing quadrant around 2006/2007, the building indicator has fallen sharply since then. The German services sector, which until a few months ago was in the upswing quadrant, now stands in the recession area, though remaining very close to the zero point. Summarising the developments in the individual climate indicators, the ECI data point

---

[11]   Assuming a normal distribution of indicator values, one can expect the standardised indicators to be above a value of 1.3 in only approximately 10% of the cases.

suggests that the German economy is now in the early downswing phase of the current business cycle, sustained by still relatively high levels of industry and consumer confidence.

Turning to France, all climate indicators are still in the boom quadrant and score at relatively high levels, particularly so in the retail trade sector. However, with the exception of consumer climate, all indicators have moved very close to the borderline with the downswing quadrant lately, i.e. are about to peak.

GRAPH 7:   Cross-section Economic Climate Tracer for Germany and France, Sep 2007
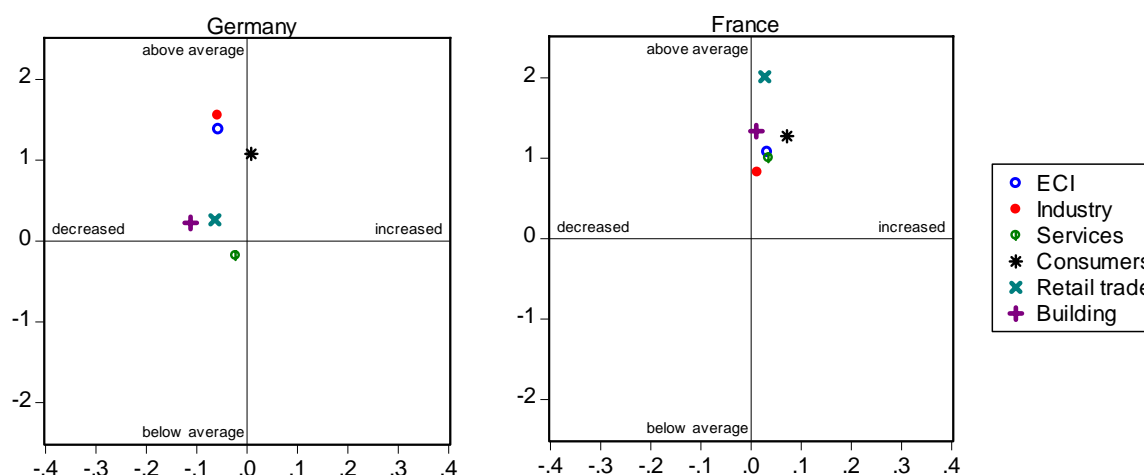
See Graph 5 for interpretation

Graph 8 shows that the overall economic climate indicator for Italy is currently just on the border between the downswing and the recession areas. This is mainly due to the consumer indicator, scoring at an exceptionally low level in the recession quadrant, and the services indicator, which is approaching the recession area. The industry and retail trade climate indicators are currently situated in the downswing quadrant. Finally, the building indicator has been hovering around the origin of the graph for several months in a row.

Spanish survey data continue to indicate a rather weak performance of the economy, as summarised by the ECI data point in the recession quadrant. Currently, the climate indicators in the services and retail trade sectors as well as for consumers are located in the recession quadrant. The industry and construction climate indicators are in the downswing quadrant. The very low and further decreasing level of confidence in the services sector is somewhat puzzling given the more upbeat picture suggested by hard data for the sector.

GRAPH 8:   Cross-section Economic Climate Tracer for Italy and Spain, Sep 2007
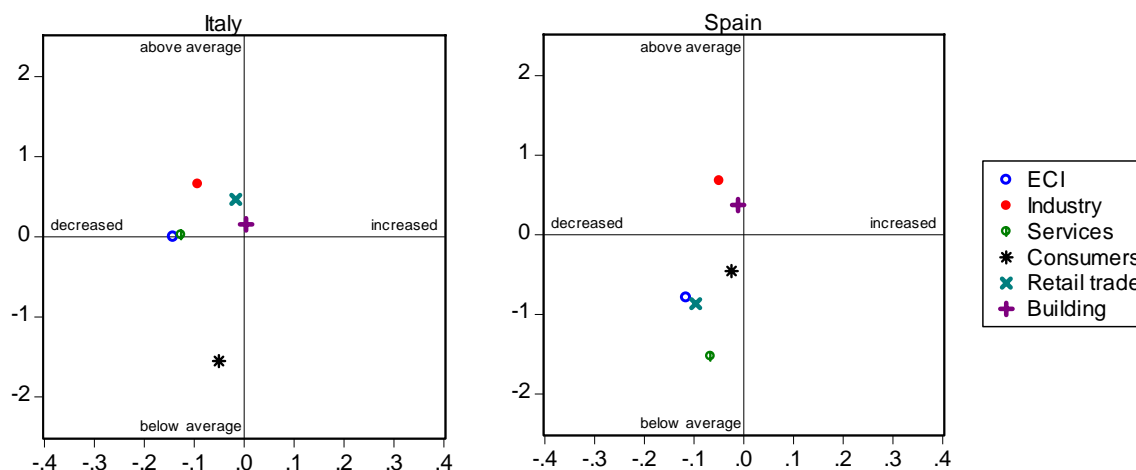
See Graph 5 for interpretation

4.   A critical note: smoothness versus absence of revision

The crucial part of the cycle tracing system is the computation of the filtered, i.e. smoothed input series, since smoothing leads to revisions at the end of the sample when new observations become available. A Hodrick-Prescott filter suppressing short-term movements of a duration of less than 1.5 years (18 months) was applied to all series for the results reported above. It is important to note that the applied filtering does not entail a trend-cycle decomposition. Since all qualitative survey series are stationary by their nature, they can be assumed to carry genuine cyclical information plus noise only. Therefore, trend-adjustment is not necessary and the question of whether the cycles of the filtered series are real, i.e. present in the original series, is not relevant. The main issue is whether the filter performs well in practice, that is in real time, so as to give an accurate monthly picture of underlying business cycle developments.

The results of the revision analysis are provided in the annex. In summary, the HP filter seems to work well compared to other standard smoothing procedures. Based on experiments with the industry and consumer climate indicators, it can take between two and five months before a peak or trough is reliably indicated in the filtered series in real-time. Given the fact that a turning point can possibly be detected at the earliest one period after it occurred, the lag introduced by smoothing the series is thus between one and four months. This means that a data point e.g. in the upper-right quadrant (increase) of the cycle tracer might potentially be revised to the upper-left quadrant (decrease) up to four months later, if the corresponding previous period is retrospectively found to mark a peak in the smoothed series based on more data points. This built-in, implicit time lag or blur around cyclical turns is the flip side of the benefit that erratic movements through the quadrants around turning points are avoided. Obviously, such explicit blur due to noise in the data precludes a timely and reliable detection of turning points in a very similar way.

The trade-off between smoothness and absence of revisions is not easy to solve. However, if the focus is on an easy and fast-to-use graphical tool, the smooth and steady evolution of the graph over time might be valued higher. The risk of surprises by possible later revisions can be mitigated, first, by cross-checking the evolution of the original, unsmoothed indicators and, second, by having a combined look across survey sectors. If many of the sectors seem to be close to the line between continued improvement and beginning deterioration, this should be a sign that the turning point might actually already have occurred in some of the sectors. Thus, the Economic Climate Tracer can be a useful tool in monitoring turning points in the economy.

5.   Conclusions

Cross-plots of current business perceptions and expectations can be attractive tools to visualize the cyclical stance of the economy. However, there are also drawbacks. First, the cyclical information can be superposed by a considerable amount of short-term variation, leading to erratic movements from month to month. Second, even filtering out the disturbing short-term variation does not necessarily result in the desired clockwise rotation through the quadrants of the graph, depending on the length and stability of the lead of the expectations component over the current assessment component.

This note presented an alternative tool to visualize and analyse the state of the economy on the basis of the climate indicators derived from the Joint Harmonised EU Programme of Business and Consumer Surveys. The *Economic Climate Tracer* is based on smoothed climate indicators and plots their levels against their period-on-period changes, resulting in circular, counter-clockwise movements through the four phases of the business cycle. A

time-series view and a cross-section view of the Economic Climate Tracer can be produced. While the first focuses on the development of a particular indicator over time, the second displays several sectoral indicators jointly for the most recent observation, allowing for both the "overall picture" and a more detailed sector-wise analysis of the state of the economy.

It is worth noting that the involved smoothing implies later revisions of past data points, especially around cyclical turns. Consequently, the Climate Tracer cannot always display the turning points immediately. On the other hand, of course, using raw data means that one also has to wait several months before one can be sure (enough) that a possible change in direction is due to cyclical rather than idiosyncratic forces. Therefore, it is basically a matter of choice whether the inevitable time lag of turning point detection is made explicit or implicit. If the focus of the analysis shall be on the visualisation of the underlying, truly cyclical rather than irregular movements of the time series, then smoothing is essential. In any case, the main benefit of the climate tracer lies in the combined analysis and comparison across several business sectors and consumers. Given the diffusion character of the business cycle, a flattening or turning of one or several surveyed sectors should raise the vigilance for corresponding changes in other sectors.

In summary, the Economic Climate Tracer seems to be a useful and efficient tool for the description and analysis of the business cycle in the euro area and its Member States. It offers a reliable representation of the current overall state of the economy, enables a comparative sector analysis and helps to detect major turning points in the business cycle.

References

Abberger, K. (2005), Report – Another Look at the Ifo Business Cycle Clock, Journal of Business Cycle Measurement and Analysis, 2 (3), 431-443.

Gayer, C. and J. Genet (2006), Using Factor Models to Construct Composite Indicators from BCS Data, European Economy - Economic Papers 240, January.

Van Ruth, F., B. Schouten and R. Wekker (2005): *The Statistics Netherlands' Business Cycle Tracer. Methodological aspects; concept, cycle computation and indicator selection*, second draft October, available at http://www.cbs.nl/en-GB/menu/themas/dossiers/conjunctuur/ publicaties/conjunctuurbericht/klok/ck-homepage.htm

Annex: Revision analysis

The aim of this analysis is to evaluate how much uncertainty there is in the real-time computation of the filtering method. It suffers from the end value problem. For an accurate computation of the cycles of the last observations, future observations are necessary, and as these are unavailable, an approximation is needed. This will lead to revisions as more data become available. It shall be quantified how sensitive the filtering approach (HP, lambda 69) is to this problem. To test this important aspect of filter performance, a quasi real-time simulation of the identification of two major turning points in the cycle was performed using the euro-area climate indicators for industry and consumers. Both series share the peak in 2000 while the subsequent trough came as soon as in 2001 for industry while it took until 2003 for the consumer index to reach its trough. Revisions have their potentially greatest impact at major turning points in the cycle, and timely and reliable identification is important. The performance of the HP filter was compared to that of two different specifications of the Henderson smoother, which delivers the standard trend-cycle component in CensusX12. Starting at respectively 2000:01, 2002:01 and 2003:01, for each method, the filtered series was computed, the series lengthened by one month and the filtered series computed again. This process was repeated twelve times. It was then determined when the turning points were securely identified, compared to the ex-post dating based on the whole available data series.

The graphs below compare the HP69-filtered series to two versions of the Henderson smoother. The first is based on the default moving average (ma) of 13 terms, the second uses a longer 17 terms ma. As can be seen, the three smoothed series are very close in levels for both industry and consumers, with the major cyclical turning points being largely unaffected by either method. However, looking at the first differences of the smoothed series, i.e. the month-on-month changes, there are some important differences in terms of smoothness, particularly around turning points (lower panel of Graph A1). Obviously, the shorter ma of the default Henderson smoother leaves more short-term volatility in the series. These extra oscillations of the first differences would translate into comparably erratic movements along the horizontal axis of the Climate Tracer, making it difficult to infer the current underlying direction of changes. The longer 17-terms ma is rather similar to the HP filter in terms of smoothness. On the margin, however, the HP filter can be seen to smoothen out a few temporary dips that remained in the Henderson series.

GRAPH A1: Levels and first differences of series smoothed with different methods
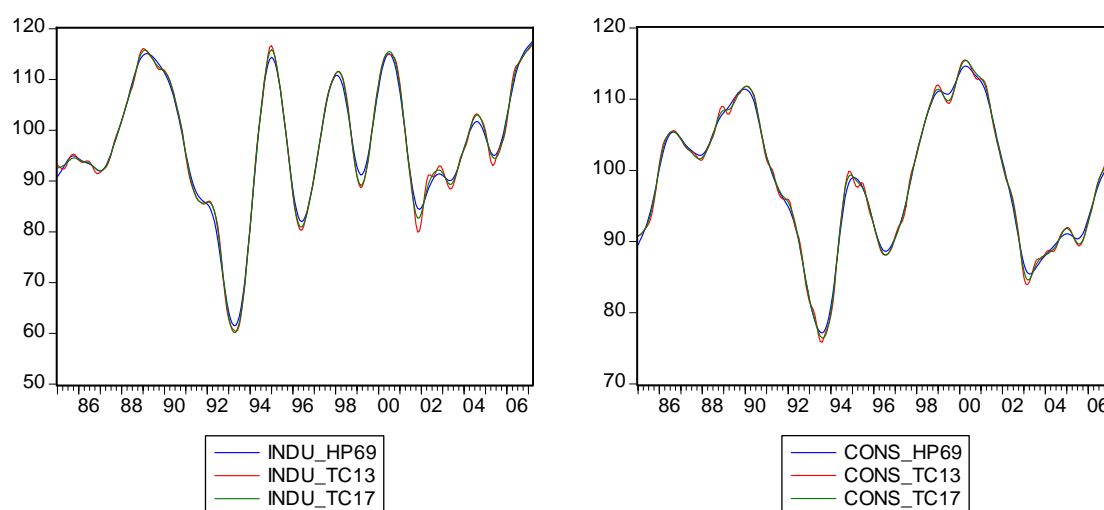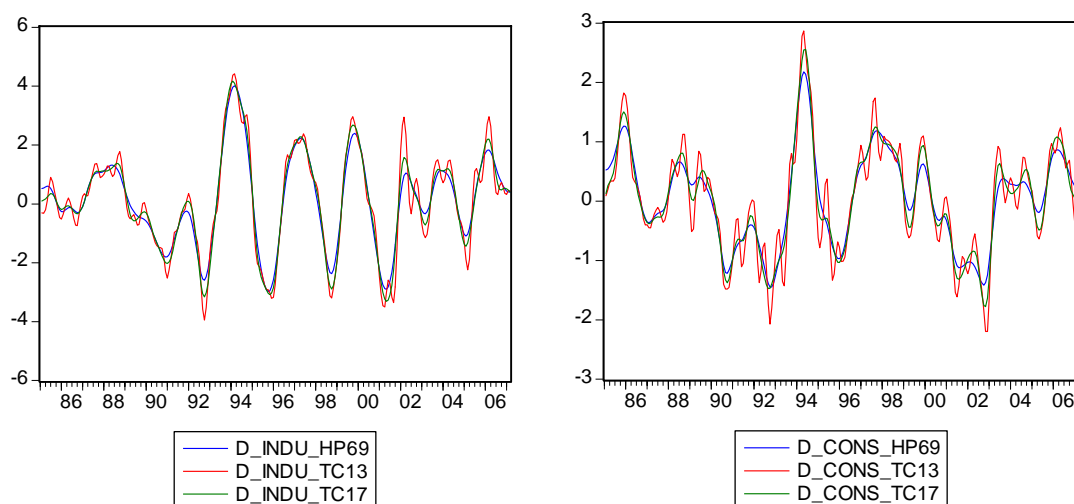
The following table shows the ex-post turning points in the smoothed series based on all available data points. As expected from the graphs above, the turning points are very close across methods.

Table A1: Ex post dating of turning points based on different smoothing approaches

	Industry			Consumers		
	HP69	TC13	TC17	HP69	TC13	TC17
Peak	2000M7	2000M6	2000M7	2000M7	2000M6	2000M7
	2001M1	2001M1	2001M1			
Trough	2	1	1	2003M5	2003M4	2003M5

Source: Own calculations

Using e.g. the TC17-filtered consumer index, which peaked in 2000M7, the following graph illustrates the evolution of the smoothed data series over time in the period between 2000M1 and 2000M12. As can be seen, the peak was indicated for the first time based on 2000M10 data, i.e. in October. In August and September, though, the end value problem, i.e. the "blindness" of the filter at the end of the available sample, resulted in false signals of continued increases of the underlying trend. Therefore, it took the filter two months longer than earliest possible to detect the turning point. Based on analogous graphs, Table A2 displays the dates when the individual turning points in the smoothed industry and consumer indicators were for the first time securely identified in real time across methods.

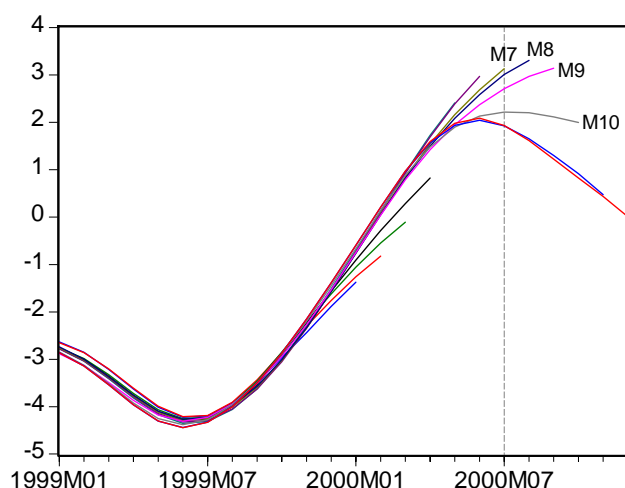Graph A1: Example of simulated real-time experiments

Table A2: First detection of turning points based on different smoothing approaches

| | *Industry* | | | *Consumers* | | |
	HP69	TC13	TC17	HP69	TC13	TC17
Peak	2000M12	2000M8	2000M12	2000M9	2000M8	2000M10
Trough	2002M4	2002M1	2002M5	2003M9	2003M8	2003M9

Source: Own calculations

Comparing the two sets of dates and keeping in mind that a turning point can at the earliest be detected one period after it occurred, results in the following delays before peaks and troughs are reliably identified in the smoothed series.

Table A3: Delay of turning point detection based on different smoothing approaches

| | *Industry* | | | *Consumers* | | |
	HP69	TC13	TC17	HP69	TC13	TC17
Peak	4	1	4	1	1	2
Trough	3	1	5	3	3	3

Source: Own calculations

As could be expected by the lesser degree of smoothing, and thus revision implied by the shorter Henderson filter (TC13), the method appears somewhat faster in identifying turning points, especially in the case of the industry survey. However, this comes at the cost of more noisy short-term fluctuations remaining in the filtered series. Since the TC13 filter is not superior to the HP filter in the case of the consumer series, the better performance for the industry series should not over-compensate its general drawback of insufficient smoothness. The smoother Henderson and the HP filter are comparably fast in detecting turning points, with slight advantages for the latter. To sum up, given that a certain degree of smoothness is needed for the cycle tracer to depict steady cyclical developments over time, the HP filter eliminating fluctuations of below 18 months in duration seems to work well in practice.[12]

---

[12]   The study by Ruth, Schouten and Wekker (2005), comparing various cycle extraction methods, also reports that the Hodrick-Prescott method is fast in identifying turning points in real time.