3.3 The ifo Business Cycle Clock

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3.3.1 Motivation

The purpose of economic indicators is to describe cyclical economic activity as timely and accurately as possible. Economic indicators can be divided into leading, coincident, and lagging indicators according to their temporal relationship with the cycle. The leading indicators are of particular importance for business cycle analysis. A good leading indicator is characterized by the fact that its turning points signal the turning points in the development of the economy early and as clearly as possible (i.e., without false alarms). In addition, the lead time should be stable so that it can be assessed with relative certainty how early the signal from the indicator will occur. Furthermore, the indicator values should be available punctually and not subject to major revisions after publication (Abberger and Wohlrabe 2006).

A particularly reliable leading indicator of economic development in Germany is the ifo Business Climate Index (Abberger and Nierhaus 2007). This is calculated as the geometric mean value of the two components "Business Situation" and "Business Expectations for the coming six months". The geometric averaging slightly dampens the fluctuations of the ifo Business Climate Index at extreme values compared to arithmetic averaging. The two components regarding the current situation and the business outlook were combined by the ifo Institute to visualize from which economic situation a certain assessment is made. For instance, the anticipation 'to remain roughly the same' has a different meaning in a boom phase than in a recession (Goldrian and Strigel 1989).

The ifo Business Climate Index was first published in 1971, but initially only for the manufacturing industry. One year later, the data for all sectors covered by the ifo Business Survey – manufacturing, construction, and wholesale and retail trade – were combined into the overall ifo Business Climate Index for Industry and Trade. This was in response to a diffusion indicator presented two years earlier by the German Council of Economic Experts for the assessment of overall economic development. In 2018, the new ifo Business Climate Index for Germany replaced the previous index. In addition to the manufacturing sector, the construction industry, and wholesale and retail trade, the service sector was integrated in this new index. Furthermore, the base year for the index calculation was adjusted from 2005 to 2015.

The ifo Business Cycle Clock presents a four-quadrant scheme for the cyclical relationship between the business situation and the business expectations. It was first published in spring 1993, although, at that time, the movement of the variables in the scheme was still counterclockwise due to a different assignment of axes (Nierhaus and Leibfritz 1993). The current clockwise presentation was introduced in 1999 (and then named the ifo Business Cycle Clock).

In this diagram, the business cycle – visualized as a situation-expectation graph – crosses the quadrants labelled “upswing”, “boom”, “downturn” and “recession”, provided that the expectation indicator sufficiently leads the business situation indicator. The names of the quadrants are not to be interpreted as strict classifications of the economic situation. They rather reflect the relationship between the development of the current situation and the expectations for the next months, i.e., the two components of the ifo Business Climate Index.

3.3.2 The Ideal Business Cycle Clock

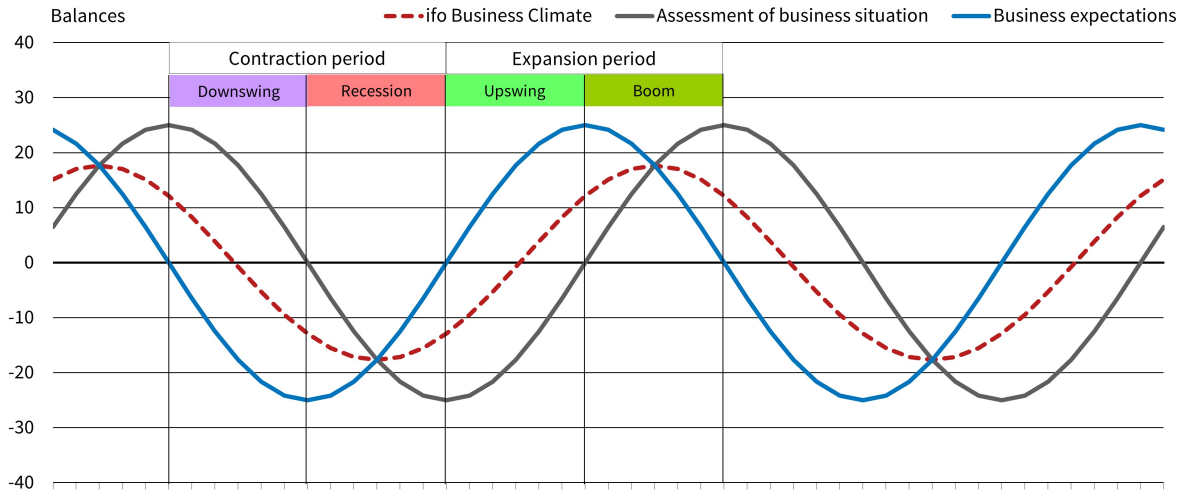
Business cycles can be defined on the basis of fluctuations of cyclically relevant variables over time. Cycles consist of expansion and contract phases, whereby the individual phases are connected by lower and upper turning points. Figure 3.5 shows an artificial ifo Business Climate Index with its two components – business situation and business expectations – whereby the economic dynamics in the concrete example are generated by a two-year sinusoidal oscillation. The expectation indicator leads the situation indicator by exactly six months; the business climate as an average of the situation and expectations thus has a constant lead time of three months before the business situation.

A complete expansion phase – measured here by the course of the situation indicator – spans from a lower turning point to an upper turning point. After the lower turning point has passed, the business situation improves, but it is still bad on balance (i.e., negative). Only after the zero level is exceeded does the situation become good (i.e., positive) on balance. The two sub-phases are given the placative names “upswing” and “boom”. A contraction phase ranges from an upper turning point to the lower turning point of the business situation. Here, too, two sub-phases can be distinguished and given placative names: “downturn” and “recession”. In a downturn, the situation worsens, but on balance is still good (i.e., positive). In the recession, the business situation is bad on balance (i.e., negative) and deteriorates further. Since the current situation and the expectations indicators are not subject to any trend, all four economic phases are of equal length, i.e., exactly six months for the two-year sine wave assumed here.

The underlying idea of the ifo Business Cycle Clock is to allocate the respective business expectations reported by the respondents to the business situation. The abscissa of the ifo Business Cycle Clock is therefore the situation indicator, and the ordinate the corresponding value of the expectation indicator. The crosshairs of the two zero lines divide the diagram into four quadrants, which – measured against the concrete course of the business situation – mark the four phases: upswing, boom, downturn, and recession (see Figure 3.6) (Abberger and Nierhaus 2008a).

If the companies’ assessments of the current situation and expectations are bad on balance, i.e., negative, the economy is in recession (bottom left quadrant). If the expectation indicator moves into the positive area (with an improving but on balance still negative business situation), one enters the “upswing” phase (upper left quadrant). If the balances of the business

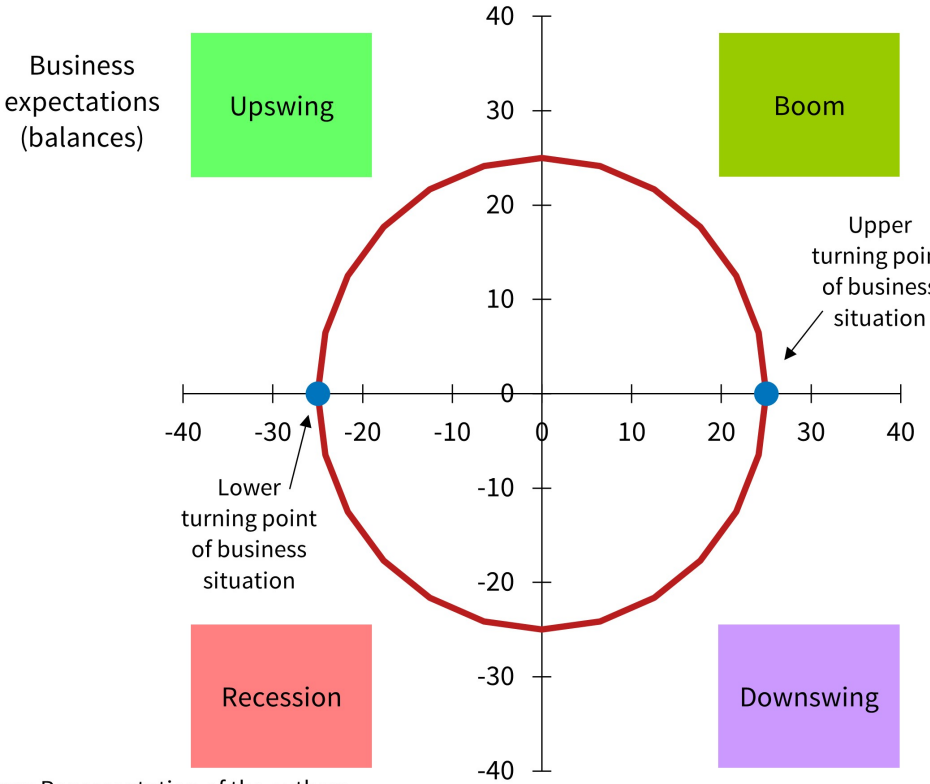
Figure 3.5: Business situation, business expectations and business climate in the economic cycle



[a] Two year sine-wave fluctuation. Lead of business expectations over business situation: 6 months.

Source: Representation of the authors.

Figure 3.6: Ideal typical ifo Business Cycle Clock



[a] Business cycle: two year sine-wave fluctuation. Lead of business expectations over business situation: 6 months.

Source: Representation of the authors.

situation and business expectations are both positive, then there is a “boom” (upper right quadrant). If the expectation indicator turns negative (with a deteriorating, but on balance still good business situation), the downturn has begun (lower right quadrant). Because the expectation indicator in the chosen example systematically leads the situation indicator by exactly six months in a two-year business cycle, the economy in this diagram moves clockwise in a circle. The Situation-Expectation-Graph crosses the abscissa of the ifo Business Cycle Clock when the maximum or minimum of the economic situation is reached (upper or lower economic turning point). The ordinate of the clock is crossed when the business situation reaches the zero balance “coming from below” or “coming from above”. All points above the abscissa indicate the economic phase “expansion”; all points below the abscissa indicate the phase “contraction”.

3.3.3 Deviations from the Ideal Typical Pattern

In fact, the interrelationships between the business situation and business expectations are naturally somewhat less stringent than in the case of the ideal-typical representation of the ifo Business Cycle Clock. This is, for example, because short-term irritations in the formation of corporate judgements, misjudgments, asymmetrical response behaviour, etc. can result in unsystematic movements of the situation-expectations graph within and between the individual quadrants of the ifo Business Cycle Clock. These movements mask the actual cyclical movement, and can even amount to a temporary backward trajectory. The latter development pattern always occurs when the expectations indicator temporarily lags the situation indicator.

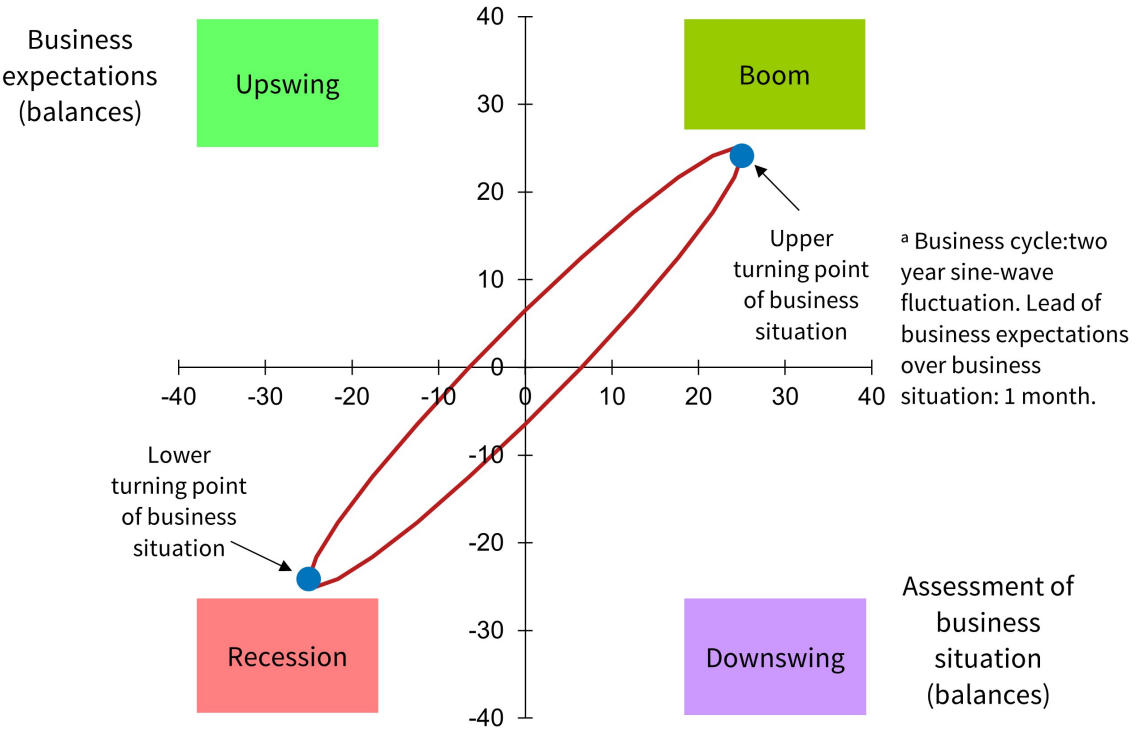
As far as erratic disturbances in the movement of the clock are concerned, an empirical analysis of the irregular components in both time series shows that these are only minor compared to the smooth component. Using the Census-X-13ARIMA SEATS method for the decomposition of the series, the MCD measure for the situation indicator is two months, and for the particularly smooth expectations indicator only one month. The MCD measure shows from when the average change in smooth components outweighs the irregular movement of a time series. It thus indicates the average waiting time before one can be relatively sure that changes of direction for indicators are due to cyclical factors and not random.[11] More serious, however, is the objection that the ifo Business Cycle Clock in the four-quadrant scheme in the above ideal-typical example only moves on an exactly circular path if the lead of the expectation indicator over the situation indicator – as in the example described here – is just a quarter of the length of the cycle. From a mathematical point of view, the circular course results when the two indicators are orthogonal to each other.[12] This is the case in the example presented

[11] The MCD measure (= Months of Cyclical Dominance) was developed by Shiskin in 1957. In calculating the MCD measure, the average changes in the irregular component of a time series are related to the average changes in the smooth component for successively extended time periods θ. The MCD measure indicates the lowest θ for which the average change in the smooth component outweighs the average change in the irregular movements (Abberger and Nierhaus 2009).

[12] Two functions $f(x), g(x)$ are orthogonal in the interval $[a, b]$, if the product $f(x)g(x)$ is a function with integral

here (in which the situation indicator is modelled by an ideal-typical sinusoidal oscillation) regardless of the length of the cycle, if the expectation indicator is the first derivative of the situation indicator (i.e., the cosine) at any given time.

Figure 3.7: Elliptically distorted economic clock



[a] Business cycle:two year sine-wave fluctuation. Lead of business expectations over business situation: 1 month.

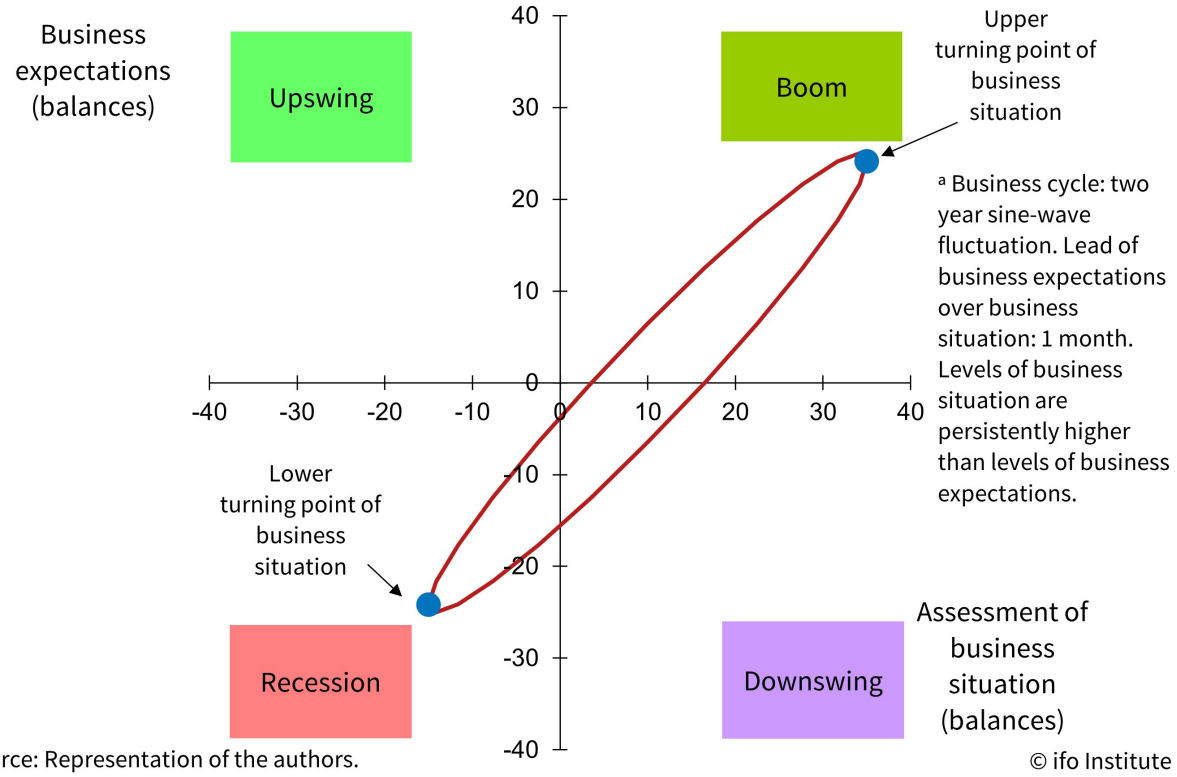
Source: Representation of the authors.

The average length of a business cycle in Germany and other industrialized countries is considerably longer than the two-year period selected here. Thus, the empirically observable lead of the expectations indicator over the situation indicator is not long enough for the two curves to be orthogonal to each other. This distorts the ideally observable circular rotation of the clock to a movement along the main diagonal that connects the boom quadrant with the recession quadrant. Empirical observations in the upswing or downturn quadrant are therefore less frequent than observations in the boom or recession quadrant. Figure 3.7 shows an example of an elliptically distorted business cycle clock in the case of a shortened lead time of one month for the expectations before the situation. In practice, however, this hardly affects the usefulness of the ifo Business Cycle Clock as an analytical tool. Moreover, it is possible to eliminate the distortion of the clock resulting from the violation of the orthogonality condition by an appropriate transformation of the business situations and business expectations with the instrument of principal component analysis (Abberger and Nierhaus 2011b).

zero in the interval $[a, b]$.

If the situation indicator and the expectations indicator are permanently at different levels, this results in an additional shift of the ifo Business Cycle Clock to the right or left. Figure 3.8 shows an example of a business cycle clock that is shifted to the right and elliptically distorted for the case of a higher balance of the situation assessment compared to the expectations. A possible shift in the ifo Business Cycle Clock can be eliminated by a simple linear variable transformation, i.e., by subtracting the average balance from the respective input series.

Figure 3.8: Shifted elliptically distorted business cycle clock



Source: Representation of the authors.

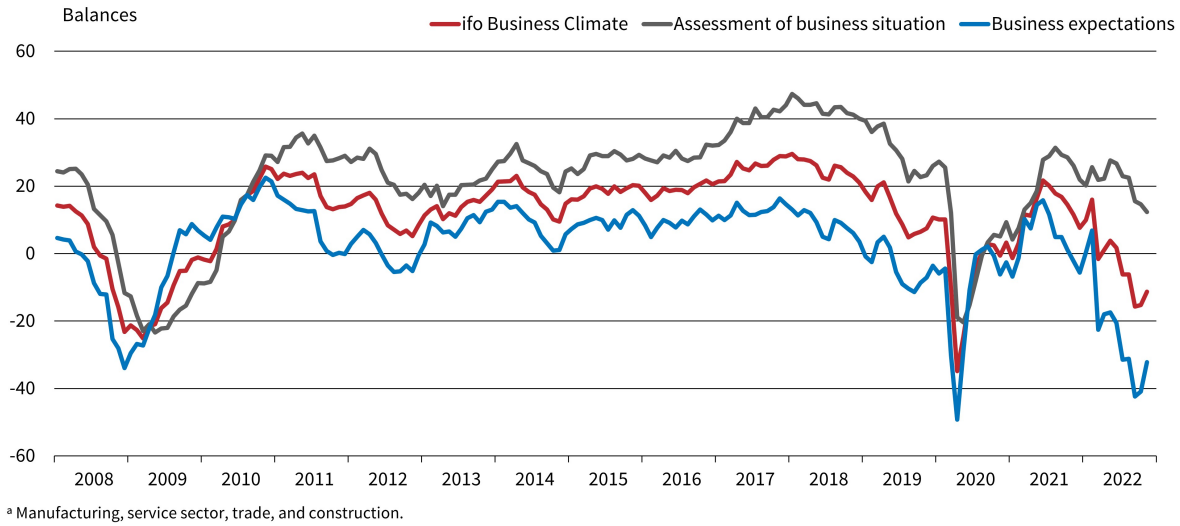
Another reason for a systematic deviation from the circular course is the different types of the two indicators. While the business situation is surveyed as a level indicator (good/satisfactory/bad), the business expectations are surveyed as a change (more favorable/remain the same/less favorable). Mechanically, this has two effects, which act in opposite directions: The changes that are expressed in the expectations can accumulate in the assessment of the situation. If 100 respondents expect a less favorable situation in one month, and 100 more do so in the following month, it may be consistent that a total of 200 companies will revise their situation downwards in these two months. The fact that not every reported change has to result in an adjustment of the business situation has the contrary effect. For example, a good situation may develop less favorably, but remain good, just less good. Also, a bad situation can become even worse and thus remain bad.

These considerations show that, conceptually, the situation indicator and the expectation indicator can show different levels of fluctuation. The amplitudes of the indicators may therefore differ. If this characteristic is undesirable in the analysis of the indicators, it can easily be eliminated by standardizing the indicators individually. In addition, the ifo Business Cycle Clock can also degenerate into a straight line. This is the case when expectations have no lead time at all before the assessment of the current situation and the two indicators thus coincide. Finally, the clock may temporarily run backwards. Such a development always occurs when the expectations indicator temporarily lags the situation indicator.

3.3.4 The Empirical ifo Business Cycle Clock

Figure 3.9 presents the two input series of the ifo Business Cycle Clock and the ifo Business Climate Index for the period January 2008 to November 2022.

Figure 3.9: ifo Business Climate Index for Germany



[a] Manufacturing, service sector, trade, and construction.

Source: ifo Business Survey.

In 2005, an export-driven upswing had begun in Germany, which reached its cyclical peak in the first quarter of 2008. Thereafter, the German economy gradually cooled down in the wake of the recessions in the USA and Japan. In autumn 2008, the German economy also fell into a severe recession. With the collapse of the US investment bank Lehmann Brothers, the financial crisis came to a climax, with production and demand collapsing synchronously in both industrialized and emerging countries worldwide. World trade fell sharply, as did industrial production – in particularly export-dependent economies such as Germany and Japan even at double-digit rates.

The lower economic turning point – measured by the cyclical component of real GDP – was reached in the third quarter of 2009. The upper turning point of the following cycle was reached in the third quarter of 2011, after which the economy cooled down quite significantly.

The ongoing European financial and confidence crisis also affected the domestic German economy for the first time. In the second quarter of 2013, a new, albeit initially modest, long-lasting upswing set in, driven by domestic demand. A strong upturn in employment increased disposable income, stimulating private consumption and boosting retail sales, and an influx of refugees led to a sharp increase in public spending. Meanwhile, the low interest rate policy of the European Central Bank stimulated demand for investment in construction.

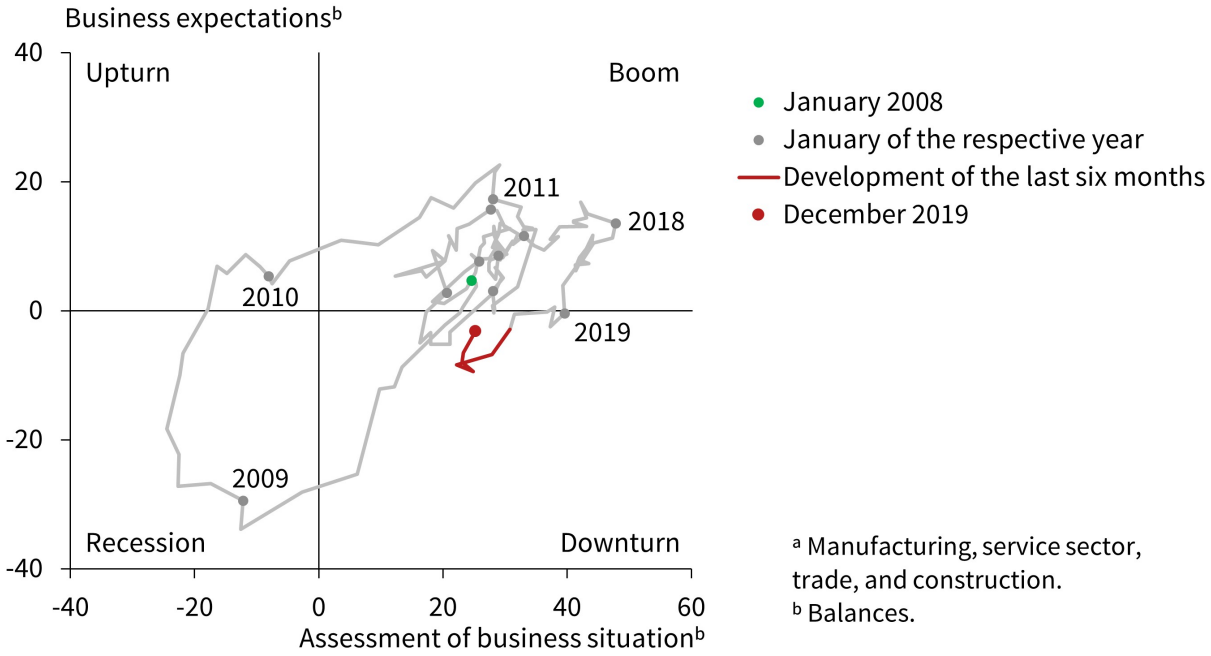
Overall, economic output rose at rates that were only slightly above the potential rates, leading to a gradual increase in capacity utilization. Excessively dynamic wage and price increases did not occur, and the upturn was only moderate. However, at the beginning of 2018 the German economy began to cool off, and a split in economic development emerged: The export-oriented manufacturing sector was caught in a severe recession. Economic policies that attempt to change the globalized economic order through isolation, sanctions, and threats increased uncertainty worldwide, cooled industrial activity, and caused world trade to plummet. At the same time, domestic service providers and the construction sector were recording robust and at times strong growth.

The movement of the ifo Business Cycle Clock was relatively "round" in the period 2008 to 2012. The lead time of the expectation indicator compared to the situation indicator was large enough to generate a largely circular movement of the situation-expectation graph. However, the lead time of the expectations indicator compared to the situation indicator was not large enough to fulfil the orthogonality condition in the strict sense. Therefore, the ideal-typically expected perfectly circular rotation of the clock became elliptical along the main diagonal connecting the boom and recession quadrants. Therefore, data points in the upswing and downturn quadrants were less frequent than data points in the boom and recession quadrants (see Figure 3.10).

From 2013 to the end of 2019, however, no clearly identifiable pattern of movement of the clock was apparent (see Figure 3.10). The main reason for this pronounced anomaly is that during most of this period the strong lead of the expectations indicator over the situation indicator, which is indispensable for the ifo Business Cycle Clock to function, was no longer given. A cross-correlation analysis between the situation and the expectations shows the highest statistical correlation in the years 2011-2016 in the case of a one-month lead (Table 3.2). Both the lead and strength of the correlation declined compared to the period 2005-2010, when the highest correlation is found when the expectations indicator leads the situation by four months (Wohlrabe and Wollmershäuser 2016). Another phenomenon particular to the period 2013 to the end of 2019 is the relatively small cyclical fluctuation from mid-2015 to the end of 2016, when the economic course is almost horizontal. The cyclical signal or the variance of the signal is very small in this phase, and the variance of the indicators is mainly attributable to the irregular component of the indicators.

In such a phase, it is not surprising if there is no pronounced lead time for any of the indicators. Table 3.2 also shows that the cross-correlation decreases considerably from 2011 to 2016.

Figure 3.10: ifo Business Cycle Clock from 2008 to 2019



[a] Manufacturing, service sector, trade, and construction.
[b] Balances.

Source: ifo Business Survey.

This is also typical for a phase where the variance of the signal is low. The data for 2017 at least indicate an upward movement in the boom quadrant and for 2018 and 2019 a downward tendency. Though the cross-correlations rise again in this period, there is no considerable lead of the expectations indicator over the situation indicator.

Figure 3.11 presents the ifo Business Cycle Clock for the most recent period January 2020 to October 2022. As a result of the Coronavirus pandemic, in the first half of 2020 the German economy fell into a severe recession, followed by a strong rebound. In 2021, economic activity continued to be damped by the pandemic. In 2022, the war in Ukraine and the extensive policy measures taken in this context slowed economic growth. Soaring energy prices massively reduced purchasing power in Germany, but so far a new recession has been avoided.

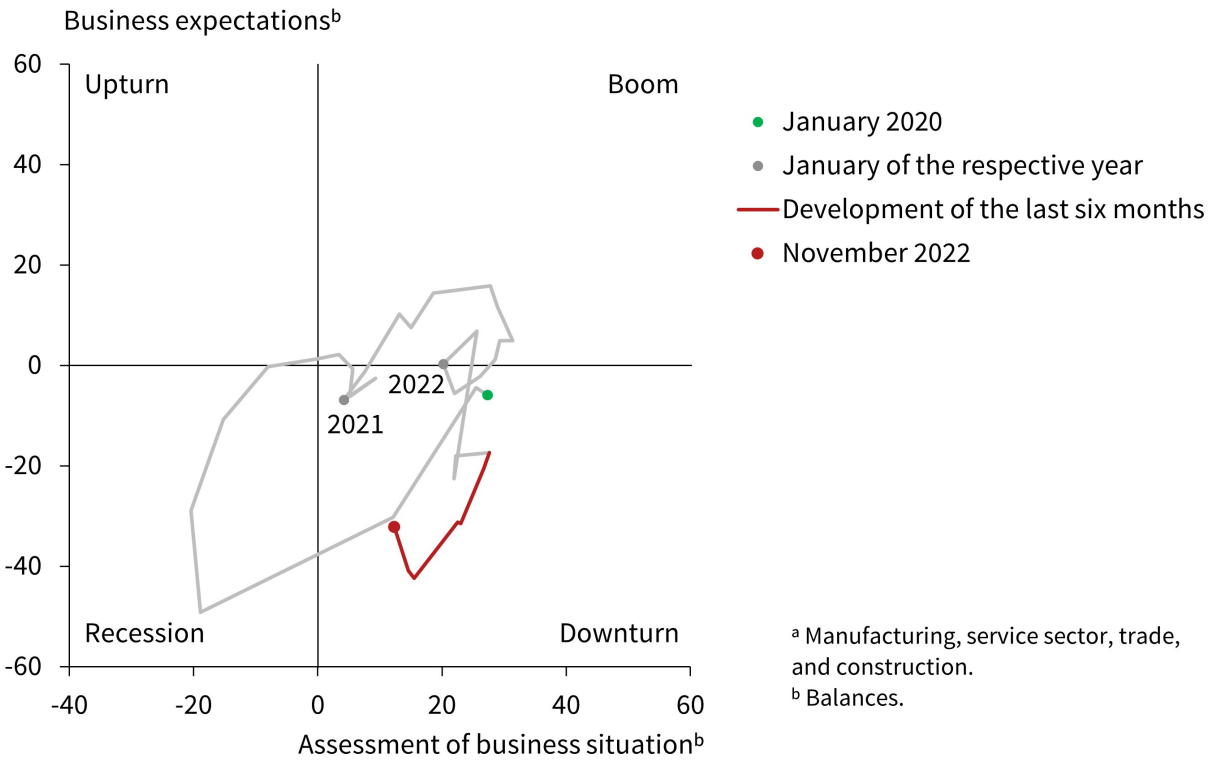
The movement of the ifo Business Cycle Clock in this period was relatively “round” again. Due to the shortened cycle length, the lead time of the expectations indicator compared to the situation indicator was long enough to generate the normal circular movement of the situation-expectation graph. However, this lead time was not long enough to fulfil the orthogonality condition equally, resulting one again in the ifo Business Cycle Clock being somewhat elliptically distorted (Figure 3.11).

Table 3.2: Cross-correlations between situation and expectations

Lead of business expectations in months	2005-2010	2011-2016	2017-2019
-6	-0.137	-0.401	0.054
-5	-0.014	-0.302	0.147
-4	0.117	-0.173	0.294
-3	0.251	-0.023	0.431
-2	0.383	0.154	0.580
-1	0.520	0.339	0.721
0	0.640	0.509	0.823
1	0.713	0.594	0.852
2	0.766	0.590	0.831
3	0.803	0.575	0.794
4	0.826	0.531	0.715
5	0.827	0.519	0.653
6	0.812	0.470	0.604

Source: ifo Business Survey, own calculations.

Figure 3.11: ifo Business Cycle Clock from 2020 to November 2022



[a] Manufacturing, service sector, trade, and construction.
[b] Balances.

Source: ifo Business Survey.

3.3.5 Conclusion

"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", visualizing the interaction between managers' business assessment and expectations" (Gayer 2008, page 1). Since 1993, the ifo Institute has presented the above-mentioned cyclical relationship between the situation and expectations components of the ifo Business Climate Index in a four-quadrant diagram. The abscissa of the clock shows the assessment of the current situation, the ordinate shows the expectations of the surveyed companies. The intersection of the two zero lines divides the diagram into four quadrants, which mark four sub-phases: Upswing, boom, downturn, recession. If the situation indicator and the expectations indicator are orthogonal functions, the economy – visualized as a situation-expectation graph – moves clockwise.[13]

If the situation indicator and the expectations indicator are not orthogonal to each other, which is empirically the rule rather than the exception due to the insufficient lead time, the ideal-typical circular rotation of the clock is deformed into a movement along the main diagonal that connects the boom quadrant with the recession quadrant. If necessary, the ifo Business Cycle Clock can be corrected using the instrument of principal component analysis.

The ifo Business Cycle Clock is available promptly, provides clear signals without major disruptions, and is not subject to revisions. It thus fulfils important characteristics of indicators for business cycle analysis (Moore and Shiskin 1967). In contrast to other modern graphic monitoring systems that depict the cycle in a four-quadrant system of the basic economic phases – such as the "Business Cycle Tracer" of the Dutch Statistical Office, the "Economic Climate Tracer" of the EU Commission and the "Konjunkturmonitor" of the German Federal Statistical Office[14] – the ifo Business Cycle Clock shows the cyclical development without the need for prior *trend adjustment* of the input series. This eliminates the problems associated with such a trend adjustment. For example, the economic development at the current edge of the time series, which is particularly important from a forecasting point of view, and in particular the appearance of new turning points when new values are added or when the previous original data are revised, can sometimes change. The assessment of the economic situation is therefore very uncertain at the edge of the observation range. Newly added values can significantly change the image drawn through the filter (Kaiser and Maravall 2001). The ifo Business Cycle Clock gives clear economic signals even without an aprioristic trend adjustment.

[13] Since March 2021, the ifo Institute has published a mean-adjusted clock in order to present a more centered rotation of the clock. In addition, the labeling of the four quadrants was changed to "Boom", "Slowdown", "Crisis", and "Recovery" (Wohlrabe and Wollmershäuser 2021).

[14] These monitoring systems are generally based on the deviation of the trend-cycle component of an indicator from the trend or its change over time (Van Ruth et al. 2005, Oltmanns 2009, Gayer 2008, and Abberger and Nierhaus 2011b).

Overall, the ifo Business Cycle Clock is suitable for presenting the course of the economy as a whole and the associated dynamics solely on the basis of entrepreneurial judgements and assessments. However, the clock is less suitable for distinguishing the individual economic phases of the filtered real gross domestic product. For an exact cycle classification, analytical instruments specially optimized for this purpose should be used. The strongest point of the ifo Business Cycle Clock, however, is that it provides an excellent alternative visualization of the current economic development.