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The CNB's approach to setting the countercyclical capital buffer

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Abbreviations

BCBS	Basel Committee on Banking Supervision
BIS	Bank for International Settlements
BLS	Bank Lending Survey
BPI	Banking Prudence Indicator
CCoB	capital conservation buffer
CCyB	countercyclical capital buffer
CISS	Composite Indicator of Systemic Stress
CNB	Czech National Bank
CRD	Capital Requirements Directive
CRR	Capital Requirements Regulation
CZ	Czech Republic
CZK	Czech koruna
CZSO	Czech Statistical Office
ECB	European Central Bank
ESRB	European Systemic Risk Board
EU	European Union
EWMA	exponentially weighted moving average
FCI	Financial Cycle Indicator
GBP	British pound
GDP	gross domestic product
HP	Hodrick-Prescott
IRB	Internal Rating Based Approach
IRS	interest rate swap
LGD	loss given default
LLP	loan loss provision
OIS	Overnight Indexed Swap
pp	percentage point
PRIBOR	Prague InterBank Offered Rate
PX INDEX	Prague Stock Exchange Index
S1, S2, S3	degrees of asset impairment according to IFRS 9
SRB	systemic risk buffer
STA	Standardised Approach
USD	American dollar

1. Foreword

The CNB is the designated macroprudential body for the Czech Republic[1] and is responsible for assessing the degree of cyclical systemic risk on quarterly basis. Based on this assessment, it may set a countercyclical capital buffer (CCyB) rate for institutions'[2] exposures in the Czech Republic and in other countries. The CNB decides to set a CCyB rate in order to maintain the resilience of the Czech banking sector to negative impacts of potential impairment losses on loans provided in the upward phase of the financial cycle and to smooth lending to the real economy in the event of adverse developments.

The point of the CCyB macroprudential tool is to create a capital buffer when cyclical risks are accumulating in institutions' balance sheets and to release it when those risks are decreasing through materialisation or through a natural gradual decrease in balance sheets. In principle, therefore, it is a simple countercyclical tool. From the perspective of decision-making and communication, however, the specific CCyB rate applied must be backed up with an appropriate justification (Article 12o(8)(d) of the Act on Banks and Article 8al(8)(d) of the Act on Credit Unions).

This paper aims to present key aspects of the CNB's approach to setting the CCyB rate, contribute to the formation of expectations about the future path of the rate, and thereby facilitate capital planning for credit institutions.

When deciding on the CCyB rate, the CNB follows national legislation and BCBS and ESRB methodologies and guidelines.[3] Based on these methodologies and guidelines, the CNB calculates and publishes the credit-to-GDP gap and the corresponding benchmark CCyB rate. In light of the recommendation to consider the specificities of the Member State concerned, the CNB takes into account a number of other indicators. These are mainly macrofinancial indicators and indicators specific to the banking sector which the CNB uses to determine the position of the domestic economy in the financial cycle and to monitor institutions' vulnerability to cyclical risks. Based on a comprehensive assessment of the indicators, the CNB assesses the degree of cyclical systemic risk currently accepted in institutions' balance sheets or accumulated in previous periods. Further to this, the CNB estimates the sufficiency of institutions' capital buffers to cover potential losses arising from cyclical risks and maintain smooth lending to the real economy in the event of adverse developments. On the basis of this assessment, the CNB may set or change the CCyB rate.

Considering the nature of systemic risks,[4] the CNB maintains some flexibility in its decision-making and is prepared to take into account new information leading to greater resilience of institutions in its approach to setting the CCyB rate. For this reason, this document may be revised and updated as needed with regard to (i) changes in statistical reporting and potential revisions of data entering the decision-making process on the setting and calculation of the CCyB rate, (ii) refinements of the CNB's modelling system, (iii) legislative changes and (iv) changes in internationally agreed practices.

1 Act No. 6/1993 Coll., on the Czech National Bank, as amended, and other legal regulations.
2 Throughout this document, "institution" means banks and credit unions pursuant to Act No. 87/1995 Coll.
3 Act No. 21/1992 Coll., on Banks, as amended, Act No. 87/1998 Coll., Act No. 87/1998 Coll., on Credit Unions and Certain Related Measures and on the Amendment of Czech National Council Act No. 586/1992 Coll., on Income Taxes, as amended, as amended. BCBS (2010): Guidance for national authorities operating the countercyclical capital buffer. Recommendation of the ESRB on guidance for setting countercyclical capital buffer rates (ESRB/2014/1), part B, paragraph 2.
4 Frait, J., Komárková, Z. (2011): Financial stability, systemic risk and macroprudential policy, Thematic Article on Financial Stability, FSR 2010/2011.

2. Basic information on the setting of the CCyB rate

The CNB assesses the degree of cyclical systemic risk in the Czech Republic **on a quarterly basis**. Based on this assessment, it may set or change the CCyB rate for risk-weighted exposures[5] in the Czech Republic.[6] When making its assessment and deciding on the level of the CCyB rate, the CNB primarily takes into account:

a) a benchmark indicator based on the standardised deviation of the credit-to-GDP ratio from its long-term trend (the standardised credit-to-GDP gap) calculated in accordance with BCBS guidance[7] (see section 4 and Appendix 1),
b) another benchmark indicator based on the additional credit-to-GDP gap calculated in accordance with ESRB recommendations[8] (see section 4 and Appendix 1),
c) the financial cycle indicator (FCI) constructed by the CNB and other indicators of lending, risk perceptions and risk pricing which together help to determine the position of the Czech Republic in the financial cycle (see section 4 and Appendix 2),
d) macrofinancial indicators and indicators specific to the banking sector aimed at determining the size of the cyclical risks currently accepted and accumulated in the domestic banking sector's balance sheet and the domestic banking sector's level of vulnerability (see section 4),
e) benchmark CCyB rates calculated based on the standardised gap referred to in point a) and the additional gap referred to in point b) (see Appendix 1),
f) CCyB guide rates calculated based on the CNB's quantitative methods reflecting the macrofinancial specificities of the Czech Republic (see section 5).

In order to comprehensively assess the macrofinancial conditions, including the economic outlook and the configuration of economic policies in the Czech Republic and abroad, the CNB also takes into account projections of some of the above indicators calculated based on scenarios consistent with the CNB's forecast and the results of its macro-stress tests[9] when setting the CCyB rate.

The CNB usually sets a CCyB rate of **between 0% and 2.5%**, calibrated **in multiples of 0.25 pp**. All institutions in EU Member States are required to use the same rate for risk-weighted exposures in the Czech Republic in this case. In extraordinary cases also justified by items a) to f), **the CNB may set a rate in excess of 2.5%**. Institutions supervised by the CNB must abide by this rate, whereas institutions with exposures in the Czech Republic supervised by an authority of another EU Member State must in this case follow the instructions of their designated authority.

In the event of an **increase in the CCyB rate**, institutions are obliged to start applying the new CCyB rate usually **one year after the date of issue of the decision** (see section 6). In exceptional cases, the CNB may shorten this period. In the event of a decision to **lower the CCyB rate, this period is**

5 For the calculation of the total risk exposure amount, see Article 92(3) of Directive (EU) No 575/2013 (CRR).
6 For simplicity, the CCyB rate here refers to the CCyB rate for risk-weighted exposures in the Czech Republic unless indicated otherwise.
7 BCBS (2010): Basel III: A global regulatory framework for more resilient banks and banking systems, BCBS (2010): Guidance for national authorities operating the countercyclical capital buffer.
8 ESRB recommendation on guidance for setting countercyclical capital buffer rates (ESRB/2014/1), part B, paragraph 2.
9 https://www.cnb.cz/en/financial-stability/stress-testing/

not usually applied. In the event of a decrease in the CCyB rate, the CNB will determine and state in its decision an indicative period during which no increase in the CCyB rate is expected.

In addition to setting a CCyB rate for risk-weighted exposures in the Czech Republic, the CNB in some cases decides on **the recognition of a CCyB rate for risk-weighted exposures in other countries**. When making these decisions, the CNB mainly takes into account the amount of credit provided by the supervised institutions in these countries and the consequences for the degree of cyclical systemic risk in the domestic financial sector. In the case of EU Member States, the CNB decides on the recognition of a CCyB rate for risk-weighted exposures in these countries for institutions which it supervises if the rate has been set in excess of 2.5% by the designated macroprudential authority of that country.[10] In the event of a decision not to recognise a rate in excess of the limit, the CNB will set the CCyB rate at 2.5% (see section 6). In the case of a non-Member State of the EU, the CNB may set a CCyB rate of up to 2.5% where the relevant authority of that country has not set a CCyB rate, or has set it lower than 2.5%, and the CNB evaluates the amount of credit provided in that non-Member State by institutions supervised by the CNB as risky. Where the relevant authority of a non-Member State of the EU has set a CCyB rate in excess of 2.5%, the CNB proceeds in the same way as it does with EU Member States.

3. Evolution of cyclical risks over the financial cycle

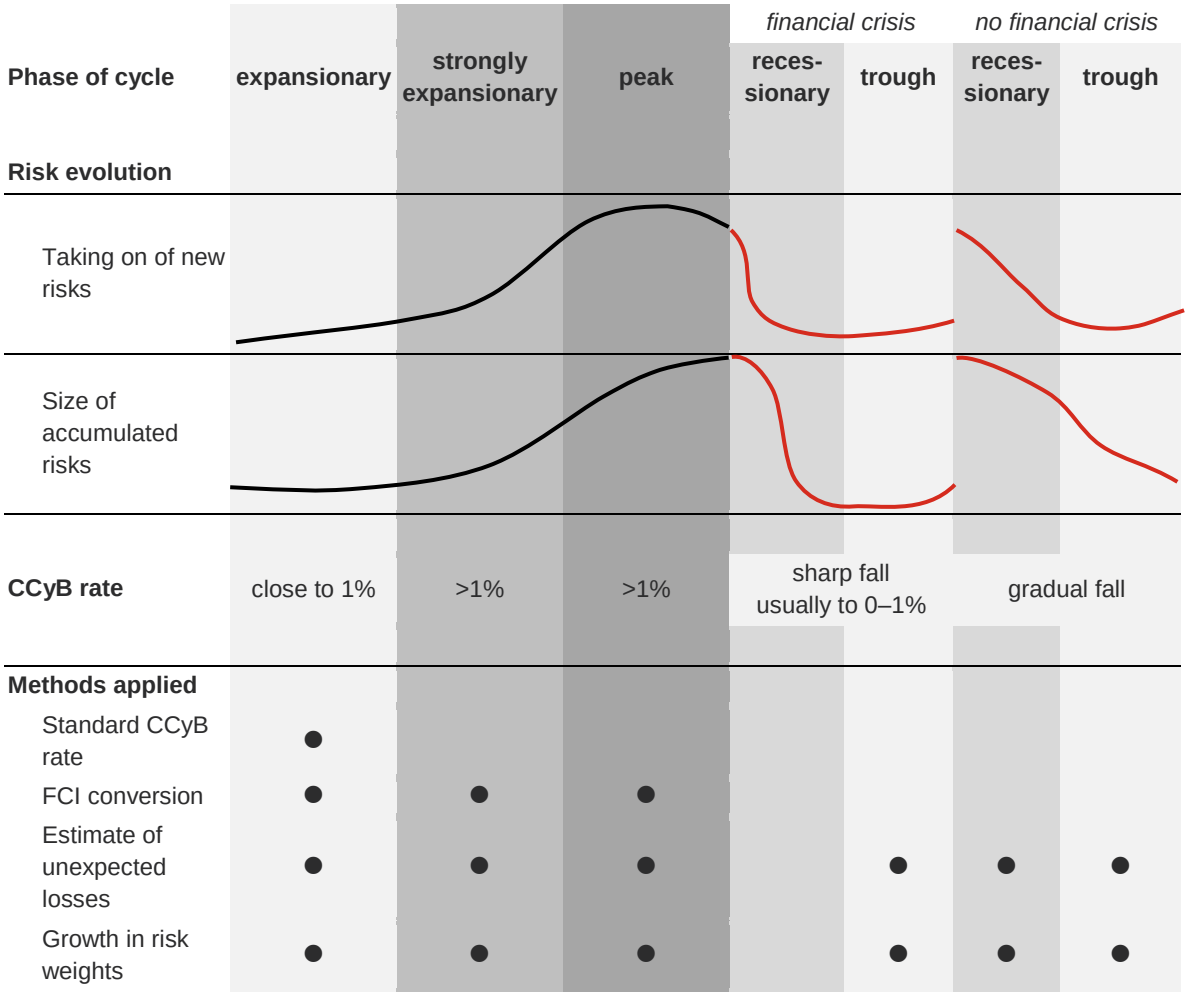
For setting the CCyB rate, the CNB's basic starting point is to determine the current position of the Czech economy in the financial cycle. Similarly to the economic cycle, this cycle has an expansionary phase, a recessionary phase and turning points – a peak and a trough.[11] It is subsequently important to assign the expected evolution of the taking on of cyclical risks in institutions' balance sheets to the identified position in the financial cycle and, at the same time, to estimate the size of the cyclical risks accumulated in previous periods. In this sense, the size of the cyclical risks (newly accepted or accumulated) can be described as subdued, standard, increased or decreasing (see Figure 1).

The expansionary phase of the financial cycle is associated with **the standard (usual) size of cyclical risks newly accepted and accumulated in institutions' balance sheets**. This is typical of times when market sentiment is improving and macrofinancial indicators are pointing to a bottoming-out of the recessionary phase of the **financial cycle** but are not usually at strongly above-average levels. Lending activity and prices of financial assets and property are increasing modestly, credit losses[12] are not usually rising, credit standards are flat or being relaxed slightly and institutions are generating reasonable profits. Risk weights of exposures and the cost of capital[13] are broadly flat and, given the falling perceived probability of a recession, may start to decline gradually. Where the CCyB rate is set at a low level at the start of this phase, **the CNB expects to start the process of raising it**. It may be hard for the CNB to assess the real level of growth in new cyclical risks and

10 Up to a rate of 2.5%, reciprocity is automatic. Simply put, this means that up to this level, institutions supervised by the CNB automatically apply the CCyB rate for risk-weighted exposures in other EU Member States set by the designated authority of that Member State.
11 The financial cycle may at times follow an atypical course, with some of these phases either not occurring at all or lasting an unusually short or long time.
12 Credit losses are a cost item in the profit and loss statement.
13 In the sense of market conditions affecting the costs of increasing capital in the form of retaining earnings, issuing new shares or changing the structure of portfolios.

their size in the financial system early in the expansionary phase of the cycle, as in this phase the indicators (see section 4) or models may provide insufficiently robust or mixed signals of this growth. To ensure timely creation of the CCyB, and to avoid the need to make sharp changes to it in the future, the CNB may initially apply the concept of the **standard CCyB rate**, which it has estimated at **1%** (see section 5.1). If the expansionary phase of the financial cycle is long-lasting, the CNB expects the CCyB rate to stay at or close to the standard level after it has reached that level.

Figure 1: Evolution of cyclical risks over the financial cycle



Source: CNB

The **strongly expansionary phase** of the financial cycle is characterised by **faster taking on** of new **cyclical risks** in institutions' balance sheets and the simultaneous rapid accumulation of those risks. The financial cycle is heading towards its peak. The relevant indicators are at above-average levels. In this phase, credit growth and asset prices are usually rising sharply against a backdrop of relaxed financial conditions. Investors have a very optimistic view of the amount of risk being taken. Credit losses, risk weights of exposures and the cost of capital are declining steadily, nearing or reaching long-term lows. In this phase, the CNB expects to **raise the CCyB rate above 1%, to as high as 2.5**% (see section 5.1) or even higher in exceptional cases.

At or immediately past the peak of the financial cycle, the speed of the taking on of cyclical risks peaks and then starts to fall. However, due to their previous elevated levels and the absence of risk materialisation, **the risks continue to accumulate in institutions' balance sheets or stagnate at high levels**. Some forward-looking indicators (such as credit growth, asset/property prices and risk weights of some types of exposures) may be signalling a turnaround in the financial cycle. In this situation, the CNB does not expect to change the CCyB rate.

The recessionary phase of the financial cycle is typified by **a faster slowdown in the speed of the taking on of new cyclical risks** and **a decrease in the size of the cyclical risks accumulated** in institutions' balance sheets**.** The first signs of a turnaround in the financial cycle are apparent primarily in market indicators (see Appendix 4). In the recessionary phase of the financial cycle, asset prices tend to stagnate or fall, financial conditions may become tighter, investors are pessimistic about the level of risk and credit growth slows. Where this phase is associated with a recession or crisis, cyclical risks materialise and loan defaults and institutions' losses increase. The speed of the decline in the accumulated risks may thus be relatively high. Risk weights of exposures and the cost of capital stop falling sharply and, given the growing probability of a deterioration in economic conditions, may start to increase. In this phase, CNB expects to **lower the CCyB rate**. Depending on the depth of the economic slowdown, **the buffer may be released completely and the rate set at 0%** (see section 5.2, The CCyB rate-reducing process). This decision requires signals of **materialisation of previously assumed cyclical risks** directly affecting the **supply of credit to the real economy.** If the recessionary phase of the cycle is not associated with a crisis and the materialisation of cyclical risks, the cyclical risks accumulated in balance sheets decrease relatively slowly. In this case, the CNB expects to start reducing the CCyB rate. However, given the uncertainty regarding the further course of the financial and business cycles, it will do so slowly and gradually.

A financial cycle close to its trough is characterised by **a continued decline in the taking on of new cyclical risks** in institutions' balance sheets. The relevant indicators (see section 4, Table 1) are below their long-term levels. Demand for loans remains subdued as a result of economic conditions and adverse sentiment linked with investors' limited motivation to take on financial risks. **The evolution of the cyclical systemic risks accumulated in balance sheets depends on the nature of the previous recessionary phase of the financial cycle.** Where these risks did not materialise as institutions' credit losses, the cyclical risks accumulated in institutions' balance sheets **continue to decline gradually**. In this case, the CNB expects **a further gradual decrease in the CCyB rate** consistent with the pace of decline in the cyclical risks in the banking sector's balance sheet. Where the previous decline in the financial cycle to a trough was associated with a recession or crisis, realised losses and an asset price correction, the accumulated cyclical risks also materialised. **In this case, the size of the accumulated cyclical systemic risks is already low at the trough of the cycle**, asset prices are no longer falling sharply and institutions' credit losses are no longer rising sharply. Risk weights of exposures and the cost of capital remain elevated, while credit standards remain tight. When the financial cycle reaches its trough, the CNB expects **the CCyB rate** to remain at **0–1%** until the start of a new expansionary phase.

4. Indicators used to determine cyclical risks and the resilience of the financial system

When deciding on the CCyB rate, the CNB assesses a series of indicators that should provide a guide to when the CCyB rate should be raised, maintained or lowered, or the buffer fully released. These are mostly macro-financial indicators used to determine the position of the Czech Republic in the phase of the financial cycle (see section 3) so that systemic cyclical risks can be estimated, and banking sector-specific indicators used to monitor the sector's vulnerability/resilience. These indicators help estimate whether the capital buffers are sufficient to cover potential losses stemming from the materialisation of cyclical risks.

The CNB selects suitable indicators in accordance with ESRB recommendations,[14] among other things. The ESRB recommends calculating for each quarter the credit-to-GDP gap estimated using the HP filter based on the BCBS/ESRB methodology. The Czech Republic, however, is a country where the calculated gap does not provide a reliable signal for identifying the emergence of systemic cyclical risks (see Appendix 1). For these reasons, the CNB, in accordance with ESRB guidance, calculates the gap using an alternative method (the expansionary credit gap[15]). The signalling potential of the alternative gap is higher, but it still does not sufficiently reflect the credit cycle and the risks of excessive credit expansion in the Czech Republic. Based on empirical findings and ESRB recommendations, the CNB uses additional indicators (see Table 1) that complement the above-mentioned gaps and have a greater ability to track the evolution of cyclical risks in the Czech Republic.

The **composite financial cycle indicator (FCI) plays an important role** in determining the position of the Czech economy in the financial cycle. The FCI was created in order to measure the speed of the taking on of new risks in financial institutions' balance sheets and hence also the accumulation of these risks in balance sheets. The FCI thus provides an early warning signal (6–8 quarters ahead of the potential materialisation of such risks) of the increasing size of the risks, which could jeopardise the stability of the domestic financial sector. The FCI includes subindicators covering a wide range of demand and supply factors which, according to earlier studies and the CNB's expert judgement, sufficiently characterise the cyclical swings in financial risk perceptions (see Appendix 2).

Another indicator monitored is the dynamics of bank loans with respect to both the stock (overall amounts) and flows (new business) of credit. The **dynamics of the stock of loans** provide information on the evolution of overall leverage, while the **dynamics of new loans**[16] indicate current tendencies in risk-taking by banks, households and non-financial corporations. Long-term averages and past values from periods assessed in retrospect as upper limits are used as benchmarks for evaluating whether credit growth is excessive. To assess the dynamics of the stock of loans, the year-on-year rate of growth is complemented by the year-on-year changes in absolute amounts in order to eliminate the low base effect. Absolute amounts are used in particular when assessing new bank loans.

14 ESRB recommendation on guidance for setting countercyclical capital buffer rates (ESRB/2014/1).
15 Hájek, J., Frait, J., Plašil, M. (2017): The countercyclical capital buffer in the Czech Republic, Thematic Article on Financial Stability, FSR 2016/2017, CNB.
16 Pure new loans including loan increases, i.e. loans adjusted for refinancing and other renegotiations, are monitored in particular.

Table 1: Main indicators/tools used by the CNB in setting the CCyB rate

Type	Indicators	Note	Data frequency
Macrofinancial indicators	Financial Cycle Indicator (FCI)	Composite indicator: evolution of new loans, changes in property price index, debt sustainability, lending conditions, PX stock index, adjusted current account to GDP ratio; see Appendix 2	Q
	Credit growth	Growth in loan stock and new loans	M
	Financial conditions	Interest rates on new loans and their relationship to inflation and nominal income growth	M and Q
	Default rates for households and non-financial corporations	Newly defaulted exposures relative to non-default loans	M and Q
	Property price overvaluation	The CNB estimates overvaluation using two approaches: prudential and valuation-based. See Plašil, M., Andrle, M. (2018): Assessing house price sustainability.	Q
	Composite Indicator of Systemic Stress CISS	Market data: money market, equity market, government bond market, foreign exchange market, financial intermediation; see Appendix 4	D
Banking sector-specific indicators	Structure and evolution of capital and capital ratio	Classed into Pillar 1 and Pillar 2, SRB, CCoB, CCyB, voluntary surplus	Q
	Risk weights and evolution of risk-weighted exposures	Evolution of time series, model-based approach (see section 5.1)[17]	Q
	Evolution of provisioning	Ratio of provisions to stock of loans, expected credit losses, coverage of loans by provisions. Related BPIs – ratio of margins on loan stock/provisions per unit of credit, adjusted for ratio of loans to capital excluding CCyB.[18]	M and Q
	Asset quality	Banking sector credit losses, shares of S1, S2, S3 assets in credit portfolio, change in asset structure over time	M
	Prudential estimate of unexpected credit losses due to nature of position in financial cycle	Model approach; see Appendix 3	Q
	Structure and evolution of profit	Net interest income excluding income on excess liquidity, return on assets, after-tax profit in absolute terms	M
	Capital capacity for lending	Credit to private non-financial sector potentially provided from difference between total capital and capital requirement or comparison of this difference with capital to cover loans in scenarios considered	Q
	Indication of demand and supply constraints according to BLS		Q
Others	Stress test results	Stress tests of banks, households, non-financial corporations, insurance companies, pension companies, investment funds, public finances	H (banks, households, non-financial corporations), Y (others)
	Other policy tools		

Source: CNB
Note: D daily, M monthly, Q quarterly, H half-yearly, Y yearly

17 The description of the approach will be published in 2023 as a CNB Working Paper, probably under the title *Modelling risk-weighted assets: Looking beyond the stress tests* (J. Švéda, J. Panoš and V. Siuda, 2023).
18 BPIs (Banking Prudence Indicators) are vulnerability indicators capturing the evolution of cyclical risks in the banking sector, including (as the case may be) in the context of leverage. See Pfeifer, L., Hodula, M.: A Profit-to-Provisioning Approach to Setting the Countercyclical Capital Buffer: The Czech Example. CNB Working Paper 5, 2018.

In addition to credit dynamics, the CNB pays attention to **property market indicators**. Besides the annual rate of growth of property prices, it estimates their over/under-valuation and sustainability relative to economic fundamentals.[19] Furthermore, the CNB focuses on **indicators of indebtedness of economic sectors, external imbalances** and lending conditions and credit standards.[20]

The FCI and credit dynamics mainly indicate the speed of the taking on of new cyclical risks. However, the perspective of **the amount of cyclical risks gradually accumulated in institutions' balance sheets** is also important. The key factor here is the riskiness of credit portfolios. To this end, the CNB monitors **loan default rates** – both their historical values and future projections. In a broader context, the CNB also evaluates additional information on the structure of credit portfolios at the micro-level and conducts stress tests of non-financial corporations and households, which may indicate the extent of potential losses in the event of expected or more adverse developments. This provides a basis for **a model-based approach to assessing potential losses** on existing credit portfolios using the conditional probability distribution (see section 5 and Appendix 3).

Another accompanying feature of the different phases of the financial cycle is the evolution of the banking sector's vulnerability in the sense of its prudence as regards internal provisioning for a deterioration in macrofinancial conditions. Procyclicality – and hence growth in vulnerability – is usually reflected mainly in **provisioning** (expected losses, ratio of provisions to stock of loans, BPI) and **risk weights**.[21]

The CNB also uses other primary indicators to decide on whether to maintain or lower the CCyB rate. Empirical findings indicate that market indicators have some forward-looking ability to signal the future materialisation of risks in a timely fashion. As representative of this category (and based on ESRB recommendations), the CNB uses the **Composite Indicator of Systemic Stress – CISS** (see Appendix 4). When deciding on the level and rate of release of the CCyB, the CNB monitors the materialisation of cyclical risks (in particular credit risk, i.e. asset quality and especially **credit losses**, which feed through to the mechanism for absorbing credit losses through **profit** and **capital**). To indicate the possible constraint on the supply of credit by the capital requirement in the recessionary phase of the financial cycle, the CNB uses the **Capital Lending Capacity Indicator** (see section 5.2) and supplementary information on the evolution of lending conditions and credit standards.

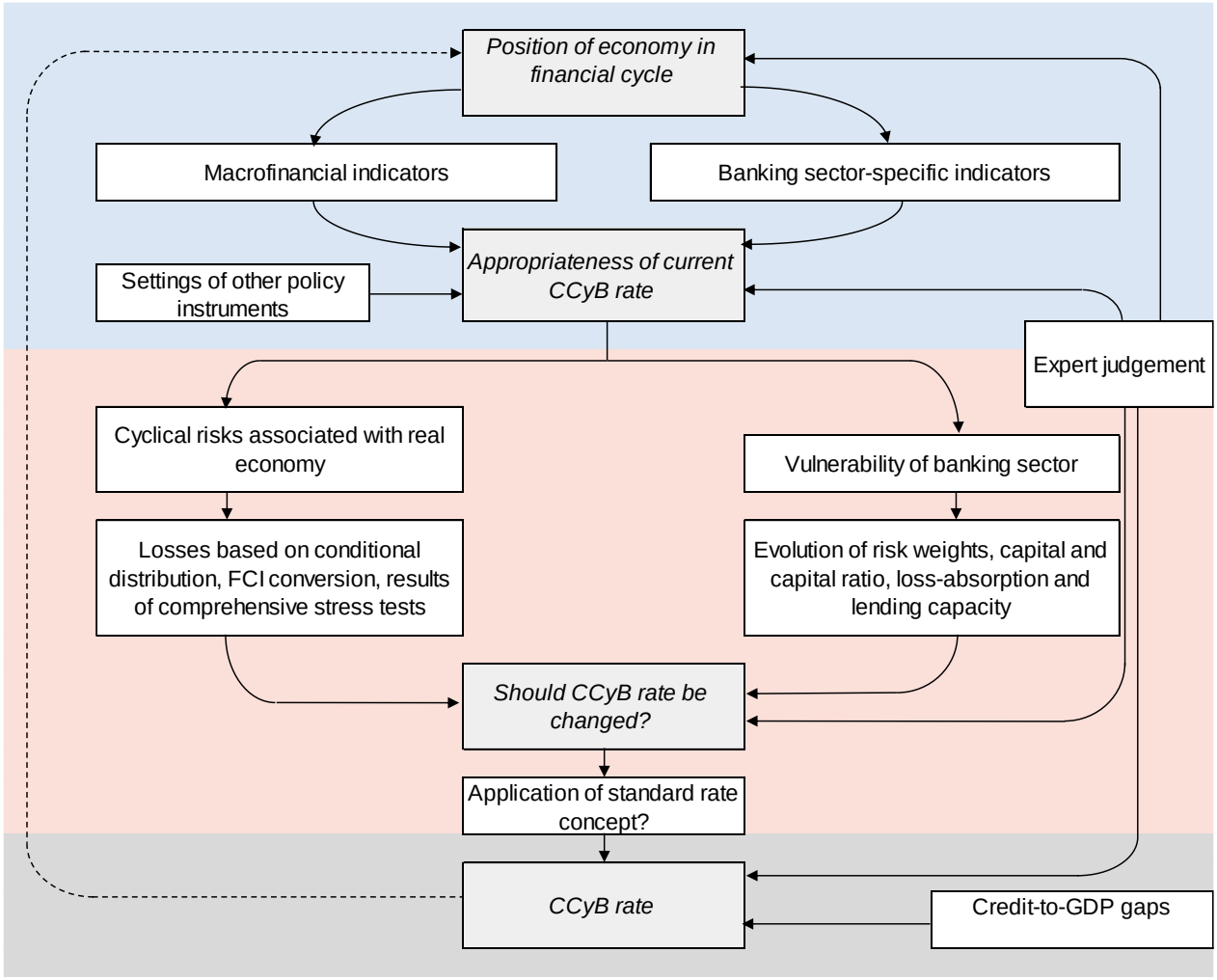
The CNB regularly evaluates the predictive ability of the above indicators and recalibrates the relationships in the models it uses. The option of creating new indicators or refining the models themselves is not neglected either.

19 The CNB uses two model-based approaches to assess house price sustainability; see Plašil, M., Andrle, M. (2018): Assessing house price sustainability, Thematic Article on Financial Stability 1/2019.
20 More information in this area is provided by the BLS: https://www.cnb.cz/en/statistics/bank-lending-survey/.
21 Risk-weighted portfolios under the IRB approach. At the aggregate level, the CNB typically registers a decrease (increase) in risk weights and a resulting lower (higher) amount of risk-weighted assets during the expansionary (recessionary) phase of the financial cycle.

5. Calibration of the CCyB rate

The methodology for setting the CCyB rate was formulated by the BCBS and subsequently introduced into EU regulatory practice through the CRD IV directive and its transposition into Czech law. The framework was further developed by the ESRB. Under this methodology, a **benchmark CCyB rate** is set using the deviation of the credit-to-GDP ratio from its long-term trend (the credit-to-GDP gap) based on the HP filter (see section 4). The benchmark CCyB rate calculated in accordance with this methodology is not suitable for the Czech Republic (see Appendix 1) and for the CNB it represents merely a starting point for a more comprehensive evaluation. The alternative gap (see section 4) also does not imply a CCyB rate taking sufficient account of the manifestations of cyclical risks in the Czech Republic. The CNB therefore likewise considers the rate based on the alternative gap as only a very rough guide.

Figure 2: The CNB's approach to setting the CCyB rate



Source: CNB

The CNB sets the CCyB rate using its own approach (see Figure 2). It takes into account a **series of indicators** reflecting the specificities of the Czech Republic in the area of systemic cyclical risks, in accordance with ESRB recommendations (see section 4). At the same time, the CNB uses several quantitative methods which directly quantify the appropriate level of the CCyB rate based on the available data.

5.1 Quantitative methods used by the CNB

The standard CCyB rate[22]

Use of the method: early in the expansionary phase of the financial cycle

In deciding on the CCyB rate in the expansionary phase of the financial cycle when the amount of new cyclical risks and their size in institutions' balance sheets are at standard levels, CNB uses **the standard rate concept.** Under this concept, the CNB gives greater weight to historical experience and patterns observed in the past. The application of this concept has no direct effect on the CCyB rate attained at the peak of the financial cycle; it merely represents a different **distribution of the creation of the buffer over time.**

The CNB uses two approaches to calibrate the optimum CCyB rate. The first is based on the sustainable rate of credit growth in the Czech Republic and the second on the conversion of FCI values (see section 4 and Appendix 2). The results of both approaches indicate a need to set the **standard CCyB rate in the Czech Republic at 1%.**

The first approach helps the CNB to **decide when to start creating the CCyB.** Under this approach, a situation where the annual absolute growth in the stock of credit is around 4% of nominal GDP – assuming a long-term annual nominal GDP growth rate of 4.5% – is identified as the usual level of cyclical risks in institutions' balance sheets (this rate of growth corresponds to a situation where the Czech economy is operating close to its potential). The CNB expects to start considering raising the CCyB rate to 1% when growth in the stock of loans nears this level.[23]

The second approach helps the CNB **decide on the pace of increase of the CCyB rate** in this period. It is based on the method used as a tentative guide to setting the CCyB rate based on the values of the composite FCI (see section 4 and Appendix 2). In this method, the CNB assumes that the usual level of cyclical risks in balance sheets corresponds to the historical median of the sub-indicators entering the composite FCI calculation. The CNB regularly evaluates the **relationship between the FCI values and the CCyB rate** and publishes a **conversion table** semi-annually (see Appendix 2 and section 6). In the conversion table, a CCyB rate close to 1% corresponds to the situation where cyclical risks are at their usual levels. Experience from the previous two financial cycles shows that the period between starting to create the CCyB and reaching the FCI values corresponding to a standard rate of 1% lasts around eight quarters. This corresponds to a **pace of increase of the CCyB rate of 0.5 pp a year.**

22 Plašil, M. (2019): The countercyclical capital buffer rate for covering the usual level of cyclical risks in the Czech Republic, Thematic Article on Financial Stability 2/2019, CNB..

23 In 2018, the rate of growth in the ratio of the stock of loans provided to the private, non-financial sector to nominal GDP of 4% corresponded to roughly CZK 40–50 billion.

Conversion of FCI values into a CCyB rate

Use of the method: a guide in the expansionary and strongly expansionary phase of the financial cycle

The FCI (see section 4) serves as a guide to setting the CCyB rate, especially in periods when the speed of the taking on of new cyclical risks in institutions' balance sheets is increasing. The calibrated relationship between FCI values and CCyB rates is defined in a conversion table (see Appendix 2). The conversion is non-linear, so the bands of FCI values are not necessarily of the same width for all the rates, and it does not hold that an increase in the FCI values leads to a proportional change in the CCyB rate. As a result of changes in the overall range of the FCI values, the CNB recalibrates the intervals implying a specific CCyB rate every quarter. The CNB publishes the current conversion table semi-annually (see section 6).

Estimation of unexpected losses based on the conditional distribution

Use of the method: quantification of the absolute amount of capital needed through the financial cycle

This formal approach to setting the CCyB rate adopted by the CNB is based on the premise that the CCyB level should cover potential unexpected credit losses related to the cyclical risks which may materialise in the event of a future shock. As the probability of occurrence and severity of a shock varies over the financial cycle, **the CNB uses a conditional probability distribution to estimate potential unexpected losses[24] caused by the position in the financial cycle**. In the case of the conditional distribution, the risk of a crisis – and hence also the probability of greater cumulative losses in future – steadily increases as the economy moves into the strongly expansionary phase of the cycle. At the same time, the risks accumulated in institutions' balance sheets increase as the strongly expansionary phase of the cycle lengthens. In the recessionary phase of the financial cycle and at the bottom of the financial cycle, by contrast, the probability of the situation worsening further and the size of the accumulated risks both decrease. Unlike FCI conversion, the method thus takes into account not only the speed of the taking on of new risks in balance sheets, but also their previous accumulation, and can therefore be used in all phases of the financial cycle.

To estimate the size of the cumulative credit losses over a two-year horizon, the CNB constructs the probability distribution of the default rates. The shape of this distribution is conditional on projections of the FCI and other macrofinancial indicators (for details see Appendix 3). Based on the distribution obtained, the CNB determines the default rate in the event of adverse developments at the level of the 90% quantile. It then derives the potential losses on the basis of this rate and depending on portfolio volumes. The choice of the 90% quantile reflects the CNB's preference to cover even relatively unlikely losses with the countercyclical buffer, subject to data constraints (see Appendix 3). The estimated absolute amount of losses is then compared with banks' provisions for the portfolio of non-default loans, which represent the expected losses for the purposes of the calculation. The resulting difference is equal to the unexpected losses caused by the position of the economy in the financial cycle and hence to the need to hold a corresponding amount of capital in the form of the CCyB. The amount of capital is then used to derive the appropriate CCyB rate based on the current value of risk-weighted assets.

24 This estimate relates to loan impairment losses.

Estimation of the impacts of a change in institutions' vulnerability

Use of the method: quantification of the absolute amount of capital needed through the financial cycle

The conditional distribution and FCI conversion approach primarily provides information on the absolute size of the institution's potential credit losses, but **does not fully cover** aspects of the financial cycle related to change in **institutions' vulnerability**. This vulnerability is closely linked with procyclicality of the banking sector's prudence as regards internal provisioning for a deterioration in macrofinancial conditions. Procyclicality, and hence an increase in vulnerability during the expansionary phase of the financial cycle, is usually reflected in the level of provisioning and the evolution of risk weights.

The risk associated with cyclicality of provisioning in relation to the calibration of the CCyB is partially quantified by estimating the unexpected losses from the conditional distribution, where losses at the tail of the distribution are compared with provisions. Cyclically lowered provisioning thus implies a higher CCyB rate. However, costs may also be associated with a surge in provisioning for non-default parts of the credit portfolio (the cliff effect). Nonetheless, the CNB does not currently carry out a quantitative conversion of this risk into a CCyB rate. The CNB therefore monitors provisioning and its cyclicality at the indicator level (see section 4).

The CNB quantifies **the need to raise the CCyB rate due to cyclically lowered risk weights and to growth in risk exposures as a result of credit defaults** based on the model-implied evolution of non-financial private sector risk weights in a strongly adverse economic scenario. This method uses simulated PD and LGD values obtained from the calculation of the conditional probability distribution of credit losses (the 90% quantile of the probability distribution) and substitutes them into the regulatory formulas for the derivation of risk weights. Using the risks weights obtained in this way, a hypothetical risk-weighted exposure corresponding to the developments in the simulated adverse scenario is calculated. The difference between the actual capital requirement and the capital requirement calculated from the estimated hypothetical risk exposure is expressed in relation to the current level of risk-weighted assets. This gives us **the CCyB rate that should cover a decrease in the capital requirement caused by cyclical growth in risk weights in an extremely adverse scenario**. This buffer rate does not overlap with the rate quantified to cover unexpected losses. The CNB therefore sets the resulting CCyB rate as **the simple sum of the estimated unexpected losses from the conditional distribution and the possible increase in risk weights**.

5.2 The CNB's approach to calibration depending on the phase of the financial cycle

In its decision-making on the CCyB rate, the CNB assigns different weights to the above quantitative methods depending on the current phase of the financial cycle (see section 3) and on expert judgement regarding the fulfilment of the model assumptions and regarding the consequences of the simplifications made. It also takes into account the consistency of the results of the quantitative methods with the paths of the indicators it monitors (see section 4). In the expansionary phase of the financial cycle, the CNB proceeds in a forward-looking manner when setting the CCyB rate, and the importance of the quantitative methods is usually higher. In the recessionary phase, the CNB proceeds with due regard to the nature of the decline. A gradual slowdown of the cycle allows it to continue monitoring the results obtained using the quantitative methods and to adopt a prudent approach to reducing the CCyB rate. In the event of large-scale risk materialisation, the CNB assigns a large weight to the calculation of the required reduction in the CCyB rate in order to safeguard the banking sector's capacity to lend to the real economy.

The CCyB rate-increasing process

The CNB usually starts the process of increasing the CCyB rate from a very low level in accordance with the standard CCyB rate concept. When the rate reaches 1%, the CNB monitors the speed of the taking on of new cyclical risks and the accumulation of those risks, while also taking into account the results of the conversion of FCI values into a CCyB rate and the quantification of the total need to cover unexpected losses and cyclical growth in risk weights by the CCyB. After the peak of the financial cycle, the CNB monitors in particular the need for the CCyB to cover unexpected losses that reflect the previous accumulation of risks and, in line with that, may leave the CCyB rate at an elevated level or continue to raise it even though the conversion of FCI values into a CCyB rate may already be indicating a decrease.

The CCyB rate-reducing process[25]

The CNB begins to consider lowering the CCyB rate when the Czech economy is in the recessionary phase of the financial cycle.[26] This position of the economy is a necessary but not sufficient condition for starting to lower the CCyB rate. The process of **lowering the CCyB rate** is linked with a **decline in the size of cyclical risks in institutions' balance sheets.** When deciding whether to lower the CCyB rate, the CNB primarily assesses if and how **cyclical risks (mainly credit risks) are decreasing** in institutions' balance sheets. While doing so, it **continuously** evaluates the impacts of the decline on **capital** and the intensity of their materialisation. The speed, extent and timing of lowering the CCyB rate are based on this evaluation.

25 Brož, V., Holub, L., Konečný, T. and Pfeifer, L. (2020): The CNB's Approach to Releasing the Countercyclical Capital Buffer. Thematic Article on Financial Stability 3/2020.
26 This phase usually includes the period of stress referred to in EU legislation in connection with the CCyB.

The CNB regards a clear decrease in the amount of cyclical risks (in particular credit risks) in institutions' balance sheets as representing the **occurrence of systemic losses**,[27] which will be manifested in a decrease in capitalisation. In addition to an absolute decrease in institutions' capital, a decrease in the capital ratio is interpreted as a decrease in capitalisation. This situation usually corresponds to a severe recession (or even a financial crisis), with economic sentiment deteriorating sharply in both the real economy and the financial sector. The increasing default rate, loss realisation and overly pessimistic expectations of institutions are reflected, with a lag, in **growth in risk weights** and risk-weighted assets. In this case, the release of the CCyB is intended to absorb the observed losses.[28] Depending on the amount of those losses, the **CCyB rate** can be lowered all the way to **0%.**

A decline in the capital ratio causes banks' **capital capacity for lending** to the sound part of the real economy to fall. This is undesirable from an economic policy point of view, especially in the recessionary phase of the business cycle, as it may also give rise a long-term shortfall in the supply of credit to viable projects. The CNB measures the adequacy of the capital capacity for lending using the amount of additional credit that can be provided from capital in excess of the capital requirements. The CNB finds the **capital capacity** for lending to be sufficient if it **covers at least an annual rate of growth in the credit to nominal GDP ratio of around 4%** (see section 5.1, The standard CCyB rate). If the CNB evaluates the capacity as insufficient, it is prepared to release the CCyB so that the credit supply does not become constrained.

The CNB may also lower the CCyB rate even in cases **where cyclical risks in balance sheets are decreasing naturally and systemic losses are not occurring and/or the available lending capacity is sufficient**. This situation may arise during a shallow recession or economic slowdown when the accumulation of cyclical risks slows or stops and the observed macro-financial situation is indicating a decrease in the probability of another sudden and significant economic downturn. In most cases, the non-financial sector is able to continue servicing its loans thanks to its financial reserves and relatively low stress levels. This naturally reduces the cyclical risk in institutions' balance sheets and the need for CCyB coverage. The observed credit losses are relatively low and are usually absorbed to a sufficient degree by institutions' profits. The CNB does not expect the CCyB rate-reducing process to be dramatic and rapid in cases where cyclical risks are disappearing naturally from institutions' balance sheets. It also does not expect the CCyB buffer to be released in full. In this case, the CNB expects to continue to monitor the total CCyB need for covering unexpected losses and cyclical growth in risk weights as indicated by the quantitative methods. In view of the potential risks associated with a shallow recession – including a switch to a more serious economic downturn – the CNB will proceed with caution when reducing the CCyB rate and rely more on comprehensive assessments and analyses in its decision-making. The decrease in the CCyB can be expected to be more gradual in these conditions than indicated by the quantitative methods.

27 For the purposes of setting of the CCyB rate, the CNB regards losses of at least 0.25% of the total risk-weighted exposures of institutions as being systemic losses. Under the legislation, this is the smallest part of the CCyB the CNB can release.
28 Provided that institutions' capitalisation for the intended purposes is maintained, the CNB is also ready to release the CCyB in cases where systemic losses have not occurred but are highly likely to occur in the near future.

6. Communications

The CNB assesses the degree of cyclical systemic risk in the Czech Republic on a quarterly basis and may set a CCyB rate based on this assessment. It discloses the result of the assessment and, as the case may be, the level of the rate in a **press release.** The new rate becomes legally binding on institutions on the publication of a Provision of a general nature on setting the countercyclical capital buffer rate, which the CNB announces in a manner enabling remote access. The text of the provision contains an evaluation of the current situation and the values of the key indicators used in making the decision. If the CNB's assessment does not result in the setting of a new rate, the CNB issues an official information document, in which it justifies leaving the CCyB at its current level. For easier traceability of past decisions and the justifications for them, the history of provisions and official information documents issued is available on the CNB website under Financial stability – Macroprudential policy – Countercyclical capital buffer. The CNB publishes more detailed analyses underlying its CCyB rate decisions semi-annually in its Financial Stability Reports.

The CNB's decision on the level or recognition of the CCyB rate for risk-weighted exposures in other countries for institutions supervised by the CNB is issued by means of provisions of a general nature published on the CNB website, again under Financial stability – Macroprudential policy – Countercyclical capital buffer.

Appendix 1: Credit-to-GDP gap

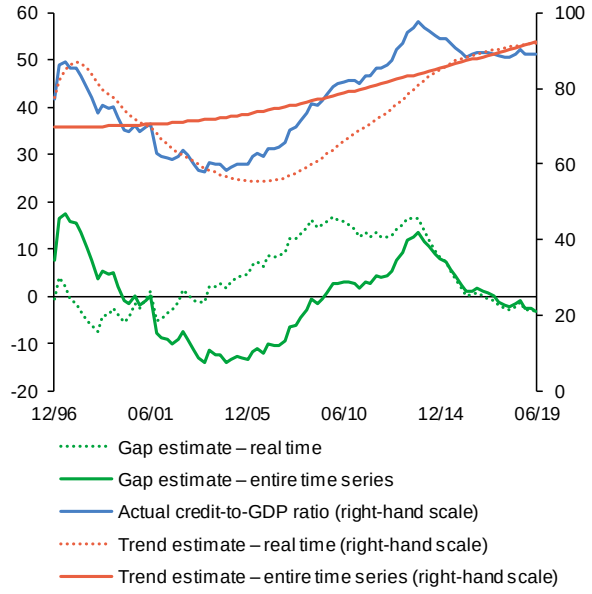
The deviation of the credit-to-GDP ratio from its long-term trend – the credit-to-GDP gap – is one indicators used for determining the position of the economy in the financial cycle. An increasing positive gap should indicate excessively rapid credit growth with respect to the potential of the economy and the accumulation of systemic cyclical risks. Empirical studies[29] show that, for many countries, this gap has good signalling properties for identifying an impending financial crisis. For this reason, the size of the gap was chosen by the BCBS[30] as the starting point for determining the optimal CCyB rate and subsequently became part of European law (Article 136(2) CRD). The ESRB also assessed the credit-to-GDP gap as an appropriate indicator of the financial cycle and, in a 2014 recommendation,[31] required Member States to publish its value quarterly. In its financial stability publications, the CNB regularly emphasises that this approach does not provide a suitable guide to determining the position of the Czech economy in the financial cycle or the optimal CCyB rate. Recent ESRB documents have also pointed out some of its shortcomings,[32] in particular the insufficient ability of the basic methodology to indicate the true level of cyclical risks after a long period of credit expansion or in converging economies. The following paragraphs of this appendix summarise the key weaknesses of this indicator.

In the basic methodology, the trend of the credit-to-GDP ratio is estimated using an HP filter with a smoothing parameter (lambda) of 400,000. The advantage of this approach is that it is easy to apply. However, the weak link of the HP filter to economic theory and the excessive construction simplicity give rise to both statistical and economic issues.

From the statistical perspective, the significant revisions that are made to the estimate of the credit-to-GDP gap at the end of the time series as new observations arise are particularly problematic in practice. The size of the deviation from the estimated trend in real time is thus subject to significant uncertainty.[33] The behaviour of the gap calculated according to the BCBS methodology based on the available data sample is illustrated for the Czech case in Chart 1.[34] It shows the trend estimate made with knowledge of the entire time series and the trend estimate based solely on the data available up to the given quarter (in real time). Estimated in real time, the gap implying the level of the rate was positive from the start of 2004 until the end of 2016, despite the occurrence of recessions in 2009 and 2013–2014 and an observed credit contraction. The real-time gap would have implied a CCyB rate of 2.5% for most of the period. The gap obtained with knowledge of the entire time series, however, also fails to provide intuitive and economically plausible results.

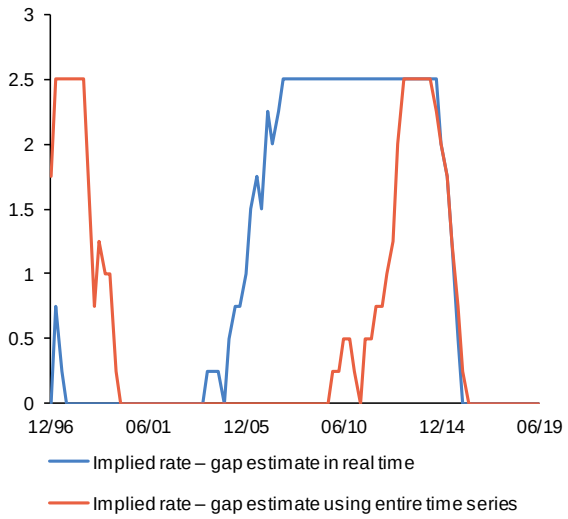
29 See, for example, Drehmann, M., Juselius, J. (2014): Evaluating early warning indicators of banking crises: Satisfying policy requirements, International Journal of Forecasting, 30(3), pp. 759–780, and Drehmann, M., Yetman, J. (2018): Why you should use the Hodrick-Prescott filter – at least to generate credit gaps, BIS WP 744.
30 BCBS (2010): Countercyclical capital buffer proposal, consultative document.
31 ESRB (2014): Recommendation on guidance for setting countercyclical buffer rates.
32 Buch, C., Vogel, E., Weigert, B. (2018): Evaluating macroprudential policies, ESRB WP Series 76.
33 The HP filter can be expressed in state-space form, which implies specific structural assumptions for the trend and cyclical components of the time series (see, for example, Harvey, A., Trimburt, T. (2008): Trend estimation and the Hodrick-Prescott filter, Journal of Japan Statistic Society, 38(1), pp. 41–49, and Harvey, A. (1989): Forecasting, structural time series models and the Kalman filter, Cambridge University Press), assumptions which are not met for typical macroeconomic series. The reasons for the significant revisions are also clear from the implied weights assigned to the individual observations at the end of the time series.
34 Data for previous periods may also revised as new observations arrive. These revisions also have an effect on the estimated gap. In the illustrative example, however, we abstract from them and use the currently available revised data for the calculation.

Chart 1: Comparison of the trend and gap estimated on the basis of the entire time series with the estimate made in real time
(% of GDP)



Source: CNB, CZSO
Note: The estimate does not take into account data revisions over time, and the latest available time series is used.

Chart 2: Comparison of the CCyB rate implied by the credit gap using calculations based on the entire time series and in real time
(% of total risk-weighted exposure)

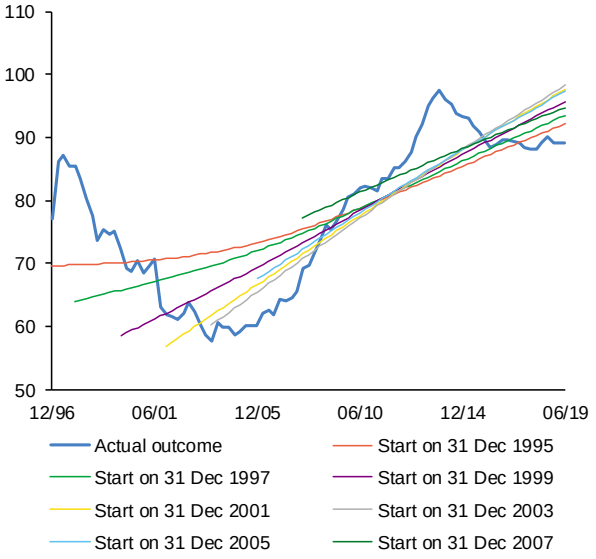


Source: CNB
Note: The implied rate does not take into account data revisions over time, and the latest available time series is used.

Long time series are needed in order to obtain economically meaningful results using the HP filter. Given the chosen smoothing parameter, it is recommended to completely drop from the assessment the size of the estimated gap in the first at least 15–20 years, as the results strongly depend on the cyclical position of the economy at the starting point of the time series.[35] In the case of short time series, the method gives a completely different picture of the cyclical risks observed above depending on the chosen starting date of the analysis. Given that data for the Czech Republic are only available from 1995 and that structural breaks are present in the first half of the time series, increased variability in the results continues to be observed depending on the specific choice of starting date (see Chart 3).[36]

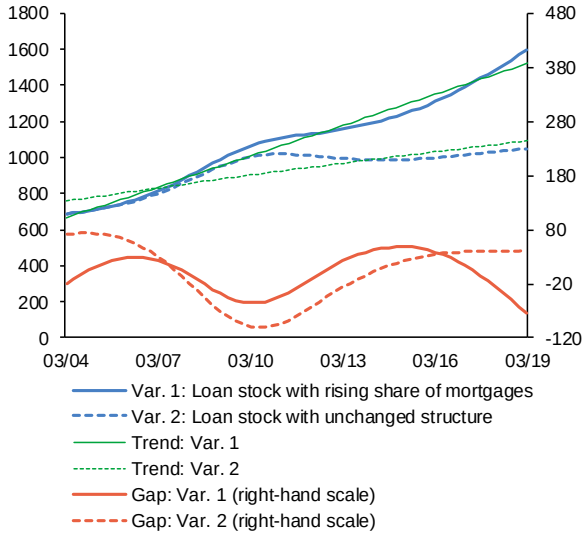
35 See, for example, Drehmann, M., Tsatsaronis, K. (2014): The credit-to-GDP gap and countercyclical capital buffers: Questions and answers, BIS Quarterly Review, and Plašil, M., Seidler, J., Hlaváč, P. (2016): A new measure of the financial cycle: Application to the Czech Republic, Eastern European Economics, 54(4), pp. 296–318.
36 The structural breaks are related, among other things, to the 1997 currency and banking crisis, when bad loans were transferred from the banking sector's balance sheets to the Czech Consolidation Agency until 2004. The clean-up of banking sector balance sheets caused a significant decrease that did not reflect a credit contraction.

Chart 3: Effect of the choice of starting date on the trend component estimate
(% of GDP)



Source: CNB
Note: Estimate using the entire time series.

Chart 4: Effect of changes in loan portfolio structure on the stock of loans and the size of the corresponding gap
(CZK billions)



Source: CNB
Note: The illustrative example assumes the same initial loan stock and the same amount of new loans in all quarters for both variants, but a gradual change in loan portfolio structure towards long-term debt (mortgage loans). The loan structure at the start and end of the time series corresponds to the actual ratio of corporate to household debt. The same fixed interest rate is used for loans to corporations and households over the entire time series.

The structural breaks in the Czech Republic are accompanied by a natural process of financial deepening, an increase in the share of economic agents with credit and, for example, by an overall change in the loan portfolio towards mortgage loans.[37] Because of its simplicity of construction, the HP filter does not distinguish between the effects of these changes and excessive lending and may misinterpret the natural part of the credit growth as being a result of the financial cycle (see Chart 4). The implicit property of the HP filter whereby its application to typical macroeconomic time series leads to a stationary deviation from the trend component is also problematic for convergence economies. This assumption may not be met, at least for converging economies, and the sustainable level of debt may be above the default level of private non-financial sector debt for an extended period in the initial years of convergence.[38]

The outcomes of the recommended methodology are also difficult to defend in some phases of the financial cycle. The time series of debt is a stock variable and changes only slowly over time. It therefore takes quite some time for either a positive or negative gap to close, regardless of the current level of financial risks. As a result, the size of the gap cannot describe the cyclical risks immediately after the peak of the expansionary phase of the financial cycle occurs or after a deep

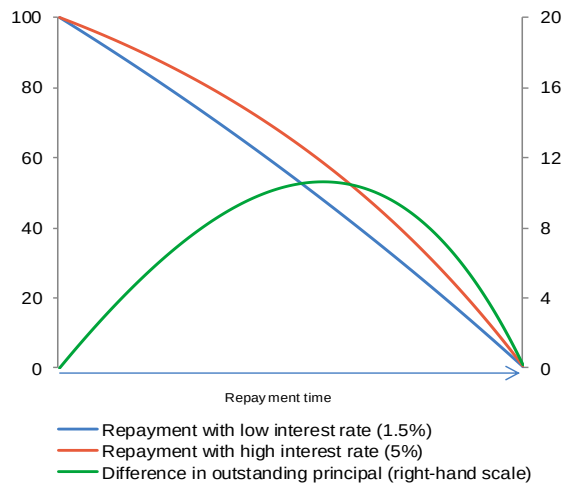
37 Mortgages are of a long-term nature and stay in banking sector balance sheets for longer. All other things being equal (with equally large volumes of new business), the pace of growth of the stock of credit/debt rises as the weight of mortgages in banks' loan portfolios increases.
38 Geršl, A., Seidler, J. (2011): Credit growth and capital buffers: Empirical evidence from Central and Eastern European countries, Research and Policy Note, CNB.

recession has faded away, when new cyclical risks are already emerging, while the gap remains highly negative.

Besides the statistical shortcomings, one also needs to take into consideration the fact that the trend component estimated on the basis of the HP filter has no direct economic interpretation and does not take sufficient account of the structural characteristics of the economy. In the estimate of the long-term trend, it thus overlooks the effect of demographic factors, interest rates and the fact that the current level of debt is affected by the repayment of old debt in addition to new loans. The repayment profile and thus the evolution of the stock of loans in institutions' balance sheets is influenced both by past interest rates (see Chart 5) and by the specific path of loans granted in the past (see Chart 6). Abstracting from this effect may significantly distort the level of real cyclical risks in real time. The interest rate path not only affects debt repayment, but also has a direct impact on the evolution of sustainable debt over time. If nominal interest rates have been declining in the long term and their return to the former average is not guaranteed, this has an impact on the safe level of the debt that the private non-financial sector is able to service at a given level of income. A decrease in interest rates at a constant level of debt implies a lower ratio of debt servicing costs to income and hence generally more safely repayable debt.

Chart 5: Effect of different interest rate levels on the outstanding amount of loans over time

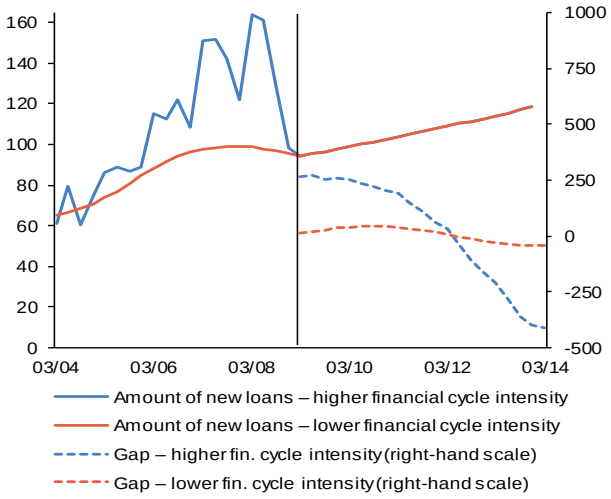
(%; right-hand scale: pp)



Source: CNB

Chart 6: Alternative path of new loans in the past and its effect on the size of the current gap

(three-month totals in CZK billions; right-hand scale: CZK billions)



Source: CNB

Note: In both variants, the stock of loans is the same at the moment when new loans continue along an identical path (separated by the vertical line).

Appendix 2: Financial Cycle Indicator

The composite financial cycle indicator (FCI) was designed to determine the extent of new cyclical risks, encompassing both supply and demand factors. The construction method is based on Holló et al. (2012).[39] The components of the indicator were selected on the basis of the results of empirical studies and expert judgement[40] and should cover the widest possible range of financial risks in the real economy. The FCI is composed of the following sub-indicators:

Credit growth: Excessive credit growth is one of the best explanatory variables for future problems in the financial sector.[41] In the expansionary phase of the financial cycle, the general optimism of consumers and firms is often accompanied by high quantities of lending. Lenders who are willing to lend to riskier clients may also suffer from short sightedness.[42] Credit growth is represented in the FCI by the 12-month moving sum of new loans for the household sector and the non-financial corporations sector separately. This sum is expressed in relation to the relevant income aggregate (gross disposable income or gross operating surplus) in order to capture credit growth in the context of the general nominal trend and the income situation of households and firms.

Property prices: The onset of financial crises is usually associated with sharp growth in property prices and the formation of a property market bubble.[43] High optimism and cheap financing can lead to property prices becoming overvalued and create a spiral between property prices and house purchase loans. The rapid return to equilibrium usually has a negative impact on banking sector balance sheets. The year-on-year change in the property price index published by the CZSO is used to capture the dynamics of the property market.

Debt sustainability: The ratio of household and corporate debt to disposable income/gross operating surplus has a tendency to grow in the expansionary phase of the financial cycle. In this phase, economic agents may incorrectly assess their future income situation and take on too much debt. If borrowers' income situation turns out worse than they expected, they will often become insolvent. In converging economies, including the Czech Republic, the relative debt level of the private sector is constantly rising, so falling risk aversion is measured using year-on-year changes, i.e. using the rate of growth of debt relative to income. Owing to the short time series available, total debt is proxied for now by bank loans only (which are currently the main source of external financing in the Czech Republic).

Lending conditions: Lending conditions characterise financial risk perceptions on the credit supply side. At times of heightened market optimism, banks encourage less creditworthy clients to borrow by relaxing their lending conditions through lower risk mark-ups on interest rates. At times of high risk aversion, by contrast, banks have a tendency to tighten their lending conditions too much and

39 Holló, D., Kreimer, M., Lo Duca, M. (2012): CISS – A composite indicator of systemic stress in the financial system, ECB WP Series 1426
40 For more on the motivation for the selection of each indicator, see Plašil, M., Seidler, J., Hlaváč, P. (2016): A new measure of the financial cycle: Application to the Czech Republic, Eastern European Economics, 54(4), pp. 296–318.
41 See Drehmann, M., Borio, C., Tsatsaronis, K. (2012): Characterising the financial cycle: Don't lose sight of the medium term! BIS WP 380, and Babecký, J., Havránek, T., Matějů, J., Rusnák, M., Šmídková, K., Vašíček, B. (2013): Indicators of crisis incidence: Evidence from developed countries, Journal of International Money and Finance 35(C), pp. 1–19.
42 Brandão-Marques, L., Chen, Q., Raddatz, C., Vandenbussche, J., Xie, P. (2019): The riskiness of credit allocation and financial stability, IMF WP.
43 This relationship is described in more detail by, for example, Giese, J., Andersen, H., Bush, O., Castro, C., Farag, M., Kapadia, S. (2013): The credit-to-GDP gap and complementary indicators for macroprudential policy: Evidence from the UK, mimeo, Drehmann, M., Borio, C., Tsatsaronis, K. (2012): Characterising the financial cycle: Don't lose sight of the medium term! BIS WP 380, and Rünstler, G., Vlekke, M. (2016): Business, housing and credit cycles, ECB WP Series 1915.

restrict the supply of credit to the sound part of the real economy. As the bank lending survey in the Czech Republic has too short a history,[44] the lending conditions are approximated using the difference between the interest rate on koruna-denominated client loans and the three-month PRIBOR. The calculation is performed separately for households and non-financial corporations. In the case of non-financial corporations, the calculation also includes the difference between the rate on euro-denominated loans and the EURIBOR, and the resulting value is obtained as the weighted average of the differences in each currency, with the volume of loans in the given currency used as the weight.

Stock index: The stock index provides an overall picture of the current investment sentiment among market participants, although its evolution is linked primarily with the economic cycle.[45] The value of the PX stock index is included in the FCI.

Adjusted current account deficit-to-GDP ratio: The current account deficit indicates how much more is saved than invested in the economy. A negative current account thus implies imports of capital from abroad and may be a source of growth in imbalances and future problems repaying loans.[46] The current account deficit sub-indicator is further adjusted for the balance of reinvested earnings.[47]

To ensure that the input time series are mutually comparable, the components are first transformed into the interval (0, 1) using the kernel estimate of the distribution function,[48] where zero corresponds to the trough of the financial cycle and one to the peak. The aggregation of the sub-indicators into the FCI captures both the time dimension of risk and the cross-sectional dimension of risk (the correlations between all the sub-indicators). The time dimension of risk is given by the magnitude of the sub-indicators themselves. The time series have differing importance for the final FCI value. The weights of the sub-indicators were calibrated to best predict credit losses six quarters ahead (see Table 2[49]).

Table 2: FCI input variables

Variable name	Weights in FCI	Data source
12-month moving sum of loans to households/gross disposable income of households	35%	CNB, CZSO
12-month moving sum of loans to non-financial corporations/gross operating surplus of firms	27%	CNB, CZSO
Property price inflation	9%	CZSO
Debt growth/gross disposable income of households	8%	CNB, CZSO
Debt growth/gross operating surplus of firms	7%	CNB, CZSO
Interest rate spread for households	5%	CNB
Interest rate spread for firms	5%	CNB
PX index	2%	PSE
Adjusted current account deficit/GDP	2%	CNB, CZSO

Source: CNB

44 https://www.cnb.cz/en/statistics/bank-lending-survey/
45 Borio, C. (2012): The financial cycle and macroeconomics: What have we learnt? BIS WP 395.
46 Especially when the investment is financed by portfolio investment of a short-term, speculative nature.
47 Plašil, M., Seidler, J., Hlaváč, P. (2016): A new measure of the financial cycle: Application to the Czech Republic, Eastern European Economics, 54(4), p. 296–318.
48 The source method described in Holló, D., Kremer, M., Duca, M. L. (2012). CISS – A composite indicator of systemic stress in the financial system, ECB WP No. 1426, works with a simple estimate of the empirical distribution function.

The evolution of the cross-sectional dimension of risk is represented by the time-varying correlations between the FCI input variables. The stronger are the correlations between them, the higher is the FCI and the stronger is the signal sent out about the overall nature of the observed cyclical risks.[49] This implies that the sub-indicators that show a strong positive correlation with each other have the strongest upward effect on the FCI. In the case of perfect correlation between all the input variables, the FCI would attain its highest possible value with respect to the values of the sub-indicators.

The CNB uses the FCI when considering the level of the CCyB rate. Table 3 shows the indicative relationship between the FCI values and the CCyB rate. The presented relationship can be formally derived by adopting a set of assumptions, two of which exert a decisive influence on it. The first is that the maximum observed FCI value from the peak of the previous cycle in mid-2008 corresponds to a rate of 2.5%.[50] The second is that the median of the sub-indicators entering the FCI calculation corresponds to a kind of "equilibrium" situation where the financial cycle is not significantly subdued and significant cyclical risks are not being taken. The FCI is constructed using a quadratic system of weights,[51] so the conversion between FCI values and the CCyB rate is non-linear. A consequence of this property is that the bands of FCI values are not necessarily of the same width for all the rates, and it does not hold that an increase in the FCI values leads to a proportional change in the rate. The conversion of the FCI value into the CCyB rate should be taken as a guide, and other aspects of the economic environment should also be taken into account in setting the rate itself. As of the second quarter of 2019, for example, an FCI of 0.15 implied a CCyB rate of 1% using the conversion table (see Table 3).

Table 3: Conversion table between FCI values and the CCyB rate

Range of FCI values		CCyB rate
from	to	
0	0.09	0.00%
0.09	0.11	0.25%
0.11	0.12	0.50%
0.12	0.15	0.75%
0.15	0.17	1.00%
0.17	0.19	1.25%
0.19	0.22	1.50%
0.22	0.26	1.75%
0.26	0.29	2.00%
0.29	0.33	2.25%
0.33	1	2.50%

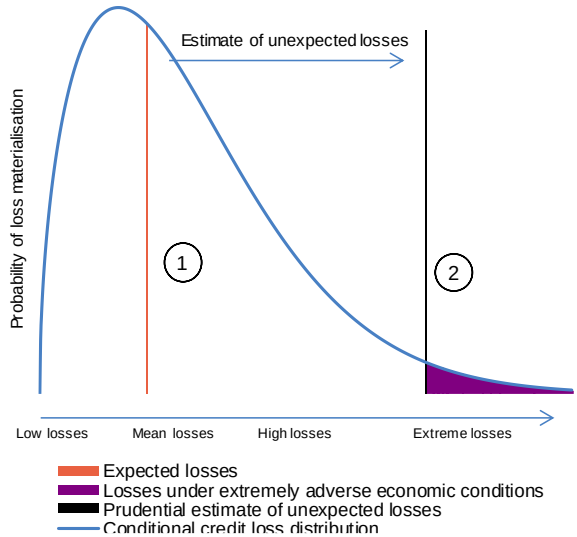
Source: CNB

49 This property is useful for setting the CCyB, which is a broad tool and should respond to general growth in optimism and risk-taking in the economy.
50 With the benefit of hindsight, it can be said that in the Czech economy, as in many other developed countries, the financial expansion that occurred just before the start of the global financial crisis was so strong that if the CCyB had been available as a macroprudential policy instrument, it would have required the setting of the "upper-bound" rate of 2.5% at least.
51 Hájek, J., Frait, J., Plašil, M. (2017): The countercyclical capital buffer in the Czech Republic, CNB thematic article.

Appendix 3: Conditional credit loss distribution[52]

The construction of the conditional credit loss probability distribution is based on banking sector stress testing. The purpose of stress testing is to verify the resilience and quantify the credit losses of the banking sector in the chosen stress scenario. The CCyB rate should cover the unexpected credit losses associated with the materialisation of less likely, less favourable scenarios (see Chart 7). The conditional distribution takes into account the fact that the probability of scenarios implying relatively high credit losses changes over the financial cycle.

Chart 7: Conditional credit loss distribution



Source: CNB
Note: (1) expected losses; (2) 90% quantile of credit loss Probability distribution caused by position of economy in financial cycle.

The initial volume of loans in the main credit segments of the private non-financial sector (loans to non-financial corporations, loans to households for house purchase and loans to households for consumption) enter the calculation of credit losses. The size of the total losses in the scenario are obtained based on modelling of the default rate and the average loss given default (LGD) for each credit segment over a two-year horizon.

The estimation of the conditional loss distribution is based on obtaining the probability distribution of the default rates. The latter is estimated separately for the key credit portfolios – loans to non-financial corporations, loans to households for house purchase and loans to households for consumption. The specific shape and variance of the distribution is influenced by the prior course of the financial cycle (defined in the model as the integral under the area of the FCI over the past twelve quarters). Put simply, the longer the economy stays in the strongly expansionary phase of the

52 This entire appendix relates to loan impairment losses.

financial cycle, the greater is the likelihood of higher losses due to the previous accumulation of risks in balance sheets. The distribution is also affected by the projections for other variables: the unemployment rate, real GDP growth, money market rates, property price growth and the projections of the default rates in the above portfolios in the baseline scenario, which are in turn a function of a wide range of projections of macroeconomic variables. The estimation is performed using Bayesian quantile regression with a probability restriction on the position of the median of the estimated distribution. The median of the estimated distribution is driven towards the default rate projections in the baseline scenario.[53] The loss distribution is subsequently obtained on the basis of the loan portfolio volumes and the LGD parameter.

The difference between the unlikely scenario (a high quantile of the conditional distribution) and the expected losses represents the unexpected losses for which the CCyB should be created. For the purposes of the CCyB, expected losses are considered to be the provisions created by banks for the portfolio of loans showing no signs of default (more than 90 days past due). This enables the size of the risks (the more distant tail of the distribution) and the potential cyclical behaviour of banks in making their own estimates of the expected losses to be taken into account in this approach.

The estimation of the average LGD from the individual credit segments takes place outside the main model and depends on the current position in the credit cycle and on a set of explanatory variables for each credit segment. The upper bound on the LGD value is then the estimate from the adverse scenario of the regular macroprudential test of the banking sector.

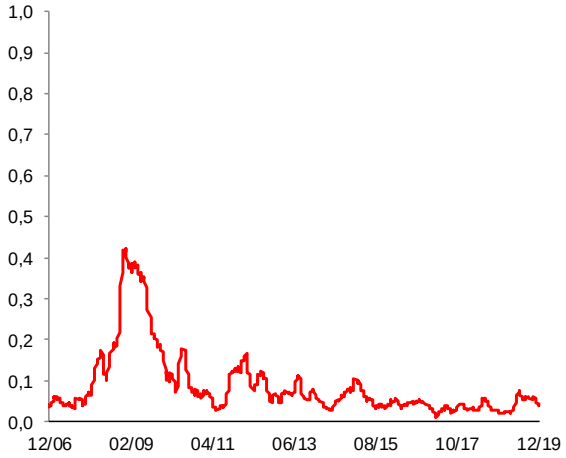
When deciding on the CCyB rate, the macroprudential authority has a preferred level of prudence. The CNB applies a cautious approach in an effort to cover even unlikely credit losses. It therefore sets the size of the potential unexpected losses as the difference between the 90% quantile of the probability distribution (see Chart 7, (2)) and the expected losses (the stock of provisions or the estimated losses in the baseline scenario). The CCyB rate covering the unexpected losses resulting from the current phase of the financial cycle then corresponds to the estimated size of the unexpected losses relative to risk-weighted assets.

53 The approach is based on the method presented in M. Szabo (2022): Growth-at-Risk: Bayesian Approach. CNB Working Paper 3/2020.

Appendix 4: Composite Indicator of Systemic Stress

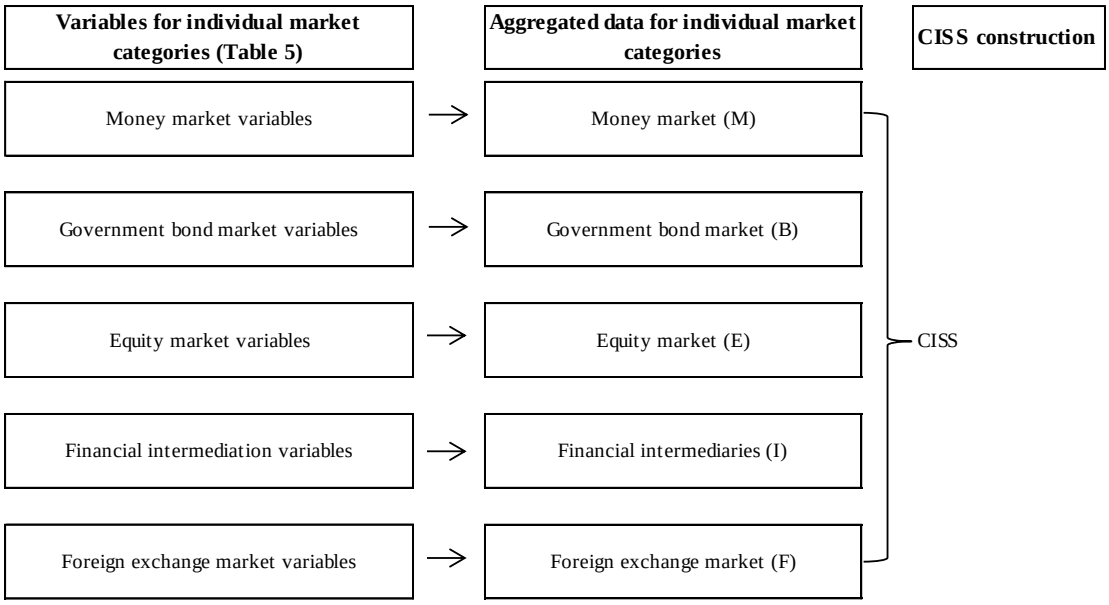
The Composite Indicator of Systemic Stress (CISS) for the Czech Republic (see Chart 8) is compiled by aggregating financial data for the money market, the government bond market, the equity market, the foreign exchange market and financial intermediaries (see Figure 2).

Chart 8: CISS for the Czech Republic
(0 minimum, 1 maximum; a higher value means greater stress)



Source: CNB
Note: Smoothed eight-week moving average (i.e. the average of the current value and seven lagged values).

Figure 3: Procedure for calculating the CISS for the Czech Republic



Source: CNB

The CISS for the Czech Republic is calculated using daily data, from which weekly variables are compiled for each financial market category (see Table 4). To obtain the aggregate index value, the

arithmetic mean of the individual variables for each market category is calculated (see Figure 3). The construction of the CISS is based on Holló et al. (2012)[54] and Adam and Benecká (2013).[55] The weights for the market categories are set as identical, and the EWMA method with a smoothing parameter of 0.93 is used to obtain the correlations between the market categories.

Table 4: Variables for each market category

Category	Input data	Variable name	Description
M	3M PRIBOR, EONIA Index	Volatility of 3M interbank rate	Absolute daily rate changes, weekly average of daily data
		Spread between 3M interbank rate and OIS	3M – OIS, weekly average of daily data on spreads
B	Government bond yield (10Y), CZK IRS rate (10Y)	Volatility of 10Y government bond yield	Absolute daily yield changes, weekly average of daily data
		Spread between 10Y koruna swap and 10Y government bond	IRS – bond, weekly average of daily data
E	Domestic stock indices (total return) for entire market and for market except financial institutions, Index of Czech government bond prices (10Y)	Volatility of non-financial sector stock market index	Absolute daily log changes in total-return index (i.e. log (It/It–1)), weekly average of daily data
		Cumulative loss for non-financial sector total-return index	Average weekly total-return index values; indicator = 1 – value for reference week/maximum for past 105 weeks (including current one)
		Increase in correlation between stock market index and government securities index	Difference in correlation between log changes in total-return stock market and 10Y government securities indices for past 20 and 522 days (including current one); weekly average of daily correlation differences. If the weekly average is negative, a value of 0 is used. Measures the increase in correlation relative to the long-term trend
I	Domestic stock indices (total return) for entire market, for financial sector and for banks	Volatility of return of banking sector stock market index over total stock market index	Residual from regression of banking sector total-return index = a0 + a1*overall total-return index; past 522 observations of log return (i.e. log (It/It–1)) including value for current day. Absolute residual value for current day used; weekly average of daily residual values
		Cumulative loss for non-financial sector total-return index	Average weekly total-return index values; indicator = 1 – value for reference week/maximum for past 105 weeks (including current one)
F	CZK/USD CZK/EUR CZK/GBP exchange rates	Volatility of CZK/USD exchange rate	Absolute daily log changes in exchange rate (i.e. log (It/It–1)), weekly average of daily data
		Volatility of CZK/EUR exchange rate	Absolute daily log changes in exchange rate (i.e. log (It/It–1)), weekly average of daily data
		Volatility of CZK/GBP exchange rate	Absolute daily log changes in exchange rate (i.e. log (It/It–1)), weekly average of daily data

Source: CNB
Note: Y year, M month

54 Holló, D., Kremer, M., Duca, M. L. (2012): CISS – A composite indicator of systemic stress in the financial system, ECB Working Paper Series, No. 1426.
55 Adam, T., Benecká, S. (2013): Financial stress spillover and financial linkages between the euro area and the Czech Republic, Finance a úvěr – Czech Journal of Economics and Finance 63(1), pp. 46–64.