

4 STRESS TESTS

4.1 SOLVENCY STRESS TESTS OF BANKS AND PENSION MANAGEMENT COMPANIES

The stress test results demonstrate that the banking sector as a whole remains resilient even in the event of an adverse shock. Despite the impacts of the implementation of a forward-looking provisioning concept under the new IFRS 9 standard, banks have a large enough capital buffer to absorb adverse shocks and maintain their overall capital ratio above the regulatory threshold of 8% even under a very adverse scenario. The schedule for the joint stress tests conducted by the CNB and selected banks (the supervisory stress tests) was moved simultaneously with the change in concept. This year, for the first time, their results are therefore not included in this section but will be published separately in the second half of 2018. The pension management company sector has long been sensitive to interest rate volatility. A decline in prices of Czech government bonds could adversely affect its profitability and solvency.

4.1.1 Solvency Stress Tests of Banks

The resilience of banks was tested in solvency macro tests using the likely *Baseline Scenario* and a hypothetical *Adverse Scenario* (see section 2.1).¹ Box 4.1 focuses on the approaches of the CNB and some foreign central banks to setting the main parameters of adverse scenarios and the degree of stress. This year, the developments represented by the *Adverse Scenario* are not extended using additional sensitivity analyses. This is because we see no major year-on-year change in the level of the risks previously analysed² and their potential impact on the sector's capitalisation. More space is devoted to the results of the implementation of the principles of the IFRS 9 financial reporting standard into the stress test methodology.

The bank solvency stress test methodology was extended to include the impacts of IFRS 9

A new financial reporting standard IFRS 9 came into force on 1 January 2018. The main goal of this standard, which is based on the expected loss concept, was to enhance the stability of financial institutions with timely and sufficient provisioning (this issue is discussed in Box 3.3 in this FSR and section 5.4.2 of FSR 2016/2017). The solvency stress test methodology incorporates the framework defined in the standard.³ First,

1 In its first two years, the *Baseline Scenario* of the stress tests of banks is based on the CNB's official macroeconomic forecast published in Inflation Report I/2018, which was approved by the CNB Bank Board on 8 February 2018. The *Baseline Scenario* for the third year and the *Adverse Scenario* were created solely for the purposes of stress testing. Neither the *Baseline Scenario* beyond the horizon of the forecast published in Inflation Report I/2018 nor the *Adverse Scenario* is an official forecast of the CNB.

2 The sensitivity analyses in FSR 2016/2017 covered losses arising from operational risks and concentration risk.

3 The CNB's approach to incorporating IFRS 9 into its macro stress testing models is based on the general framework of the standard. It will be further developed and refined in the

a model estimate was made of loan volume development in Stage 1 and Stage 2 characterising the structure of loans in terms of credit risk level.⁴ A newly developed model was then used to calibrate the risk parameters, taking into account 12-month expected credit losses for Stage 1 loans and lifetime expected credit losses for Stage 2 loans. The estimated loan volumes and relevant risk parameters were then used to model loan impairment for both stages under the *Baseline Scenario* and the *Adverse Scenario*. This impairment was reflected in the stress test results. No other substantial methodological changes were made. As usual, the other test parameters were estimated using satellite models, which were calibrated using time series updated as of the end of 2017.

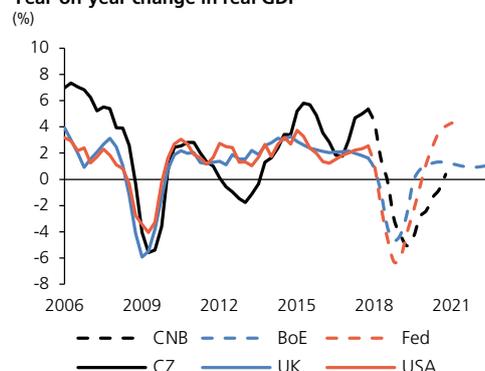
BOX 4.1: A COMPARISON OF ADVERSE ECONOMIC SCENARIOS IN MACRO STRESS TESTS OF BANKS IN THE CZECH REPUBLIC, THE UK AND THE USA

Most institutions responsible for the stability of their domestic banking sector conduct stress tests. The key component of the tests is a scenario of adverse economic developments (adverse scenario), which usually differs not in the economic variables modelled, but in the depth and length of the adverse scenario (shock) and the intensity of its pass-through to banks' financial results.⁵ In FSR 2016/2017 (Box 2), we showed that the intensity and length of the shock, as measured by a contraction of GDP, which significantly affects the paths of other variables, in the CNB's stress tests do not differ much from those observed during banking crises (see Chart IV.2 in FSR 2016/2017). We now extend this analysis to include a direct comparison between other significant variables in the CNB's *Adverse Scenario* used in FSR 2017/2018 and the adverse scenarios applied this year by the Bank of England (BoE, *Annual Cyclical Scenario*) and the Federal Reserve System (Fed, *Severely Adverse Scenario*). In the second part, we compare the path of GDP in the adverse scenarios analysed in terms of crisis depth and length. We conduct the comparison in a broader context of crises in OECD countries.

In its stress test, the CNB assumes that an external shock stemming from a contraction in economic activity in EU countries spills over to the domestic economy, causing real GDP to fall and the unemployment rate to rise. The CNB's scenario covers the 12 quarters from 2018 Q1 to 2020 Q4, with a total crisis length of nine quarters. The BoE assumes a deep recession running simultaneously in the UK and the global economy, accompanied

CHART IV.1 BOX

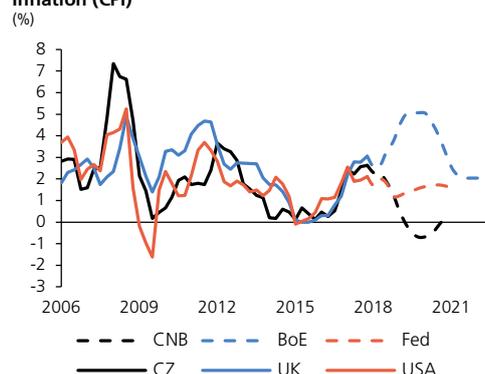
Year-on-year change in real GDP (%)



Source: CNB, BoE, Fed

CHART IV.2 BOX

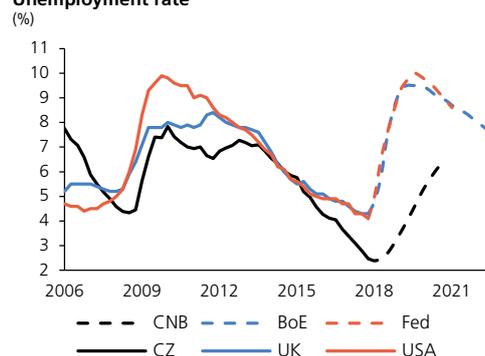
Inflation (CPI) (%)



Source: CNB, BoE, Fed

CHART IV.3 BOX

Unemployment rate (%)



Source: CNB, BoE, Fed

future based on research and analysis of the practical application of the approaches and methods used by banks and on data available from statistical and other CNB surveys.

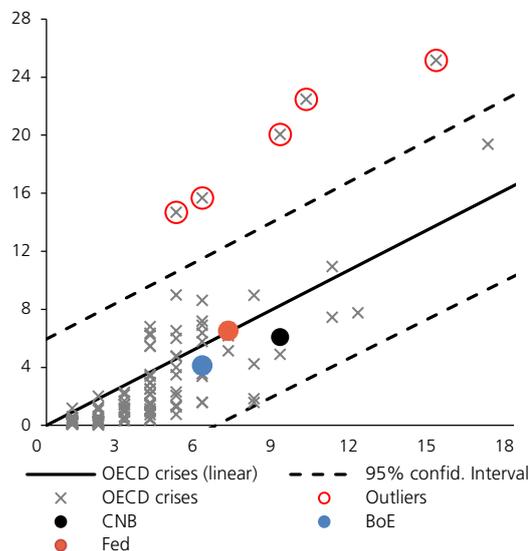
⁴ The terms "Stage 1" and "Stage 2" are explained in Box 3.3.

⁵ The scenario is usually reflected mostly in provisioning and an increase in the capital requirements for credit risk.

CHART IV.4 Box

OECD comparison – regression analysis

(x-axis: length of crisis; y-axis: depth of crisis)

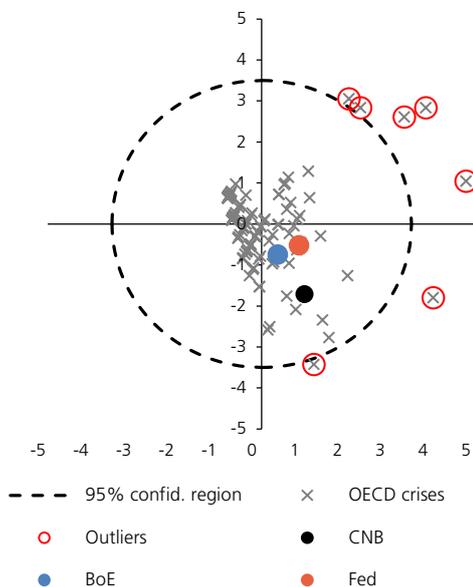


Source: CNB, BoE, Fed, OECD

CHART IV.5 Box

OECD comparison – principal component analysis

(x-axis: component 1; y-axis: component 2)



Source: CNB, BoE, Fed, OECD

by a sharp drop in prices of financial assets and property. The scenario covers the 20 quarters from 2018 Q1 to 2022 Q4, with a total crisis length of six quarters (BoE, 2018).⁶ The Fed assumes a severe global recession accompanied by global aversion to long-term fixed-income assets, leading to a steepening of the yield curve. The scenario covers 13 quarters from 2018 Q1 to 2021 Q1, with a total crisis length of seven quarters (Fed, 2018).⁷

In all the scenarios, the initial path of GDP is characterised by a sharp fall. In the case of the BoE and the Fed, the crisis peaks in 2018 Q4 with a year-on-year contraction of 4.7% in the UK and 6.3% in the USA. In the case of the CNB, the onset of the crisis is rather more gradual, owing among other factors to robust growth in the second half of 2017, and peaks in mid-2019 with a year-on-year contraction of 5.1%. Furthermore, the CNB's scenario is characterised by a slightly slower economic recovery. So, in the BoE and Fed scenarios the crisis is over before the end of 2019, while in the CNB scenario it continues almost until the end of the period modelled (see Chart IV.1 Box).

The path of inflation (CPI) shows large differences. Despite a weakening of the Czech koruna, the CNB assumes a fall into deflation, with a return to levels around zero at the very end of the period modelled. The BoE, by contrast, assumes a sizeable rise in inflation to levels around 5%. This is due to marked depreciation of the British pound, as higher import prices are reflected in an increase in both inflation and inflation expectations (BoE, 2018). Inflation then returns towards the inflation target from above in the scenario. In its scenario, the Fed models a relatively firm US dollar and low inflation volatility. Following a modest initial decrease, inflation stabilises around 1.5% over the rest of the stress scenario (see Chart IV.2 Box).

The rise in the unemployment rate in absolute terms is 4 pp in the CNB scenario, 5.2 pp in the BoE scenario and 5.9 pp in the Fed scenario. Further differences can be identified in the course of the shock, which reflects the path of real GDP and in the case of the Czech Republic additionally starts from a very low initial level. So, in the BoE and Fed scenarios unemployment peaks together with the end of the crisis before the end of 2019, while in the CNB

6 BoE (2018): Stress Testing the UK Banking System: Key Elements of the 2018 Stress Test, Bank of England, March 2018, available at <https://www.bankofengland.co.uk/news/2018/march/key-elements-of-the-2018-stress-test>.

7 Fed (2018): 2018 Supervisory Scenarios for Annual Stress Tests Required under the Dodd-Frank Act Stress Testing Rules and the Capital Plan Rule, Federal Reserve System, February 2018, available at <https://www.federalreserve.gov/publications/2018-february-supervisory-scenarios-for-annual-stress-tests.htm>.

scenario it does not peak until the end of the period modelled (see Chart IV.3 Box).

Using real GDP data from the OECD database, we can assess where the scenarios under comparison rank in terms of crisis length and depth (severity) compared with crises in the OECD countries in 1993–2017. We measure crisis length by the number of consecutive quarters in which real GDP contracted year on year. We measure crisis depth by the area between the x-axis and the real GDP curve in the relevant months.⁸ The average crisis length in the OECD data set is around four quarters and the average depth is 3.1. The crisis depth is 6.0 in the CNB scenario, 4.1 in the BoE scenario and 6.5 in the Fed scenario. In all cases, therefore, the crisis is slightly deeper than the OECD average, which is consistent with a prudent approach to stress testing.

The data set can be analysed using linear regression tools, for example (see Chart IV.4 Box). The analytically derived 95% confidence intervals for values around the regression line running through the origin suggest that none of the scenarios analysed can be regarded as an outlier in the context of crises in OECD countries. Principal component analysis offers a different view of the data (see Chart IV.5 Box). The advantage of this approach is that such suitably transformed observations have a number of favourable statistical properties that can be used to easily identify outliers. The sample 95% confidence region confirms the findings of the regression analysis.

The crisis considered by the CNB in FSR 2017/2018 does not differ markedly from those considered by the BoE and the Fed in terms of its severity, length or course. All the hypothetical crises analysed are deeper than the above-mentioned OECD average, but none of the statistical methods applied suggests that they are extremely unlikely to happen. The above is consistent with the philosophy of seeking “severe but plausible” stress testing scenarios.⁹ By contrast, the individual scenarios differ in their approach to the modelling of inflation. Precise and rigorous identification of the key fundamentals that in reality govern the final shape, severity and length of a crisis, which would in turn help further improve the scenarios modelled, thus remains the main open problem.

TABLE IV.1

Key variables in the individual scenarios
 (averages for given years)

	Actual Value	Baseline Scenario				Adverse Scenario		
	2017	2018	2019	2020	2018	2019	2020	
Macroeconomic variables								
GDP (y-o-y %)	4.5	3.6	3.2	3.2	0.7	-4.1	-1.0	
Inflation (%)	2.5	2.3	1.9	2.2	1.9	-0.2	-0.3	
Unemployment (%)	3.0	2.3	2.2	2.1	2.7	4.3	6.0	
Nominal wage growth (%)	6.7	7.2	5.1	4.5	5.8	0.7	-2.1	
Effective GDP growth in euro area (%)	2.7	2.4	2.1	1.8	0.0	-3.3	-0.7	
Credit growth (%)								
Total	6.3	6.2	6.4	6.8	3.4	-1.8	-2.8	
NFCs	4.9	6.1	7.0	8.4	4.0	-4.5	-5.4	
Households	8.4	7.3	7.0	6.8	3.6	-0.1	-1.5	
Default rate (PD. %)								
NFCs	0.9	0.7	0.9	1.0	4.1	5.0	4.8	
Loans for house purchase	1.5	1.5	1.6	1.8	4.1	4.9	5.3	
Consumer credit	4.7	4.9	5.1	5.1	8.5	9.5	9.4	
Loss given default (LGD. %)								
NFCs	45	45	45	45	51	60	53	
Loans for house purchase	22	22	22	22	30	48	59	
Consumer credit	55	55	55	55	56	62	69	
Asset markets (%)								
3M PRIBOR	0.4	0.9	1.7	2.9	0.4	0.3	0.3	
5Y GB yield	0.3	1.3	2.3	3.6	1.7	2.7	3.1	
3M EURIBOR	-0.3	-0.3	-0.1	0.3	-0.3	-0.1	0.3	
5Y EUR GB yield	-0.3	-0.1	0.4	0.9	-0.5	-0.4	0.2	
Change in residential property prices	16.3	11.7	7.7	5.3	3.5	-13.6	-12.8	
Banks' earnings								
Adjusted operating profit (y-o-y %)	-1.3	-0.5	0.3	-0.7	-8.0	-18.1	-23.7	

Source: CNB, BRCI

⁸ No loss = 0; the higher the value, the higher the loss; the area was approximated numerically using the midpoint Riemann sum.

⁹ Breuer, T., Jandacka, M., Rheinberger, K. and Summer, M. (2009): *How to Find Plausible, Severe and Useful Stress Scenarios*, International Journal of Central Banking, 5(3), pp. 205–224.

TABLE IV.2

Impact of the alternative scenarios on the banking sector	Baseline Scenario			Adverse Scenario		
	2018	2019	2020	2018	2019	2020
Provisions for non-performing loans (credit losses)						
CZK billions	-17.2	-19.6	-23.2	-59.8	-92.6	-93.3
% of assets	-0.2	-0.3	-0.3	-0.8	-1.3	-1.4
Provisions for performing loans						
CZK billions	-7.2	-3.0	-8.5	-69.8	-1.8	-24.6
% of assets	-0.1	0.0	-0.1	-1.0	0.0	0.4
Profit/loss from market risks						
CZK billions	-3.5	-7.9	-4.4	-4.7	-3.2	-1.4
% of assets	0.0	-0.1	-0.1	-0.1	0.0	0.0
Earnings for covering losses (adjusted operating profit)						
CZK billions	73.7	73.9	73.3	68.1	55.8	42.6
% of assets	1.0	1.0	0.9	1.0	0.8	0.6
Pre-tax profit/loss						
CZK billions	45.8	43.3	37.2	-66.2	-42.6	-27.5
% of assets	0.6	0.6	0.5	-0.9	-0.6	-0.4
Capital ratio at end of period in %						
Total	19.8	18.7	17.9	15.8	12.0	10.9
Tier 1	19.2	18.2	17.4	15.3	11.6	10.5
Capital injections						
CZK billions		0.4			26.9	
% of GDP		0.0			0.5	
No. of banks below 8% capital ratio		1			12	

Source: CNB

Note: Losses and provisions are presented with minus signs. Provisions for non-performing loans are the same as expected credit losses in the model.

In the *Baseline Scenario* credit risks and profit stagnate and the sector's return on assets falls

In the *Baseline Scenario*, the continuing economic growth is reflected in a growing ability of non-financial corporations and households to service their debts (see sections 2.3 and 2.4). The default rate, which is the key indicator of credit risk, is currently at its trough from the CNB's point of view. Thus, it rises marginally at the horizon of the *Baseline Scenario* for both non-financial corporations and households (see Table IV.1), causing credit losses to rise in a situation of continuing credit growth. The assumed rise in government bond yields in the Czech Republic and other EU countries leads to market losses due to a decline in the value of these debt instruments (see Table IV.2). Competition in the banking sector causes banks' traditional interest income to stagnate despite rising monetary policy interest rates. The *Baseline Scenario* therefore assumes a decrease in RoA from 1.0% to 0.9% at the test horizon owing to an increase in banking sector assets.¹⁰

The banking sector remains very well capitalised in the *Baseline Scenario*

The banking sector remains resilient and has sufficient capital reserves (see Table IV.2). The sector's aggregate capital ratio falls to 17.9% at the three-year horizon, staying well above the regulatory minimum of 8%. The Tier 1 capital ratio is only about 0.5 pp below the total capital ratio, illustrating the high quality of the capital structure. Nevertheless, one bank (accounting for only a marginal share of the sector's assets) gets into a situation of insufficient capital adequacy in the *Baseline Scenario*. This could imply a need to adjust its business model or top up its capital.¹¹

The introduction of IFRS 9 has no major impact on the results in the *Baseline Scenario*

Following the introduction of the IFRS 9 standard, provisioning for non-default loans is generally higher than under the previous IAS 39 standard (see Box 3.3). According to the CNB's model, banks would create provisions totalling CZK 5.4 billion¹² for existing non-default loans due to the switch to the new standard as of 1 January 2018 – the "one-off effect" (see Chart IV.1).¹³

10 Adjusted operating profit, which is used to calculate RoA, comprises net interest income and net income from fees and commissions less administrative expenses, depreciation and amortisation. Adjusted operating profit is largely the same as pre-provision profit but does not include the impacts of market (interest rate and exchange rate) gains/losses.

11 Banks may also get into a situation of an insufficient capital ratio because the stress test methodology assesses their business model as unsustainable even if this is not necessarily true. This is because the methodology is based on a universal bank model and may not be entirely accurate for specialised banking institutions. The CNB therefore takes institutions' specific characteristics into account when assessing the test results.

12 The actual observed one-off increase in provisions in the banking sector is almost identical – see section 3.2.2.

13 The impact of IFRS 9 in the macro stress tests does not involve any transitional period for inclusion in capital (Regulation (EU) 2017/2395 of the European Parliament and of the Council, <https://eur-lex.europa.eu/legal-content/EN/TXT/ELI/?eli=reg:2017:2395:o>).

The *Adverse Scenario* would imply significant losses for the banking sector...

The *Adverse Scenario* assumes that seriously negative developments in the EU would result in a sizeable decline in economic activity in the Czech Republic, a surge in unemployment and financial market turbulence, leading to a rise in EU government bond yields. Since this negative shock would result in a contraction of the domestic economy over almost the entire test horizon (see also Chart IV.1 Box), debt repayment by the real sector would deteriorate. This would be reflected in a substantial rise in the default rate and loss given default. Credit and market losses, coupled with a decline in operating profit and provisioning, would result in banks incurring sizeable losses (see Table IV.2).

...partly amplified by the introduction of IFRS 9...

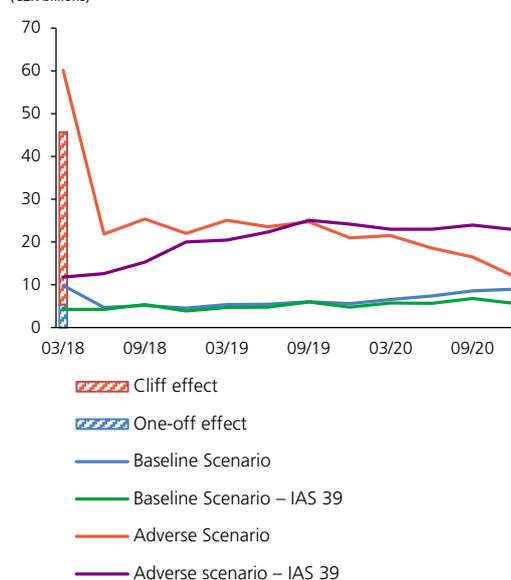
The stress test model assumes perfect foresight, i.e. that all future economic developments are known accurately at the beginning of the test. This is reflected in the provisioning under IFRS 9. As a result, a high volume of provisions, linked with the expected higher probability of default and loss given default, are created in the first year of the *Adverse Scenario*.¹⁴ Compared to the *Baseline Scenario*, the model assumes in the *Adverse Scenario* an additional jump in provisions for non-default loans of CZK 40.3 billion as of 1 January 2018. This jump, called the “cliff effect” (see Chart IV.1), shows how the new financial reporting standard changes the time path of provisioning. However, the intensity of the effect depends on banks’ approaches to modelling future developments and may be weakened in practice by adaptive behaviour of banks over time (“imperfect” foresight may instead be more probable).¹⁵ In the last year of the test, thanks to an improvement in the economic situation and outlook, provisions for non-default loans have a positive effect on the performance of the banking sector (provisions for non-default loans totalling CZK 24.6 billion are released).

...but the sector’s overall capital ratio would remain above the regulatory threshold

Although the aggregate capital ratio stays sufficiently above 8% in the *Adverse Scenario* (see Chart IV.5), twelve banks – representing about 16% of the sector’s assets – record a fall in the capital ratio below the regulatory minimum of 8% and have to top up their capital. The necessary capital injections total around CZK 26.9 billion, i.e. 0.5% of GDP (see Table IV.2, second column). Relative to the size of the banking sector, this figure is not large enough to jeopardise its stability.¹⁶ The banking sector’s stability is based on its high capital ratio¹⁷ and on its ability to generate income to cover losses even in the event of highly

CHART IV.1

Quarterly creation of total provisions (CZK billions)

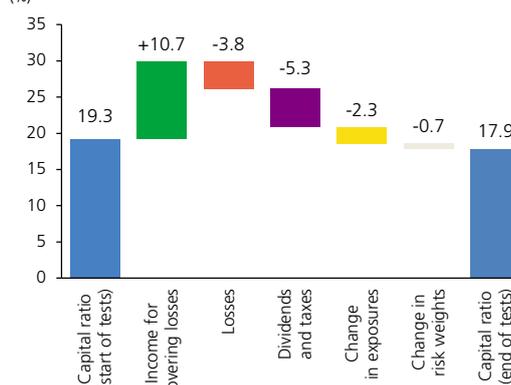


Source: CNB

Note: For IAS 39 the model assumes constant coverage of performing loans by provisions. For IFRS 9 and IAS 39 provisions for non-performing loans equal credit losses. The one-off and cliff effects capture the change between 31 December 2017 and 1 January 2018.

CHART IV.2

Decomposition of the change in the capital ratio of the banking sector in the *Baseline Scenario* (%)



Source: CNB

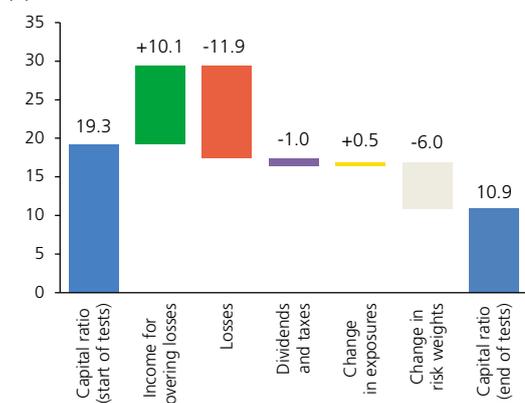
14 The practical application of the perfect foresight assumption can lead to markedly different results between institutions. This is also signalled by the observed data. See Box 3.3.

15 By definition, a tightening of the parameters based on actual developments will always take place with a lag. The gap between the provisions reported by institutions and the provisions under the assumption of perfect foresight can serve as a guide to the potential “output gap” in different model predictions of the future.

16 Banks posted after-tax profits of more than double this figure in 2017 (see section 3.2).

17 The capital ratio rose by 0.8 pp to 19.3% as of the end of 2017.

CHART IV.3

Decomposition of the change in the capital ratio of the banking sector in the Adverse Scenario (%)


Source: CNB

adverse developments. Nonetheless, the stronger impact of the stress compared to the tests published in previous Financial Stability Reports illustrates the importance of creating a countercyclical capital buffer in the current upward phase of the business and financial cycle.

The capital ratio falls only slightly in the *Baseline Scenario*...

A decomposition of the change in the capital ratio clearly illustrates the impacts of the main factors (see Chart IV.2). In the *Baseline Scenario*, income would increase the capital ratio by as much as 10.7 pp over the test horizon.¹⁸ However, most of this income would be used to cover expected credit and market losses (-3.8 pp) and to pay dividends and taxes (-5.3 pp). A rise in banks' exposures (-2.3 pp) and a change in risk weights due to a gradual rise in the default rate (-0.7 pp) would eventually reduce the capital ratio to 17.9%.

...but falls significantly in the *Adverse Scenario* mainly because of high losses and a sharp rise in risk weights

Overall, the income generated (enabling the capital ratio to be increased by 10.1 pp) would not be sufficient to fully cover all the losses over the test horizon (-11.9 pp). A rise in the default rate and LGD would – together with the application of IFRS 9 – lead to growth in provisions, which would increase the losses and, in turn, the need for capital.¹⁹ The model indicates that provisioning under IFRS 9 alone contributes 0.9 pp to this decrease in the capital ratio. For IRB banks, this impact may be partly mitigated up to 0.6 pp due to the current regulatory treatment of provisions (see Box 3.1). Dividends and taxes, paid mainly from profits for 2017, would still make a negative contribution to the capital ratio of 1.0 pp.²⁰ In addition to paying out lower dividends, banks would react to the worse situation by lowering the amount of loans, which reduces the fall in the capital ratio by 0.5 pp. The deterioration of the economic environment and the materialisation of credit risk would increase the risk weights, fostering a marked drop in the banking sector's capital ratio of 6.0 pp to 10.9% at the end of the test (see Chart IV.3). So, even the use of profits from previous years to absorb the impacts of the expected adverse economic developments in the first year of the test, brought about by the model's application of the expected credit loss concept under IFRS 9, would not help to reduce the impact of the stress test compared to the previous IAS 39 methodology. This could confirm some of the conclusions about IFRS 9 being procyclical (see section 3.2.2).

¹⁸ The income used to cover losses includes profits for 2017 and expected income in 2018, 2019 and 2020.

¹⁹ Again, we abstract from the possibility of distributing the impact of IFRS 9 on capital over time, i.e. we use the *fully loaded* approach focusing on the capital ratio after all transitional periods end.

²⁰ Without the IFRS 9 effect, however, banks could pay dividends of almost triple that amount (1.6 pp) in 2018.

The CRR/CRD capital regulatory framework increases the minimum capital ratio for the assessment of stress test results and the amount of the necessary capital injection

Following the introduction²¹ of the new capital regulatory framework for EU banks, the stress tests must also consider a minimum capital ratio above 8% which should not be breached by the impact of the stress test. This ratio takes into account the interaction between the additional Pillar 2 requirements and the combined capital buffers (see section 4.2.4 of FSR 2015/2016). The additional capital requirements may change in the years ahead, but they remain constant in the stress tests.

The effect of the stress test results on the capital requirements

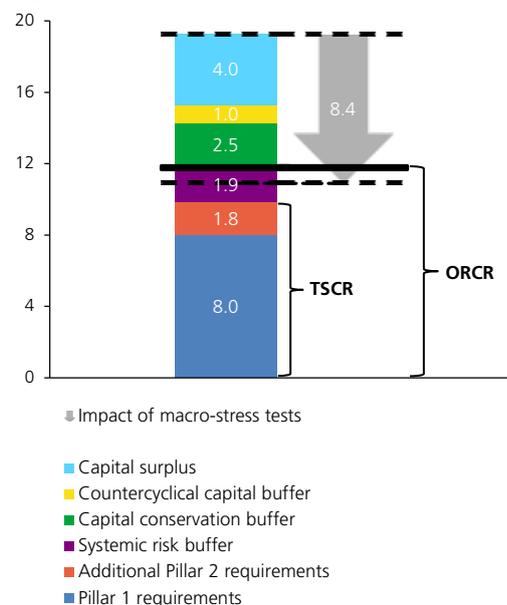
Banks must meet the total SREP capital requirement (TSCR) given by the sum of the Pillar 1 requirements and the Pillar 2 requirements at all times. If the supervisory authority decides that a bank cannot use one of the capital buffers to absorb a stress test shock, its total requirement is increased by the amount of that buffer. In this form it is referred to as the other relevant capital requirement (ORCR). The CNB defines the ORCR as the sum of the TSCR and the systemic risk buffer. This is because the purpose of the systemic risk buffer is to prevent long-term non-cyclical systemic risks, not to absorb the losses of individual banks in adverse phases of the economic cycle.

Chart IV.4 shows how fulfilment of the relevant capital requirement would look if the impact of the *Adverse Scenario* of the macro-stress test on the banking sector as a whole were to be factored in. The capital surplus, the countercyclical capital buffer and the capital conservation buffer would together be insufficient to cover the decrease in capital in the *Adverse Scenario*. At the macro level, this situation signals that it will be necessary to assess carefully in the SREP process whether individual banks have sufficient capital to meet the relevant capital requirement. At the individual bank level, supervisory stress testing in the SREP process is used for this purpose.

The path of the capital ratio (see Chart IV.5) in the *Adverse Scenario* is affected by the new approach under IFRS 9 causing the above-mentioned "cliff effect". Assuming perfect foresight of the adverse shock, the model predicts the creation of a large volume of provisions at the start of the test, leading to a decline in capital. By contrast, at the end of the test period, as the crisis fades, the model risk parameters improve and the expected credit loss therefore declines. Owing to a release of provisions, the capital ratio of the banking sector thus does not fall any further. When IFRS 9 is applied in the stress test methodology, the results suggest high sensitivity to early identification and to the estimate of the course of the crisis (length and depth). The CNB will therefore carefully assess banks' IFRS 9 implementation practices. The findings can then be applied in the further development of the stress test methodology.

CHART IV.4

Structure of bank capital requirements in the Czech Republic and impact of macro stress tests (average for sector as of end of 2017)

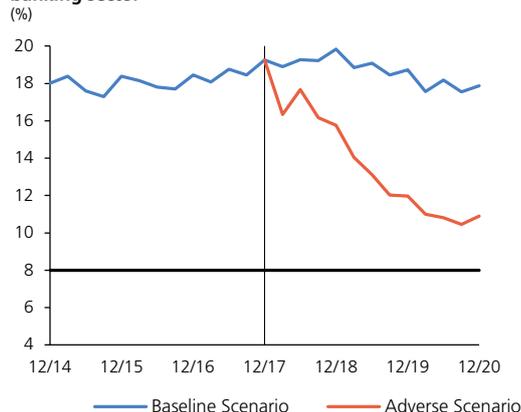


Source: CNB

Note: The illustration assumes a full countercyclical capital buffer, even though it has only been in effect since mid-2018.

CHART IV.5

Impact of the alternative scenarios on the capital ratio of the banking sector (%)



Source: CNB

Note: Black horizontal line represents 8% minimal capital ratio threshold

²¹ The stricter threshold for passing the tests in this section is based on the implementation of the EBA SREP guidelines, which is now under way in EU supervisory structures.

TABLE IV.4

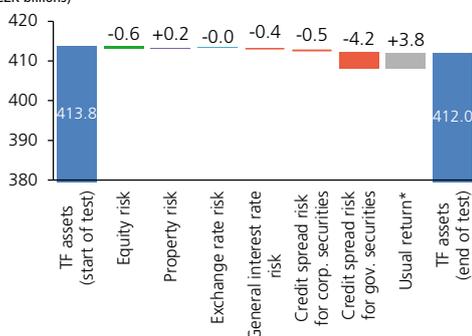
Results of the stress tests of PMCs		Baseline Scenario	Adverse Scenario
PMC equity (start of test)	CZK billions	9.0	9.0
Capital ratio (start of test)	%	139.7	139.7
Change in TF asset value - general interest rate risk	CZK billions % of TF assets	-0.4 -0.1	2.6 0.6
Change in TF asset value - credit spread risk for corporate securities	CZK billions % of TF assets	-0.5 -0.1	-1.4 -0.3
Change in TF asset value - credit spread risk for government securities	CZK billions % of TF assets	-4.2 -1.0	-15.2 -3.7
Change in TF asset value - exchange rate risk	CZK billions % of TF assets	0.0 0.0	0.0 0.0
Change in TF asset value - equity risk	CZK billions % of TF assets	-0.6 -0.1	-2.8 -0.7
Change in TF asset value - property risk	CZK billions % of TF assets	0.2 0.0	-0.1 0.0
Total impact of risks on TF assets	CZK billions % of TF assets	-5.6 -1.3	-16.8 -4.1
Profit of transformed funds	CZK billions	3.3	1.6
PMC equity (end of test)	CZK billions	8.5	2.6
Capital ratio (end of test)	%	133.0	42.4
Capital injection	CZK billions	0.4	4.2

Source: CNB

Note: Start of test: end of 2017; end of test: end of 2018. TF stands for transformed funds.

CHART IV.6

Change in the value of assets of transformed funds due to the individual types of risk in the *Baseline Scenario* (CZK billions)



Source: CNB

Note: * The assumed rise in value that would occur even without market repricing of assets in the *Baseline Scenario*. It represents dividend income, bond coupons and the return on the HTM portfolio. A usual return of 1% of the book value of assets at the start of the test is considered for all TFs. This equals the average return (net profit/assets of TFs) in recent years. Changes in the value of foreign-currency liabilities (cross-currency repos) is accounted for when considering exchange rate risk.

4.1.2 The Stress Tests of Pension Management Companies Assess the Sector's Resilience at the One-year Horizon

The stress tests of pension management companies (PMCs) focus on assessing the risks to transformed funds (TFs) managed by PMCs at the one-year horizon.²² Besides the Baseline Scenario, the sector's resilience to the Adverse Scenario was also tested; this variant captures adverse economic developments coupled with a drop in asset prices in financial markets (see section 2.1).

The PMC stress-testing methodology underwent further changes...

The PMC stress test methodology saw three main changes in 2018. First, as from this year's test, the held-to-maturity portfolio is treated as insensitive to credit spread risk in order to make the test more realistic. In previous rounds of stress testing, 20% of the size of the shock had been applied to this portfolio. Most of the held-to-maturity portfolio consists of Czech government bonds, for which default at the one-year horizon,²³ connected with a write-down of the exposure, is not assumed even in the *Adverse Scenario*. To maintain the prudent nature of the test, the potential impact of market repricing on the value of this portfolio will be monitored in a sensitivity analysis. The impact of this change can be assessed on the basis of Table IV.5. Second, the discontinuation of the second pension pillar has been taken into account. This reduces the capital requirements for the PMCs that had participated in it. Third, the methodology takes into account hedging against exchange rate risk using cross-currency repos, which some PMCs started to use in March 2017.

...and PMCs were informed of the test results

In this year's round of stress tests, PMCs were for the first time informed of their test results before publication of this Report. In this way, the CNB is satisfying demand from the tested companies and complying with the general principles of predictability and information openness. In addition, this further enhances control in the stress testing processes.

Transformed funds are mainly sensitive to interest rate risk...

The effect of the risks considered on the results of transformed funds (TFs) managed by PMCs is summarised in Table IV.4 and Charts IV.6 and IV.7. As TFs mostly invest in high-quality government bonds, general interest rate risk and credit spread risk for government bonds have the most significant effect. A rise in swap curves leads to a decline in total assets of 0.1% in the *Baseline Scenario*, whereas a decrease in swap rates in the *Adverse Scenario* causes the value of assets to increase by 0.6%. An increase in the credit spread for government bonds results in a drop in assets of 1.0% in the *Baseline Scenario* and 3.7% in the *Adverse Scenario*. Credit spread risk for corporate bonds leads to a decrease in assets not exceeding 0.3% in either scenario. TFs holding a large

22 Participation funds were not tested, as their market losses affect the funds' clients and not PMCs. They account for 8% of the sector's total assets.

23 See also the favourable result of the public finance stress test in section 4.4.

proportion of their assets in fixed-rate koruna bonds with longer durations are hit hardest by the materialisation of credit spread risks. TFs reduce the impact of a potential interest rate shock by holding bonds to maturity²⁴ (36% of the bond portfolio) and investing in floating-rate bonds (a further 25% of the bond portfolio²⁵). By contrast, TFs apply derivative hedging against credit risk to a minimal extent.

...and other types of risk have a limited impact

As in previous rounds of stress tests, losses due to equity and real estate risk remain insignificant in volume. Shares and units account for just 1.7% of TF assets; moreover, their holdings fell by 6.5% year on year. Gains and losses due to exchange rate risk also remain insignificant, as TFs hedge their foreign currency investments against exchange rate risk. TFs hold 12.9% of their assets in foreign currency, down from 16.1% a year earlier.

In the Adverse Scenario, the capital adequacy of some PMCs would fall below the required minimum

PMCs guarantee non-negative returns for the clients of their TFs by law. If a TF's assets decline below its liabilities, the relevant PMC has to top up the TF's assets. This is the case for three PMCs in the *Baseline Scenario*. As a result of topping up the TFs' assets, the capital adequacy²⁶ of one PMC falls below the required level. The PMC owners would have to inject capital of CZK 0.4 billion in order for this PMC to meet the capital adequacy requirement. In the *Adverse Scenario*, seven out of eight PMCs have to top up the assets of their TFs. As a result of the top-up, the capital adequacy of five PMCs falls below the required level, leading to negative capital for four of them. The owners would have to inject capital of CZK 4.2 billion in order for these PMCs to satisfy the capital adequacy requirement.

The risks to PMCs decreased year on year, but PMCs remain vulnerable to exceptionally adverse market developments

The impact of the *Adverse Scenario* on PMCs was lower this year than last year. This is due to a combination of methodological changes, different stress scenarios, the evolution of PMC's capital adequacy and developments in TF portfolios. Assuming identical exposures as last year, the application of this year's scenario would result in a 1.5 pp smaller decline in total assets of TFs (see Table IV.5). The change in portfolios also fostered a 1.0 pp smaller decline in total assets. By contrast, the lower capitalisation this year (see the combined capital surplus described in section 3.3) would require CZK 1 billion more in capital injections by PMC owners amid a smaller decline in assets in this year's test. The test results

TABLE IV.5

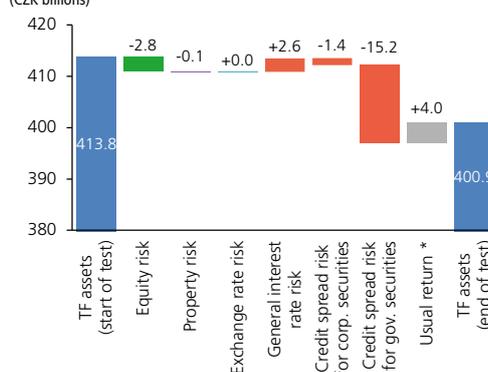
Year-on-year comparison of the PMC stress test results in the Adverse Scenario

Test methodology	Last year's (FSR 2016/2017)	This year's	This year's	This year's
Scenario	Last year's (FSR 2016/2017)	Last year's (FSR 2016/2017)	This year's	This year's
Data on capital and exposures to	31 Dec 2016	31 Dec 2016	31 Dec 2016	31 Dec 2017
Fall in TF asset value due to shocks considered (%)	7.1	6.6	5.1	4.1
Injections by owners to meet capital requirements (CZK billions)	9.9	6.5	3.2	4.2
Number of AMCs needing capital injections to meet capital requirements	8	7	5	5

Source: CNB

CHART IV.7

Change in the value of assets of transformed funds due to the individual types of risk in the Adverse Scenario (CZK billions)



Source: CNB

Note: *The assumed rise in value that would occur even without market repricing of assets in the *Adverse Scenario*. It represents dividend income, bond coupons and the return on the HTM portfolio. A usual return of 1% of the book value of assets at the start of the test is considered for all TFs. This equals the average return (net profit/assets of TFs) in recent years. Changes in the value of foreign-currency liabilities (cross-currency repos) is accounted for when considering exchange rate risk.

24 In the case of market repricing of all bonds regardless of their accounting classification, in the *Adverse Scenario* total assets fell from 4.1% by a further 2.8% and the size of the capital injection by PMC owners rose by CZK 10.1 billion.

25 Floating-rate bonds held to maturity are not included in this 25%.

26 The capital adequacy of a PMC is defined as the ratio of capital to the capital requirement. The capital requirement rises with an increase in the amount of assets in all managed funds, the share of riskier asset types in the TF and overheads. At the end of 2017, the capital requirement for risks of TFs accounted for 86% of the total capital of PMCs.

can be assessed as meaning that although the risks to PMCs decreased year on year, their vulnerability to exceptionally adverse developments remains elevated.

Pension fund risks are analysed by international institutions but do not currently pose a threat to financial stability in the Czech Republic

Pension funds in the EU, like life insurance companies, are being adversely affected by the sustained environment of low interest rates. That is one of the reasons why they are part of analyses conducted by international institutions.²⁷ The results of a stress test of 130 defined benefit pension funds and hybrid funds²⁸ from 16 countries conducted by the EIOPA in 2017²⁹ revealed that these funds already lacked 3% of total assets to cover liabilities at the start of the test. Under the adverse scenario, this shortfall rises to 21% of total assets, i.e. EUR 301 billion. However, the test impacts differ significantly across countries. Pension funds from the Czech Republic did not participate in the EIOPA tests. Pension fund risks to financial stability in the Czech Republic are low by European comparison for three reasons. First, pension funds in the Czech Republic are not defined benefit schemes and therefore do not guarantee returns on their contributions for their clients. Second, the types of pension funds currently dominant in the Czech Republic invest mostly in safe and liquid assets, for which high losses are unlikely. Third, the pension fund sector in the Czech Republic is still too small to be a source of major risks to financial stability.

27 For example the *Report on European Private Pension Schemes* by the FSB Regional Consultative Group for Europe: <http://www.fsb.org/2017/10/report-on-european-private-pension-schemes-functioning-vulnerabilities-and-future-challenges/>

28 According to the EIOPA definition, a hybrid pension scheme has both a defined benefit component and a defined contribution component. Such funds therefore offer a guarantee of investment returns on contributions via their defined contribution component.

29 <https://eiopa.europa.eu/Publications/Reports/2017/%20IOPR%20Stress%20Test%20Report.pdf>

4.2 BANK LIQUIDITY STRESS TESTS AND LIQUIDITY REGULATION

Banks having their registered offices in the Czech Republic passed the liquidity tests. Both the CNB's macro-stress test and the liquidity coverage and net stable funding ratios indicate that domestic banks are highly resilient to liquidity shocks. This is due to their strong client deposit base and high capitalisation on the liabilities side and to a significant proportion of exposures to the CNB on the asset side. Exposures to the CNB increased further in 2017, mainly in the context of high interest of non-residents in koruna assets, including short-term deposits with domestic banks. Despite the changes in the structure of their balance sheets, the liquidity position of domestic banks remained stable and strong.

The liquidity coverage ratio confirms the banking sector's high resilience to short-term liquidity risk...

Resilience to a short-term liquidity shock is regularly tested using the liquidity coverage ratio (LCR). The aggregate LCR for the banking sector as a whole was 181% at the end of 2017³⁰ and all domestic banks were compliant with the regulatory limit of 100% required as from 2018 (see Chart IV.8). Despite an increase in the liquidity buffer, the aggregate LCR fell by 8 pp year on year owing to an increase in expected outflows. Given the one-month horizon of the stress considered, the highest aggregate LCR was achieved as usual by building societies, which, compared to the other groups of banks, had a significantly lower share of deposits included in the expected outflows (see Table IV.6). Domestic banks continued to hold almost all their assets from the LCR liquidity buffer in the form of claims on the CNB and government bonds (around 96% of the buffer), to which no haircuts are applied. The share of claims on the CNB rose significantly during 2017. While it had been 58% of the liquidity buffer at the end of 2016, it reached 76% at the end of 2017. No increased balance-sheet liquidity risk currently arises from the change in the structure of the liquidity buffer.

...and the net stable funding ratio confirms sufficient stable funding

The aggregate net stable funding ratio (NSFR³¹) for the domestic banking sector as a whole was 126% at the end of 2017 (see Chart IV.8). This figure illustrates sufficient available stable funding stemming from a strong base of client deposits and solid capitalisation (see Chart IV.9). The fulfilment of the NSFR above the threshold of 100% is also due to the structure of assets. Claims on the CNB with a zero need to be covered by stable funds account for a significant share of the balance sheet of

³⁰ The LCR in other currencies declined year on year owing to the euro liquidity buffer falling from 75% at the end of 2016 to 31% at the end of 2017; the dollar value dropped from 41% to 19% over the same period. No regulatory limit on the LCR in other currencies is now set for domestic banks.

³¹ A general stable funding requirement has been in effect in the EU since 2016 (Article 413(1) of the CRR). A minimum standard specifying the calculation of the NSFR in the EU will be introduced by an amendment of the CRR (CRR2) currently under discussion. This cannot be expected to take effect before 2020.

TABLE IV.6

The LCR for groups of banks

(% of total assets of individual groups of banks as of 31 December 2017; rates in %)

	Banks			Building societies	Total
	Large	Medium-sized	Small		
Liquidity buffer	36	28	44	22	32
Liquid assets	36	28	44	22	33
Weighted average rate of eligibility after application of haircuts*	100	100	100	99	100
Expected outflows	26	18	14	4	21
Balances of outflows	96	81	93	25	85
Weighted average rate of outflow*	27	22	15	14	25
Expected inflows	4	4	3	1	3
Balances of inflows	27	26	37	4	25
Weighted average rate of inflow*	13	13	8	17	25
LCR	161	192	408	738	181

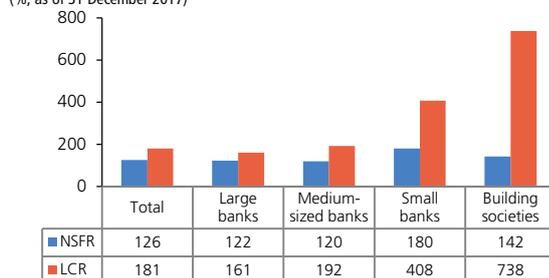
Source: CNB

Note: *The extent to which items subject to haircuts, outflows or inflows in the stress period are represented in balance sheets. The results take liquidity subgroups into account and exclude state-owned banks.

CHART IV.8

Regulatory indicators of bank balance-sheet liquidity

(% as of 31 December 2017)



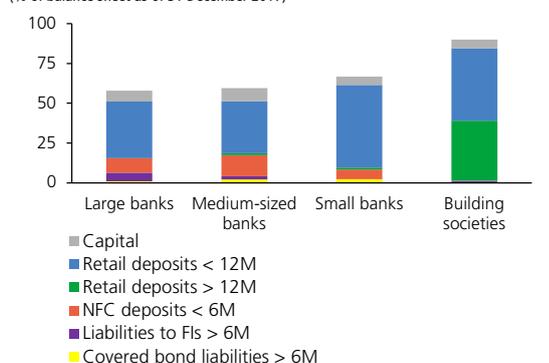
Source: CNB

Note: The LCR is the ratio of the liquidity buffer to the net liquidity outflow of banks over a 30-day stress horizon as defined by EC Regulation 2015/61. The NSFR is the ratio of available stable funding to required stable funding as defined by Basel III. The results take liquidity subgroups into account and exclude state-owned banks.

CHART IV.9

Structure and amount of items ensuring stable funding

(% of balance sheet as of 31 December 2017)



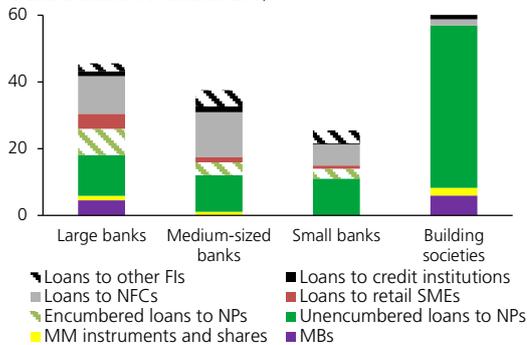
Source: CNB

Note: The chart contains items whose weights exceed 2% in any of the groups of selected banks. M: month; FIs: financial institutions; NFC: non-financial corporations.

CHART IV.10

Structure and amount of items requiring stable funding

(% of balance sheet as of 31 December 2017)



Source: CNB

Note: The chart contains items whose weights exceed 2% in any of the groups of selected banks. MBs: mortgage bonds; NPs: natural persons; NFCs: non-financial corporations; MM: money market; FIs: financial institutions, SME: small and medium-sized enterprises.

TABLE IV.7

Scenario type and shock size in the liquidity stress test

(v %)

Balance-sheet item/Maturity bands	< 3M	3M–6M	6M–9M	9M–12M
Interest rate and equity shock				
1. Liquidity buffer				
1.1 Q-o-q change in yield curve in pp*				
1Y PRIBOR	0.2	-0.1	-0.1	0.0
5Y GB yield	0.4	0.4	0.2	0.3
1Y EURIBOR	0.3	0.0	0.0	0.0
5Y EUR GB yield	0.0	-0.2	-0.2	0.0
1.2 Haircuts from value of capital instrument	39.0	-	-	-
Size of deduction from expected inflow				
2. Inflows				
2.1 Secured claims	0.2	0.3	0.3	0.4
2.2 Unsecured claims due**				
on NPs	1.1	1.2	0.3	1.3
on NFCs and retail SMEs	0.4	0.4	0.5	0.7
Expected outflow rate				
3. Outflows				
3.1 Drawdown of credit lines	5.0	5.0	5.0	5.0
3.2 Issued debt securities	100.0	100.0	100.0	100.0
3.3 Retail deposits				
insured	4.8	3.3	3.7	3.1
others	9.5	6.3	7.4	6.3
3.4 Liabilities to NFCs				
secured	19.0	12.6	14.9	12.5
others	47.5	31.6	37.2	25.0
3.5 Liabilities to FIs				
secured	19.0	12.5	14.9	12.5
others	47.5	31.6	37.2	31.3
3.6 Growth in new loans, of which***				
secured claims	0.0	2.1	1.3	0.6
due to NPs	0.0	1.8	0.1	0.7
due to NFCs and retail SMEs	3.3	1.3	1.7	0.0

Source: CNB

Note: The parameter values are the averages to those applied to individual banks. M: month, Y: year, NPs: natural persons, NFCs: non-financial corporations, FIs: financial institutions, GB: government bonds, SME: small and medium-sized enterprises.

* The haircut is determined by multiplying the change in the yield curve by the duration of the bond portfolio.

** Due claims on financial institutions were not subject to deductions 1 in this scenario. *** The credit growth assumption is calculated using satellite models in macro stress tests of bank solvency.

domestic banks. Items with a higher weight of required coverage by stable funds are dominated by loans to natural persons and non-financial corporations (see Chart IV.10). As usual, building societies had the largest share of stable funds. Deposits with a contractual maturity of over one year, which are considered 100% stable, accounted for 37% of their total liabilities. In other groups of banks, client deposits with shorter maturity accounted for the dominant share of stable funds. Client and corporate deposits with small banks increased in 2017, contributing to a year-on-year increase in the share of stable funds of around 15 pp. In large and medium-sized banks, the share of stable funding remained at the usual level of around 60%.

The CNB also assesses the banking sector's liquidity using its own macro stress test...

Besides assessing short-term balance-sheet liquidity, the CNB conducts its own macro stress test.³² The sufficiency of a bank's liquid buffer relative to the net liquidity outflow, i.e. the difference between expected outflows and inflows of liquidity, is tested over a one-year horizon (four maturity bands).³³ Their level is derived from bank's funding stability and the maturity mismatch in its balance sheet. The model thus incorporates the main features of the LCR and NSFR regulatory requirements. The model is a two-round one and takes into account the links between balance-sheet and market liquidity and the feedback reaction of the banking sector. The banking sector is first hit by scenario-defined exogenous shocks, which banks react to under certain assumptions. Those reactions then change the reputational risk of each reacting bank and the systemic risk in the banking sector as a whole (endogenous shocks). Banks have a limited ability to increase their balance-sheet totals over the entire test period. Compared to the LCR or NSFR, the liquidity macro stress test allows for better testing of the impact of scenarios with lagged pass-through of the adverse economic situation to the quality of banks' loan portfolios and to the financial markets.

The stress test was applied to 21 banks having their registered offices in the Czech Republic using the *Adverse Scenario* (see section 2.1 and Table IV.1) and the end-2017 data.³⁴ In the first round of stress, a liquidity outflow was generated for each maturity band by increasing lending (see Table IV.7, lines 3.1 and 3.6) and reducing funding (lines 3.2–3.5). At the same time, the inflow of expected liquidity (lines 2.1 and 2.2) for the relevant maturity band was lowered and the value of some assets in the liquidity buffer³⁵ (lines 1.1 and 1.2) was reduced. The second round of stress captures the consequences of the

32 For details see the thematic article in FSR 2015/2016: *The Relationship between Liquidity Risk and Credit Risk in the CNB's Liquidity Stress Tests*.

33 The expected inflows of liquidity are limited from above so that the minimum net outflow is 30% of the expected outflow.

34 State-owned banks, which have a specific business model, were not included in the stress test. The test takes liquidity subgroups into account.

35 Two liquidity buffer levels are monitored in the stress test. The level 1 liquidity buffer is defined as the sum of cash, claims on the CNB (excluding minimum reserves) and government bonds. The level 2 liquidity buffer additionally includes unencumbered corporate marketable securities.

rise in reputational and systemic risk brought about by banks' efforts to cover the net outflow and is expressed through additional losses arising from the sale of assets from the buffer.

...which confirmed their high resilience even over a longer stress period

The test results reveal that the banking sector as a whole would withstand the simulated stress and would be able to cover a net outflow of liquidity lasting even one year (see Chart IV.11). The impacts of the negative shocks on the balance sheets of the groups of banks monitored were mixed. When the impact was measured using the aggregate decline in the total liquidity buffer, large banks were hit hardest (a decline of more than 80%; see Chart IV.11), with a higher net outflow relative to their liquidity buffers. This year, building societies also recorded a relatively high impact (around 65%). As usual in their case, the stress in the form of higher outflows of liquidity manifested itself only from the second maturity bucket (3–6 months) upwards, but the composition of the sector's liquidity buffer is riskier and was subject to larger haircuts over the entire stress period. Three banks would exhaust their entire buffer during the test, doing so already in its second quarter. This was mainly due to their relatively low or riskier liquidity buffer, which was not sufficient in relation to the maturity mismatch in their balance sheets and their funding stability and consequently was not enough to cover the outflows generated. However, this balance-sheet liquidity risk does not have a systemic dimension, as the assets of the banks that exhausted their liquidity buffers accounted for 3% of the total assets of all the banks tested.

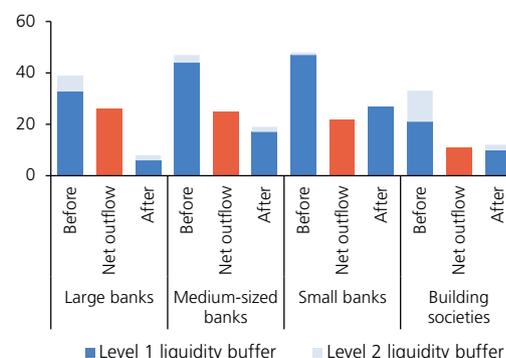
Domestic banks' balance-sheet structure changed partially...

The CNB's monetary policy actions resulted in an increase in koruna liquidity,³⁶ held largely by non-resident banks. Non-residents' interest rose sharply in early 2017 as expectations of an exit from the CNB's exchange rate commitment intensified (see Chart III.33, section 3.4). Non-resident banks with no access to CNB facilities usually placed korunas in Czech government securities (see section 4.4, Table IV.9 and Chart IV.24) or in short-term deposits with domestic banks (see Charts IV.12 and IV.13). The high interest of non-resident banks in koruna assets was reflected in an increase in their share in the financing of domestic banks and a rise in their share in holdings of Czech koruna government bonds. This led to a change in the structure of liquid assets held by domestic banks. Their holdings of unencumbered Czech government securities decreased and the encumbrance of these assets increased (see Chart IV.12). Domestic banks deposited their growing free koruna liquidity with the CNB (see Chart IV.13).

36 The CNB used the exchange rate as a monetary policy instrument between the start of November 2013 and the start of April 2017 (see http://www.cnb.cz/en/monetary_policy/bank_board_minutes/2017/170406_prohlaseni.html).

CHART IV.11

Results of the bank liquidity stress test
(% of total assets of individual groups of banks as of 31 December 2017)



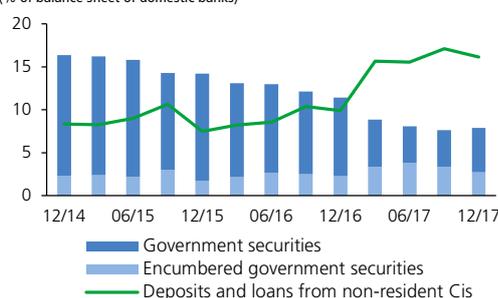
Source: CNB

Note: The column "Before" represents the pre-stress size of the liquidity buffer and the column "After" the post-stress size of the liquidity buffer. The column "Net outflow" represents the outflow of liquidity over the one-year horizon taking the liquidity inflow into account. The inflows are limited from above, i.e. a minimum net outflow of 30% of the expected outflow is assumed.

CHART IV.12

Share of government securities and loans from non-resident banks

(% of balance sheet of domestic banks)

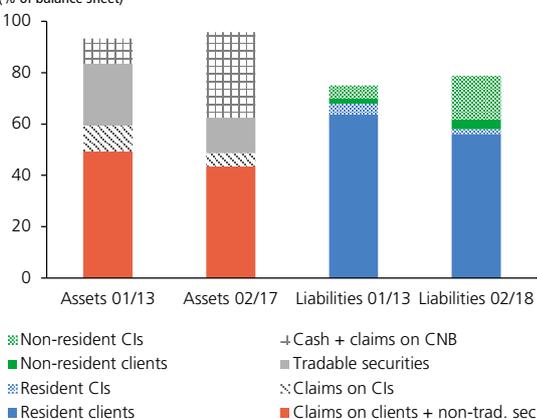


Source: CNB

Note: Cis: credit institutions.

CHART IV.13

Selected balance-sheet items of the domestic banking sector
(% of balance sheet)



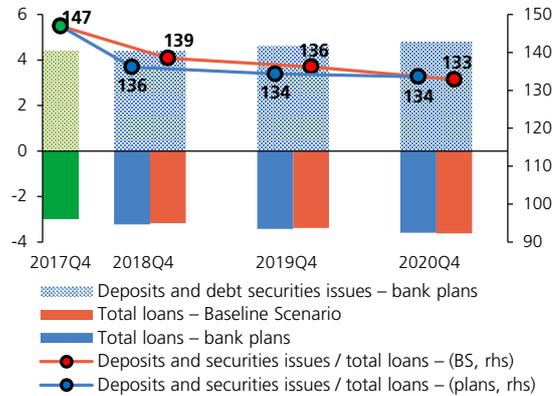
Source: CNB

Note: Cis: credit institutions.

CHART IV.14

Funding plans of domestic banks

(CZK trillions; right-hand scale: %)



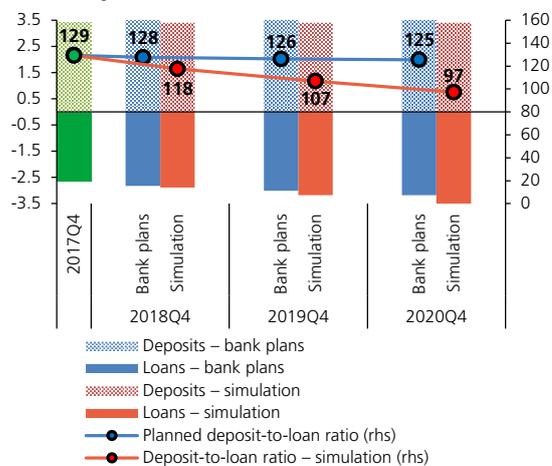
Source: CNB

Note: Includes loans and deposits to the private sector defined as households, non-financial corporations and financial institutions. Also includes debt securities with maturities equal to or more than three years. The green columns denote the position as of 2017 Q4; positive values are deposits and negative values are loans. BS as baseline.

CHART IV.15

Comparison of planned and encumbered client deposits and loans

(CZK trillions; right-hand scale: %)

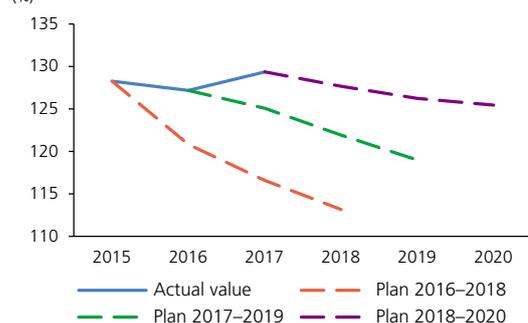


Source: CNB

Note: Clients comprise households and non-financial corporations. The simulation involves 10% year-on-year growth in loans and unchanged deposits. The green columns denote the position as of 2017 Q4; positive values are deposits and negative values are loans.

CHART IV.16

Planned and actual coverage of loans by primary funds (%)



Source: CNB

...affecting certain indicators of systemic liquidity risk...

The changes in banks' balance-sheet structure led to a slight worsening of certain indicators of systemic liquidity risk. In the banking sector, the systemic indicators include for example the systemic asset encumbrance ratio, the net cash outflow ratio, the short-term commercial funding ratio and the foreign currency funding ratio. The asset encumbrance ratio, as measured by the ratio of the sum of encumbered assets and collateral received to the sum of total assets and collateral available for encumbrance, stood at 10% as of 31 December 2017 (7% as of 31 December 2016). A similar year-on-year increase (from 7% to 10%) was also recorded for the ratio of short-term wholesale funding to total assets. The net cash outflow ratio, defined as the LCR net cash outflows to total assets, and the ratio of foreign currency funding to total liabilities excluding own funds both went up by 1 pp in the period under review, reaching 11% and 3% respectively.

...the liquidity position of domestic banks remained stable and strong

Despite the changes in balance-sheet structure, the liquidity position of the domestic banking sector remained stable and strong. This was due mainly to an increasing share of liquid assets in balance sheets and a large excess of client deposits over client loans (excluding financial institutions; see Chart IV.13). Loans from non-resident credit institutions rose from 5% of total assets (January 2013) to almost 17% (February 2018). However, this type of funding source for domestic banks was deposited with the CNB. Claims on the CNB grew from 10% to around 33% of the total assets of the banking sector. Before the CNB's exchange rate commitment was introduced, client loans had accounted for around 49% of the balance sheet (January 2013) and client deposits for about 64%. Client loans accounted for 43% and client deposits for more than 56% of the balance sheet at the end of February 2018. However, the ratio of client deposits to loans remained high at a level exceeding 130% (see section 3.2.4, Chart III.19) and above the EU average (around 104%).

According to banks' plans, coverage of loans by primary funds will remain high in the future

In their end-2017 funding plans, domestic banks expect loans to the private sector to increase on average by 5.9% year on year, from CZK 3 trillion to around CZK 3.6 trillion at the three-year horizon (see Chart IV.14). They are planning to increase private sector deposits and issuance of debt securities with maturities of at least three years on average by almost 2.8% year on year, from CZK 4.4 trillion to CZK 4.8 trillion. The planned funds of banks would sufficiently exceed their planned loans and would even cover credit growth over the entire three-year horizon in the *Baseline Scenario* (see section 2.1, Table IV.1 and Chart IV.14). The three-year outlook for the ratio of client deposits to loans, i.e. the coverage of loans by primary funds, also remains high (see Chart IV.15), although banks are planning to lower it in the medium term (see Chart IV.16). This ratio would drop below 100% assuming slightly higher-than-planned growth in client loans (10%) and unchanged client deposits. These developments would force banks to cover the higher growth in loans using other, potentially less stable, funds.

4.3 THE HOUSEHOLD STRESS TEST

The share of overindebted households decreased compared to last year in both the *Baseline Scenario* and the *Adverse Scenario* due to the favourable economic situation. The higher sensitivity of low-income households and borrowers with a DSTI ratio of over 40% to adverse economic shocks and an increase in loan rates remains a risk.

The household stress test is based on an *Adverse Scenario* simulating the situation of 2008–2009

The household stress test³⁷ focuses on the risks of household overindebtedness, whose potential debt service problems could transform into financial sector credit risk. Household overindebtedness here means an increased probability that a household will fall into arrears with its debt servicing obligations. It is defined with the aid of the “financial reserve”, which represents households’ net monthly income minus essential expenditures and loan instalments. A household is referred to as overindebted if its financial reserve is negative after the chosen scenario is applied. The pre-and post-shock shares of overindebted households are calculated for individual income groups.³⁸

The household stress test is annual and static. A slightly different *Adverse Scenario* than the one used for the banking sector stress test for the three-year horizon is therefore considered. Historical values were used to construct an *Adverse Scenario* analogous to the situation in 2008–2009, when in the space of one year the general unemployment rate increased by 3 pp (from 4.3% in 2008 Q3 to 7.4% in 2009 Q3), annual nominal wage growth decreased by 8.5 pp (from 10.7% in 2008 Q1 to 2.2% in 2009 Q1) and annual consumer price inflation dropped to zero (0.2% in 2009 Q3). Both the *Adverse Scenario* and the *Baseline Scenario* assume flat interest rates; the sensitivity of households to an interest shock is analysed separately below (see Table IV.8).

The share of overindebted households is relatively low in both the *Baseline Scenario* and the *Adverse Scenario* due to the favourable economic situation and outlook

Compared to last year’s household stress test (see FSR 2016/2017), the share of overindebted households is lower across all income groups. The share of overindebted households is relatively low in the *Adverse Scenario*

37 The household stress test is conducted using data for individual households from the Household Budget Statistics. The methodology is described in detail in CNB Working Paper 2/2014. Examples of the practical application of the CNB household stress test in macroprudential policy decisions are presented in IFC Bulletin No. 46, BIS, December 2017.

38 The CZSO Household Budget Statistics (HBS), which are the main data source for the household stress test, have a lag of almost 18 months at the time of publication of the FSR. For that reason, it is necessary to take into account the changes in household overindebtedness that occurred between the end of 2016 and the end of 2017, to which the impact of the scenarios for 2018 is linked. Publicly available macroeconomic data were used for this purpose (see CNB Working Paper 2/2014 for details). Due to the “rundown” of the current HBS survey system, the reporting set was significantly reduced in 2016 (from around 3,000 households to 1,600). The analysis is therefore conducted on a merged 2015 and 2016 data file in which the changes in household overindebtedness between 2015 and 2016 are treated in the same way as those between 2016 and 2017.

TABLE IV.8

Key variables in the individual scenarios of the household stress tests

(values in Q4 of the year)	2017	2018 Baseline Scenario	2018 Adverse Scenario
General unemployment rate (%)	2.5	2.2	5.6
Nominal wage growth (y-o-y, %)	7.8	6.2	-0.6
Inflation (y-o-y, %)	2.6	2.2	0.2
Interest rate on mortgage loans (%)	2.5	2.5	2.5
Interest rate on consumer credit (%)	10.9	10.9	10.9
Interest rate on other loans (%)	3.6	3.6	3.6
Share of refixed mortgage loans (%)	35	35	35

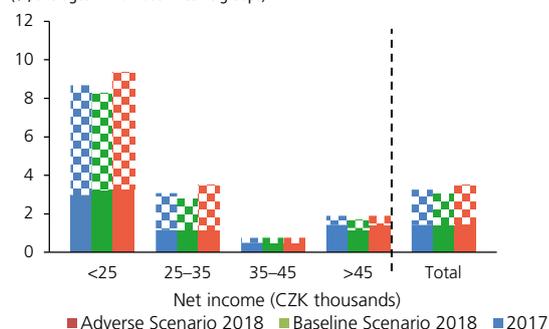
Source: CNB

Note: The 35% refixation rate corresponds approximately to the percentage of mortgage loans with a residual fixation period of up to and including one year. Interest rates correspond to rates on koruna loans provided by banks to residents of the Czech Republic on stocks of loans.

CHART IV.17

Shares of overindebted households by income group

(%: averages in individual income groups)



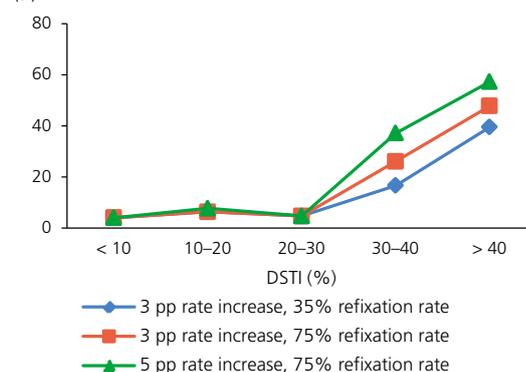
Source: CNB, CZSO Household Budget Statistics 2016

Note: Shares of households with loans. The solid part denotes the share of overindebted households with mortgages and the patterned part the share of overindebted households with loans other than mortgages.

CHART IV.18

Shares of overindebted households with net income below CZK 25,000 by DSTI ratio

(%)

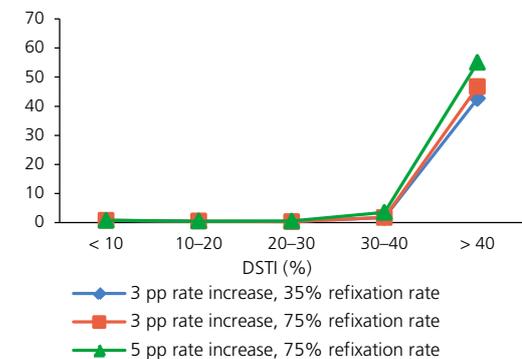


Source: CZSO Household Budget Statistics 2015 and 2016, CNB

Note: Shares of households with loans.

CHART IV.19

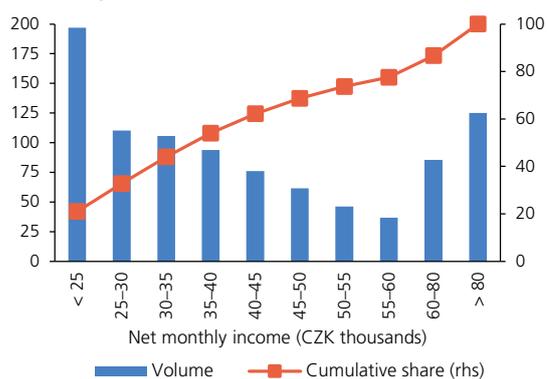
Shares of overindebted households with net income over CZK 25,000 by DSTI ratio
(%)



Source: CZSO Household Budget Statistics 2015 and 2016, CNB
Note: Shares of households with loans.

CHART IV.20

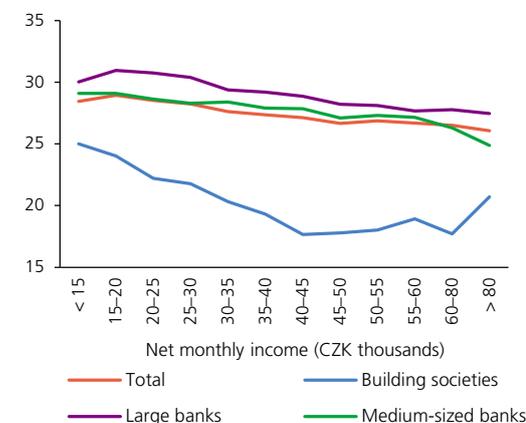
Loans secured by residential property by income group
(CZK billions; right-hand scale: %; as of 31 December 2016)



Source: CNB, data from surveys among individual banks

CHART IV.21

Risk weights of loans secured by residential property by income group and bank group
(%; as of 31 December 2016)



Source: CNB, data from surveys among individual banks

Note: The risk weights are calculated as a weighted average, where the weight is the volume of loans in each group. Building societies: CMSS, MPSS, SSCS; large banks: CS, KB, UCB; medium-sized banks: HB, MMB, RBCZ.

as well (see Chart IV.17). The difference is due to the favourable macroeconomic developments in 2017 and the positive outlook for 2018. Households with mortgages make up almost half of all overindebted households, and this share increases with increasing income. While households with mortgages account for around 35% of overindebted households in the lowest income group, in the highest income group the figure is about 75%. Despite this, the share of overindebted households with mortgages is relatively high in the lowest income group (around 3%, as compared to around 0.5%–1.5% in all other income groups). This means that low-income households fall much more often into overindebtedness due to problems servicing consumer credit and other loans, i.e. loans with a lower value than mortgages. The high share of overindebted households in the lowest income group is due mainly to a low or zero pre-stress financial reserve.

The higher sensitivity of low-income households to an increase in loan rates also remains a risk

As stated in the FSR 2016/2017³⁹, households with a DSTI ratio of over 40% are highly sensitive to financial stress across all income groups. This Report therefore devotes some space to analysing the sensitivity of Czech households to an interest shock. The analysis is based on the *Baseline Scenario*, enabling investigation of the impact of rising interest rates with an optimistic wage growth outlook and low unemployment. The sensitivity of households is tested against three alternatives in which loan rates go up by 3 pp or 5 pp and the mortgage portfolio is refixed at a rate of 35% or 75%.⁴⁰

The analysis results confirm the high sensitivity of households with a DSTI of over 40% to increased financial stress (see Charts IV.18 and IV.20). At the same time, it turns out that in the lowest income group (below CZK 25,000 a month) the share of overindebted households is already significantly increased at a DSTI ratio of between 30% and 40%. The share of this group in the total volume of mortgages issued is not insignificant. About 21% of the total volume of loans secured by residential property was provided to households with net monthly income below CZK 25,000, and another 12% or so was provided to households with net monthly income of between CZK 25,000 and CZK 30,000 (see Chart IV.20). Despite the fact that low-income households are significantly more sensitive to adverse economic developments and interest rate growth, the level of net income has only a limited impact on risk-weight setting by banks (see Chart IV.21). This is due to the fact that a certain minimum income is a general measure of a client's creditworthiness but does not enter the capital requirements calculation itself.

³⁹ Financial Stability Report 2016/2017, section 4.3, pages 69–70.

⁴⁰ The 35% refixation rate corresponds approximately to the percentage of mortgage loans with a residual fixation period of up to and including 1 year; the 75% refixation rate corresponds approximately to the percentage of mortgage loans with a residual fixation period of up to and including 5 years. Other types of loans are subject to a 100% refixation rate.

4.4 THE PUBLIC FINANCE STRESS TEST

The CNB assessed credit institutions' exposures to the Czech government as systemically important. However, given the favourable results of the Czech public finance stress test, the CNB will not require credit institutions to meet an additional capital requirement to cover the risk of concentration of these exposures over a three-year horizon.

The CNB reviews and evaluates the risks of concentration of sovereign exposures

Since 2015, based on its internal methodology, the CNB has been annually reviewing and evaluating the risks of concentration of exposures to sovereign issuers in the balance sheets of credit institutions having their registered offices in the Czech Republic.⁴¹ In its *Financial Stability Reports* it informs the market about which sovereign exposures it has identified as systemically important and whether it will require relevant credit institutions to meet an additional capital requirement to cover the risk of concentration of these exposures at a three-year horizon. The methodology defines an important sovereign exposure as an exposure to a sovereign issuer with a minimum ratio of 100% to the credit institution's eligible capital. It becomes systemic if the assets of credit institutions with important sovereign exposures exceed 5% of the total assets of all the credit institutions, including branches of foreign banks. It is indicated that an additional capital requirement must be met if the three-year outlook for the credit risk indicator of the sovereign issuer (sovereign risk indicator, ISR) exceeds one of its thresholds.⁴² The CNB requires additional capital where the credit institution holds exposures in excess of the limit and this above-limit exposure is not already sufficiently covered by capital.⁴³

Exposures to Czech government debt were assessed as systemically important...

The CNB assessed domestic credit institutions' investments in Czech government securities as a systemically important sovereign exposure. Although the value of these exposures recorded a year-on-year drop of CZK 102 billion at the end of 2017, at around CZK 485 billion it still accounted for 7.7% of these institutions' total assets and around 102% of their total capital. The assets of institutions with above-limit exposures accounted for 47% of the total assets of credit institutions and branches, as against 59.8% a year earlier. Exposures to other governments, the EU and the EIB did not reach systemic importance.

41 The internal methodology is described on the CNB website and in FSR 2014/2015.

42 The CNB primarily monitors two thresholds for the sovereign risk indicator: a *soft threshold* of 5% indicating the creation of an additional capital requirement where an additional expert analysis proves this to be necessary, and a *hard threshold* of 8% indicating unconditional creation of an additional capital requirement.

43 The above-limit part of a sovereign exposure is determined using the ISR where the ISR exceeds its thresholds. The ISR provides a simplified assessment of the risk of default on a sovereign exposure. The threshold separating the limit and above-limit parts of a sovereign exposure gradually falls as this indicator increases. As a result, the above-limit part rises. The highest effective limit is 222% and the lowest is 0%.

TABLE IV.9

Public finance stress test					
	2017	Adverse Scenario			critical limit
		2018	2019	2020	
Macroeconomic variables					
Real GDP growth (%)	4.5	0.7	-4.1	-1.0	< -2.3
Current account balance (% of GDP)	1.1	0.3	-3.6	-5.0	< -1.8
Gross national savings (% of GDP)*	27.5	27.5	27.5	27.5	< 19.3
External debt (% of GDP)*	86.5	86.5	86.5	86.5	> 99.6
Difference between real GDP growth and real 10Y GB yield (pp)	-5.5	-0.5	7.3	4.7	> 6.3
Fiscal variables					
Government debt (% of GDP)	34.7	34.1	38.4	44.0	> 64.7
Primary balance (% of GDP)	2.4	1.4	-0.8	-2.7	< -3.2
10Y government bond yield (%)	1.5	2.1	2.9	3.4	> 10.8
Government debt maturing within one year (% of GDP)	6.5	6.8	6.6	6.6	> 19.0
Share of government debt maturing within one year (%)	18.8	20.0	17.1	15.0	> 21.7
Share of foreign currency debt (%)	14.5	11.8	11.3	9.4	> 27.1
Share of non-residents in debt holdings (%)*	45.8	45.8	45.8	45.8	> 34.9
Institutional variables					
Government effectiveness (WGI score)*	1.1	1.1	1.1	1.1	< 1.0
Political stability (WGI score)*	1.0	1.0	1.0	1.0	< 0.8
Rule of law (WGI score)*	1.1	1.1	1.1	1.1	< 1.2
Banking crisis*	No	No	No	No	= Yes
Past sovereign defaults*	No	No	No	No	= Yes
Sovereign risk indicator (ISR, %)	-	0.12	0.90	0.30	

Source: CNB, CZSO, ECB, World Bank

Note: The symbol > (< or =) denotes that a higher (lower or equal) value means breaching of the critical limit and indication of increased risk. The figures are rounded. Indications of breaching of the critical limit are based on unrounded figures. Where the limit is breached, the relevant variables are further indicated in red. * Variable not modelled; last known value assumed in projection.

...but their riskiness did not exceed the thresholds

The ISR was estimated for systemically important exposures. Its three-year outlook was 0.3% (see Table IV.9) and did not exceed the supervisory thresholds of 5% and 8%. The CNB will therefore not require the credit institutions concerned to meet an additional capital requirement to cover the risk of concentration of exposures to the Czech government.

Few of the variables under review exceeded the critical limit...

Of the variables included in the ISR, the critical limit was exceeded in 2019 not only by rule of law and the share of foreign holders of government debt, but also by real GDP growth, the current account balance and the difference between the real government bond yield and the rate of GDP growth (see Chart IV.22). The combination of a decline of the domestic economy and growth in government bond yields resulted in the ISR peaking at 0.9% in 2019. However, a slowdown in the decline in GDP to 1% in 2020 meant that the estimates of this indicator and the difference between the yield and GDP returned below the critical limit. The estimated ISR went down to 0.3% in 2020, roughly in line with the result of last year's round of stress tests. The total government debt increased to 44% of GDP at the three-year test horizon. This deterioration in government finances primarily reflected lower tax revenues during the strong recession assumed in the *Adverse Scenario* (see section 2.1.3 and Table IV.9). The deterioration in public finances was also due to the reaction of financial markets in the form of growth in nominal yields on Czech government bonds, especially at the longer end of the koruna yield curve. The ten-year government bond yield rose to 3.4% at the three-year test horizon. However, the higher debt service costs had a relatively limited effect on growth in total government debt due to its relatively low initial level.

...and the low ISR level was also due to more favourable evolution of Czech government finances

Czech government debt recorded a year-on-year decline at the end of 2017. In relative terms, it has been decreasing since 2013, from 44.9% of GDP to less than 35% in 2017. Since 2014 this decrease has been fostered by economic growth and in 2017 also by a further decrease in debt service costs. The favourable trends in these variables reduced the impacts of the stress scenarios (see Chart IV.23) and were reflected in the three-year outlook for the ISR. For the first time since 2014, this year's round of stress tests showed no decline in the primary balance even in the stress scenario below -3.2% of GDP, which the CNB considers risky.⁴⁴ Czech government CDS spreads, which should reflect market perceptions of its credit risk, also decreased to historical lows.

⁴⁴ This is due in part to the high GDP deflator used in the stress scenario. The *Adverse Scenario* is thus less severe for public finances than it was in previous years.

The share of non-residents in debt holdings is the only fiscal variable with values in the critical range

Viewed in terms of the ISR indicator, long-lasting exceptionally adverse macroeconomic developments and political risk are currently the biggest risks to public finance sustainability. Fiscal variables – the public debt and its structure and the public budget balances – do not indicate much risk. Unlike in previous rounds of the stress test, non-residents' debt holdings are the only fiscal variable exceeding the critical limit. These holdings increased at the time of the exchange rate commitment, and a return to the pre-crisis levels is being hindered mainly by a persisting positive interest rate differential against the euro area. Non-residents hold the majority of koruna government securities at shorter maturities (see Chart IV.24). Any materialisation of risks on global markets (see section 2.1) leading to a disorderly outflow of foreign short-term investors might be adversely reflected in a surge in government debt servicing costs. However, the results of the public finance stress test showed that this scenario would currently pose no risk to public finance sustainability.

The government sector is resilient despite a high ratio of short-term debt

In previous Financial Stability Reports, the CNB noted a gradual decrease in average koruna government debt maturity. The average maturity of koruna government securities reached a low of 4.4 years in August 2017. By the end of 2017 it had risen to 5.1 years, roughly the same level as at the start of 2017. In April 2018, the Czech Republic was among the EU countries⁴⁵ with the shortest average government debt maturity, at 2.5 years below the EU average. Koruna government debt with maturity of up to one year accounted for 18.8% of total government debt at the end of 2017. A short-term debt ratio exceeding 21.7% is perceived as risky in the ISR. The Ministry of Finance of the Czech Republic has set a limit of 20% for the medium term in its Funding and Debt Management Strategy.⁴⁶ Short debt maturity increases the sector's vulnerability to growth in interest expenses in the event of government securities being issued in adverse market conditions. However, the government sector should not be exposed to any major refinancing risk in the short term, since the buffer against this risk was strengthened in 2017 by increasing the Treasury account balance to CZK 240 billion.

Regulation of exposures to sovereign issuers remains part of the international debate

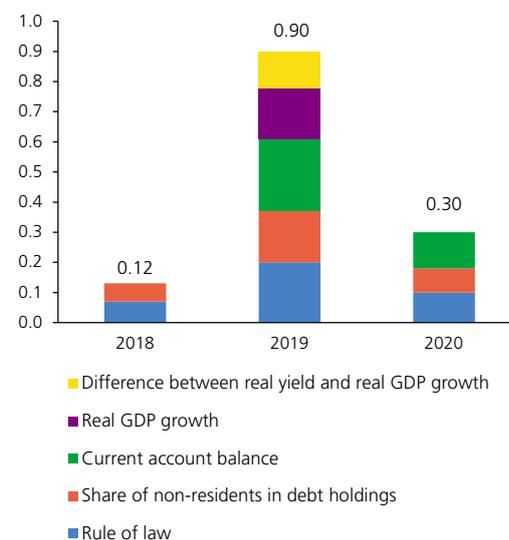
The international debate about the regulation of banks' exposures to sovereign issuers continued within the BIS in 2017. The BCBS published a discussion paper in December 2017 in which it discusses possible changes to Pillars 1, 2 and 3 in relation to such exposures. The major proposed changes included (i) the removal of the national discretion to apply a

45 This refers to government debt for 27 EU countries. Data for Estonia are not recorded in the ECB's database.

46 <https://www.mfcr.cz/assets/en/media/The-Czech-Republic-Funding-and-Debt-Management-Strategy-for-2018.pdf>

CHART IV.22

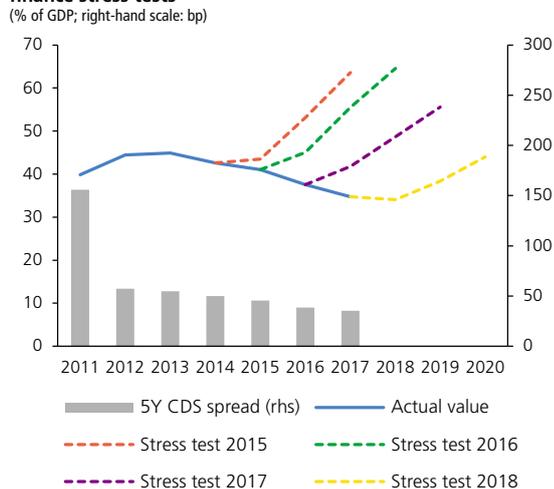
Decomposition of the sovereign risk indicator in the Adverse Scenario (pp)



Source: CNB, World Bank

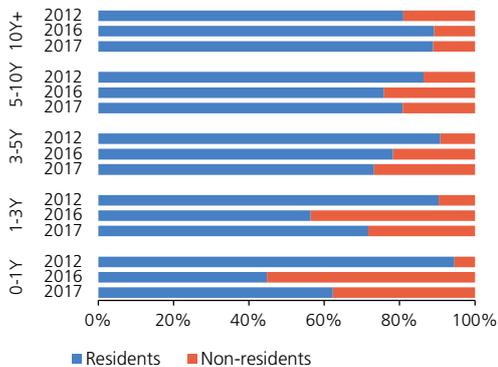
CHART IV.23

Comparison of the paths of government debt in the public finance stress tests (% of GDP; right-hand scale: bp)



Source: CNB, Thomson Datastream
Note: Year-end data.

CHART IV.24

Holdings of Czech government securities by non-residents
 (% of koruna issuance of respective residual maturity)


Source: ECB, BCPP, MFCR, CNB
 Note: As of the end of the year.

preferential (in practice zero) risk weight for exposures to the domestic sovereign issuer; (ii) adjustments to the risk weights in the standardised approach so that even the safest sovereign issuer is subject to a positive risk weight; (iii) prohibition of the use of internal models to set capital requirements owing to the difficulty of modelling sovereign defaults robustly, and (iv) the introduction of risk weight add-ons to mitigate high concentrations of a bank's exposures to a specific sovereign issuer. The CNB generally supports these proposals, especially risk weight add-ons for concentration risk.⁴⁷ There is no cross-country consensus on the regulation of sovereign exposures and it is not clear which proposals the BCBS is going to advocate.

An ESRB Task Force, in which the CNB was represented, published a feasibility study in January 2018 regarding the proposal to create sovereign bond-backed securities of EU Member States issued in euros (SBBS⁴⁸), which are classed as structured assets. The study states that the current capital and liquidity regulation of banks treats the proposed SBBS product less favourably than individual sovereign bonds without taking into account its specifics and true risks. According to the study, this represents a significant obstacle to the demand-led emergence of SBBS. In the second quarter of 2018, the European Commission should propose a legislative change reflecting the riskiness of the new product to a greater extent. Like many other countries, the CNB is sceptical about the emergence of SBBS, as it sees three main risks. The first is the potential threat of distortion of bond and other markets if SBBS unjustifiably received more favourable treatment than sovereign bonds of Member States. The second is the high costs associated with changing the existing regulation of the financial sector and with the emergence of a separate market (the maintenance of constantly high liquidity while ensuring steady and abundant simultaneous demand from various types of investors). The third is the potential adverse impact on sovereign debt issuers and managers. They would be forced to significantly change their issuing policy strategy, which could lead to additional debt management costs.

⁴⁷ The CNB's reply to the discussion paper is available on the CNB website: http://www.cnb.cz/en/supervision_financial_market/legislation/cnb_opinions/download/bcb_s_regulatory_treatment_of_sovereign_exposures_cnb_opinion.pdf.

⁴⁸ https://www.esrb.europa.eu/pub/task_force_safe_assets/html/index.en.html.