

THE INTRODUCTION AND CALIBRATION OF MACROPRUDENTIAL TOOLS TARGETED AT RESIDENTIAL REAL ESTATE EXPOSURES IN THE CZECH REPUBLIC

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This article sets out to describe how the CNB makes decisions on the introduction and calibration of macroprudential tools targeted at risks associated with exposures secured by residential property. It answers the following questions: How does the CNB assess the risks associated with exposures secured by residential property? Which macroprudential tools can and should be used to target such exposures, and when? What sorts of risks are DTI and DSTI caps targeted at? How does the CNB determine risky LTV, DTI and DSTI levels? In what situations is it desirable to combine macroprudential tools?

1. INTRODUCTION

Risks to financial stability can arise in an upward phase of the economic and financial cycle accompanied by overvalued house prices, easy credit standards and growth in loans secured by residential property (also referred to as “loans” or “mortgage loans” in this article). These risks consist in the financial sector incurring credit losses on a systemic scale, losses that can lead to a financial crisis. Given its mandate, the CNB has to respond to such developments in a timely manner by deploying macroprudential policy tools.

Some of the macroprudential tools the CNB has available to mitigate such risks are set out in the CRR/CRD IV banking regulation, which primarily contains capital requirements and capital buffers. Other tools are defined in a recommendation of the European Systemic Risk Board (ESRB)¹ but are missing from the legislation at EU level.² These include limits for loan-to-value (LTV), loan-to-income/debt-to-income (LTI/DTI) and loan service-to-income/debt service-to-income (LSTI/DSTI).³

Faced with emerging risks associated with the residential property market, the CNB in 2015 issued a *Recommendation on the management of risks associated with the provision of retail loans secured by residential property*. It was aimed at preventing these risks from growing and threatening the sound functioning of the

financial sector. Owing to property and credit market developments, the CNB tightened and expanded this Recommendation in June 2016 and June 2017. Among other things, the Recommendation sets LTV limits. It also defines DTI and DSTI thresholds at which lenders should assess loan applications particularly prudently.

Although LTV, LTI/DTI and LSTI/DSTI caps are commonly used in EU countries, they are seldom calibrated in a rigorous manner and are often based solely on a breakdown of new loans according to the values of individual indicators.⁴ This is most often due to a lack of necessary data on new loans. For such analyses, the CNB can draw on anonymised survey-based data on new loans, which it has been collecting from bank lenders since the Recommendation entered into force.^{5,6} As well as the information needed to calculate the LTV, LTI and LSTI ratios, this data contains demographic, social and geographical information allowing the riskiness of such loans to be assessed more accurately.

This article sets out to describe how the CNB makes decisions on the introduction and calibration of macroprudential tools targeted at risks associated with exposures secured by residential property. Section 2 presents a breakdown of those risks. Section 3 describes the macroprudential tools used to mitigate them. Section 4 sets out the approach currently used by the CNB to evaluate the direct risks associated with borrowers. Section 5 outlines how the tools are used. Section 6 contains an illustrative calibration and an example of the possible use of several tools simultaneously.

1 ESRB Recommendation on intermediate objectives and instruments of macro-prudential policy (ESRB/2013/1).

2 However, several countries (e.g. Austria, Belgium, Luxembourg and Slovakia) have already incorporated the recommendation into national law in legally binding form.

3 The definitions of these indicators differ to some extent across the countries that apply such limits (for example in the inclusion of gross or net income). The definitions currently applied by the CNB can be found in its *Recommendation on the management of risks associated with the provision of retail loans secured by residential property* (https://www.cnb.cz/miranda2/export/sites/www.cnb.cz/en/legislation/official_information/vestnik_2017_07_20717180_en.pdf).

4 See the *Overview of measures* at https://www.esrb.europa.eu/national_policy/other/html/index.en.html.

5 The first Recommendation of June 2015 was based on aggregate data from a survey of the largest lenders.

6 Following the adoption of the Consumer Credit Act No. 257/2016 Coll., the June 2017 Recommendation covers other consumer credit providers in addition to banks, branches of foreign banks and credit unions.

TABLE 1

OVERVIEW OF RISKS TO FINANCIAL STABILITY ASSOCIATED WITH EXPOSURES SECURED BY RESIDENTIAL PROPERTY

Breakdown of risks	Risks associated with collateral value/house prices	Risks associated with borrowers' debt servicing capacity	Risks associated with lenders' capitalisation	
	Borrower-related risks		Lender-related risks	
	- direct	- indirect	- direct	- indirect
Sources of risks	house price overvaluation potential fall in house prices method for determining collateral value	excessive household debt potential loss of, or fall in, income and rise in interest rates	undercapitalisation relative to risks associated with house prices and debt servicing capacity	
Ways in which risks materialise	↑ mortgage defaults ↓ house prices	↓ income ↑ unemployment ↑ interest rates	↑ losses on mortgages	↑ losses on other loans
Impacts of risks materialising	↑ losses on mortgages of which: ↑ default rate ↑ loss given default	↑ mortgage defaults ↑ other loan defaults ↓ household consumption ↑ credit losses, e.g. on loans to NFCs	↓ bank capital ↓ lending constraints application of resolution mechanisms	
Risk mitigation tools	LTV limits	LTI/DTI, LSTI/DSTI limits	countercyclical capital buffer systemic risk buffer increase in risk weights minimum LGD	

Source: CNB

Note: Arrows indicate links between the ways in which risks materialise and the impacts of them materialising. Defaults can occur in a situation of excessive household indebtedness coupled with a decline in income, a rise in unemployment or an increase in interest rates. This can lead to a decrease in household consumption and to credit losses, for example on loans to non-financial corporations (risks associated with borrowers' debt servicing capacity). If defaults are accompanied by a decline in house prices, losses on mortgages can occur (risks associated with house prices). Losses on mortgages or, for example, loans to non-financial corporations can exceed the funds that lenders have available to cover such losses (risks associated with lenders' capitalisation).

2. RISKS ASSOCIATED WITH EXPOSURES SECURED BY RESIDENTIAL PROPERTY

Current international practice distinguishes risks associated with (i) collateral value, i.e. property prices, (ii) consumers' income and debt servicing capacity and (iii) institutions' loan portfolios and capitalisation (see ESRB, 2016, and Table 1).

i) The dominant type of collateral used for mortgage loans is property, which is usually also financed with the loan. A risk can arise when house prices increase above their equilibrium level (and become "overvalued"), as this increases the potential loss given default in the event of a subsequent fall in house prices to, or below, their equilibrium level. The risk consists in the fact that lenders do not take house price overvaluation into account when valuing property serving as

collateral.⁷ The same LTV ratios amid more overvalued house prices mean that lenders are taking on more risk. House prices tend to be overvalued in economic good times, which are associated with growth in incomes and lending and easy credit conditions. This generates growth in demand for property, which tends to face less elastic supply. A major factor fuelling this growth in demand is that households expect house prices and interest rates to rise further, which in turn can lead them to rush into buying property. Risks can materialise when the economy takes a turn for the worse and non-performing loans (NPLs) start to increase. In this situation, a fall in property prices can give rise to credit losses when the property serving as collateral for such loans is sold.

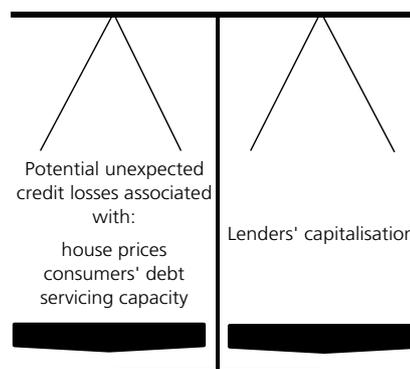
⁷ For an evaluation of the collateral value of property, see the Box 5.1 *Assessment of house price valuation by banks* in this Report.

ii) Income tends to be the main source of funds used to repay mortgage loans. Given the length of mortgage repayment terms and the possibility of loss of employment or other sources of income, borrowers' debt servicing capacity hinges on the sustainability of their income. A risk can arise if households accumulate excessive debt, as this increases the probability of default in a period of economic stress. Risks can materialise in the event of losses of, or declines in, borrowers' income, or an increase in interest rates. In such a situation, debt service costs can exceed income net of necessary expenditure, leading to default. If house prices simultaneously fall, credit losses can occur as described above. In addition, growth in household debt can lead to a decrease in consumption and indirectly put financial stability at risk, for instance through credit losses on loans to non-financial corporations. Such losses can result from economic difficulties caused by firms cutting production or service provision in response to the fall in household consumption.

iii) Lenders' credit portfolios are made up of loans with certain risk characteristics, characteristics which together tend to form a large part of their credit standards.⁸ Lenders use these characteristics as a basis for determining the risk component of the interest rate, which is largely a function of risk. This interest rate is meant to cover not only the expected losses on those loans, but also the costs of the capital held to cover unexpected losses (along with other components such as liquidity costs). A risk can arise in situations where loan rates and the capital held by lenders do not take into account the risks associated with collateral value (i) and consumers' income and debt servicing capacity (ii). An easing of credit standards is particularly common in economic good times, driven by optimistic expectations and increased competition in the credit market. Risks can materialise in the event of a sharp increase in NPLs accompanied by a fall in house prices. In such a situation, credit losses can reduce capital below the regulatory minimum, leading to a credit crunch in the real economy and even to a need to apply resolution mechanisms in the banking system.⁹

TABLE 2

DESIRABLE BALANCE BETWEEN LOAN PORTFOLIO RISKS AND LENDER RESILIENCE



Source: CNB

The first two categories of risks are referred to jointly as *borrower-related* (see Table 1) and can lead to the emergence of spirals between house prices and house purchase loans. In such case, house price overvaluation and credit growth gradually reinforce one another. The third category of risks is referred to as *lender-related*. Such risks arise when the potential loan losses are not adequately balanced by lender resilience (see Table 2).

⁸ The CNB's Recommendation and its 2017 Supervisory Benchmark both work with such characteristics (https://www.cnb.cz/miranda2/export/sites/www.cnb.cz/cs/dohled_financni_trh/vykon_dohledu/dohledove_benc_hmarky/download/dohledove_sdeleni_2017_01.pdf – available in Czech only).

⁹ See the work of SAREB in Spain (<https://www.bde.es/bde/en/secciones/prensa/infointeres/reestructuracion/>) and the lessons of the financial crisis in Ireland (<https://www.imf.org/external/pubs/ft/dp/2015/eur1501.pdf>),

including the Mortgage Arrears Resolution (Family Home) Bill 2017 (<https://www.oireachtas.ie/viewdoc.asp?DocID=36550&&CatID=59>).

3. MACROPRUDENTIAL TOOLS FOR MITIGATING RISKS ASSOCIATED WITH LOANS SECURED BY RESIDENTIAL PROPERTY

Tools can be used to mitigate both borrower- and lender-related risks.

The tools that target borrower-related risks directly restrict the volume of credit provided in relation to its riskiness. Macroprudential authorities in numerous countries set LTV limits, which are aimed at reducing lenders' losses given default by borrowers and a simultaneous fall in house prices, and LTI/DTI or LSTI/DSTI limits, which are targeted at reducing the probability of default by borrowers during an economic downturn (ESRB, 2014).¹⁰ The limits are applied to new loans and can be defined either as hard caps or as soft limits allowing a percentage of loans to be provided in excess of the limit. They restrict the volume of loans which would otherwise be granted with riskier characteristics (i.e. with ratios exceeding the limits) and, when used in a timely fashion, can thus help prevent the emergence of spirals between house price growth and house purchase loans.

The tools that target lenders are aimed at increasing the resilience of lenders during periods of financial stress and therefore influence the amount of capital they hold. They can work directly through the setting of higher capital requirements on the basis of a whole range of factors, including risks associated with real estate exposures. Such instruments include the countercyclical capital buffer and the systemic risk buffer. Others can work indirectly through variables that affect capital requirements connected with exposures secured by residential property. They include higher risk weights for banks using the STA approach to determine capital requirements for credit risk (under Article 124 of the CRR), a higher loss given default for banks using the internal rating based approach (under Article 164 of the CRR) and temporarily higher risk weights in the residential or commercial property sector (under Article 458(2)(d)(vi) of the CRR). These tools increase the amount of capital held by banks in relation to their risk-weighted exposures, enabling them to better absorb unexpected losses on existing loans secured by residential property. A side-effect is that they can again prevent the emergence of spirals as a result of the higher capital

requirements passing through to interest rates, and thereby contain or slow economic growth.

The use of the above instruments is contingent on the observed risk levels and dynamics. As a preventive measure (when risks are rising but still not elevated), it can be particularly appropriate to use tools that target borrowers. They can work more effectively against further growth in risks by directly restricting the provision of new loans with riskier characteristics. When the risks are already elevated, it can be more appropriate to deploy instruments that strengthen lenders' capitalisation. They can be complemented with tools that target borrowers, configured so as to restrict any further growth in the existing risks.¹¹ A combination of the two categories of instruments can be desirable in certain situations, because tools that target lenders can be applied to all existing loans, whereas tools targeted at borrowers apply solely to new loans. In this context, the use of instruments that target lenders is more universal, as they can be used preventively even in a situation of rising but still not elevated risks.

4. APPROACH TO EVALUATING RISKS ASSOCIATED WITH LOANS SECURED BY RESIDENTIAL PROPERTY

Given the current nature of the risks, which are rising but still not elevated, we will deal from now on with borrower-related risks and tools. Specifically, we will consider the situation where there are risks associated with collateral value and at the same time risks associated with borrowers' income and debt servicing capacity. We will focus on the direct risks associated with exposures secured by residential property and abstract from the indirect risk of a threat to financial stability resulting from a sharp fall in household consumption caused by household overindebtedness (see Table 2).

The CNB evaluates the risks described above as a function of three variables: house price overvaluation, credit standards and credit volume (see Equation 1). House price overvaluation and credit standards together determine the potential losses on the average unit volume of credit and hence are indicators of the riskiness of loans. Combined with the volume of credit, they indicate the total potential losses on those loans and are thus indicators of the total size of the risks associated with such loans. To identify the

¹⁰ These tools are not set forth in CRR/CRD IV, so national authorities either apply them as recommendations or initiate amendments to incorporate them into national law.

¹¹ One example of such use of macroprudential instruments is the Netherlands, where an LTV cap of 106% was introduced in 2012 and lowered by 1 pp a year to 100% in 2018.

risks as early as possible, the CNB relates these variables to new loans:

$$\text{risks} = f(\text{price overvaluation, credit standards, credit volume}) \quad (1)$$

For evaluation purposes, the key quantitative measures of credit standards are the LTV, which, together with house price overvaluation, determines the *loss given default* (LGD), and also the ratio of loans with excessive debt service or loan size levels (the ratio of loans at risk of default under stress), which indicate the *probability of default* (PD):

$$\text{MIPL} = \frac{\sum_i \text{loan size}_i}{\text{credit volume}} \cdot \sum_i \min[(100\% - \text{LTV}_i) - \text{overvaluation}; 0] \cdot \text{credit volume}, \quad (2)$$

where MIPL denotes the macroprudential indicator of potential losses on new loans, i denotes individual loans with at risk of default under stress, $(100\% - \text{LTV})$ denotes the share of over/undercollateralisation by property, $(100\% - \text{LTV}) - \text{overvaluation}$ denotes the proceeds from the sale of the collateral given a fall in house prices and $\min[(100\% - \text{LTV}) - \text{overvaluation}; 0]$ restricts the proceeds to negative values or zero, i.e. to credit losses.

Some simple examples can be given to facilitate a better understanding of equation (2). If the LTV is 80%, the overcollateralisation is 20% and there will be no loss on the sale of the collateral if house prices fall by 15% ($\min[(100\% - 80\%) - 15\%; 0] = 0$).¹² If, however, house prices fell by 25%, the loss on the sale of the collateral would equal 5% of the credit volume ($\min[(100\% - 80\%) - 25\%; 0] = -5\%$).¹³ If the LTV was 110%, the undercollateralisation would equal 10% and a drop in house prices of 15% would give rise to a loss on the sale of the collateral of 25% of the credit volume ($\min[(100\% - 110\%) - 15\%; 0] = -25\%$). House price overvaluation is estimated using the techniques described in section 2.2 of this Report. Loans with excessive debt service or loan size

values according to the method described in sections 6.2 and 6.3 of this article (i.e. individual loans for which the financial reserve under stress is lower than the set threshold or for which the loan size is higher than the hypothetical repayable loan under stress) are deemed to be loans at risk of default under stress. The possibility of default is evaluated at the horizon of five years from the provision of the loans, so the LTV and the loan size for the calculation of the indicator relate to that moment in time.

The MIPL is not an exact estimate of credit losses on new loans in the event of stress. Rather, it is an indicator of such losses for macroprudential purposes, one which uses certain prudent assumptions to express those losses. The loss given default can be favourably affected by lenders' ability to put the sale of collateral on hold until house prices start to go up again.¹⁴ It can be adversely affected by the actual situation on the property market and by its duration in the event of a significant price correction of a systemic nature following a long period of growth above the equilibrium level.

A rise in the MIPL over time nonetheless indicates growth in risks, to which it may be appropriate to respond with macroprudential policy (see Chart V.31 in section 5.3.1 of this Report). The evolution of the components of this indicator can meanwhile help determine which macroprudential instrument to use. A fall in the MIPL following the introduction of macroprudential instruments can then indicate the degree of effectiveness of the instruments.

5. HOW THE INSTRUMENTS ARE USED

If risks associated with collateral value are identified, the primary tool used to mitigate them is LTV limits, which represent a requirement for overcollateralisation¹⁵ and thus allow for direct or preventive restriction of credit losses in the event of default and a decline in house prices. LTV limits are by far the most commonly used macroprudential tools

¹² We abstract from transaction costs arising from the sale of the property and the termination of the credit relationship.

¹³ In this example, we abstract from the fact that the loan may have been partially repaid.

¹⁴ This ability is given by lenders' capitalisation.

¹⁵ Overcollateralisation relates to the collateral value, which, under the present regulations, can be determined as the estimated market value of the real estate used as collateral. Depending on the degree of overvaluation of house prices, a loan may also be undercollateralised with respect to the equilibrium value of the collateral.

targeted at real estate exposures in current international practice (see Table V.4 in section 5.4.1 of this Report).¹⁶

If the main risks identified are associated with borrowers' debt servicing capacity, the primary tool used to mitigate them is LTI/DTI or LSTI/DSTI limits. These can also be used to enhance the effectiveness of LTV limits. A combination of LTV and LTI/DTI or LSTI/DSTI caps will restrict the volume of loans that have simultaneously high PD and LGD levels. If the caps are defined as soft limits, moreover, the introduction of LTI/DTI or LSTI/DSTI caps will not necessarily lead to any significant additional restriction on the total volume of new loans above that given by the LTV limits, because lenders will probably decide initially to restrict those loans which exceed the caps on all the chosen credit ratios simultaneously (an illustrative example of such a case is given in section 6.5), thereby minimising the impacts of the additional measures. This can therefore be a more effective risk mitigation technique than tightening the LTV limits. The important question in such a situation is which income ratio to use.

LSTI/DSTI caps can reduce the probability of borrowers being unable to service loans continuously in accordance with their chosen repayment schedule. LTI/DTI caps can lower the probability of them failing to repay loans in full over their remaining period of economic activity (i.e. even after the loan has been restructured and the repayment schedule changed). LTI/DTI caps may be appropriate when the constraints created by the LSTI/DSTI cap are softened by a lengthening of the repayment term or by low interest rates. As LTI/DTI caps do not work with components that can give the impression of a sustainable level of debt service in the short term (LSTI/DSTI), they can slow the pace at which consumers become overindebted in real terms.

The CNB prefers the DTI ratio to the LTI ratio. The DTI ratio better captures the risks associated with borrowers' debt servicing capacity, because it takes their overall debt into account. In addition, it averts the problem of LTI and LTV limits being circumvented through the provision of unsecured loans and can thus also enhance the effectiveness of LTV limits. However, the CNB only has

information on new loans, not on the total debt of applicants for such loans. For this reason, data on the LTI ratio are used to determine the risky levels in section 6. The DTI ratio is meanwhile always equal to or higher than the LTI ratio for individual borrowers. Further loans in excess of the secured loans contained in the LTI ratio, i.e. higher DTI ratios, imply higher debt service costs and a higher risk of default at the same level of income in the event of economic stress. In addition, the same DTI levels among one set of borrowers are usually just as risky, if not more so, as the same LTI levels among other borrowers with similar income. This is because the total debt from which the DTI ratio is calculated can have a different loan structure than the loans considered for the LTI ratio. Specifically, the total debt can contain unsecured loans in place of a proportion of secured ones. Unsecured loans typically have higher interest rates and shorter repayment terms than secured ones. Total debt can therefore imply higher debt service for a borrower than a secured loan of the same amount. Higher debt service in turn implies a higher risk of default at the same level of borrower income. One can therefore regard DTI levels equal to or lower than those determined on the basis of LTI data as risky. Likewise, the CNB prefers the DSTI ratio to the LSTI ratio; here again, the DSTI ratio is always equal to or higher than the LSTI ratio for individual borrowers.

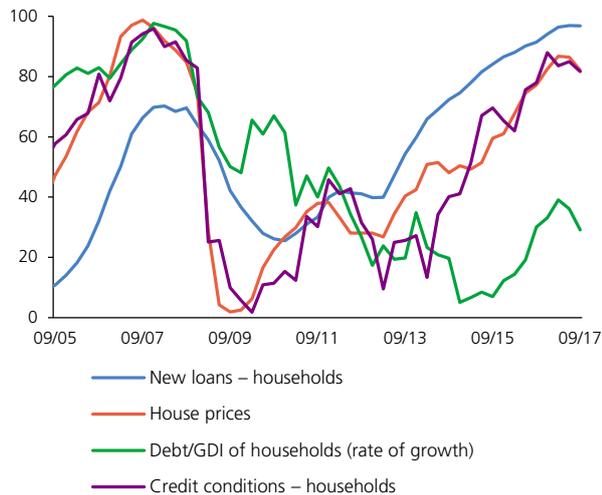
In its decisions on the introduction and calibration of macroprudential tools, the CNB considers the cyclical position and structural characteristics of the financial sector and the real economy. The cyclical position has a significant bearing on the timing of the introduction and withdrawal of these tools and on their calibration. The financial cycle indicator (Plašil et al., 2014; see Chart 1) is a useful measure for estimating the cyclical position of the Czech economy. Structural characteristics – especially the size of exposures secured by residential property in lenders' balance sheets – are a key factor in deciding whether existing or emerging risks may take on a systemic scale for the financial sector and whether the CNB therefore needs to apply its powers to ensure financial stability.

¹⁶ A total of 16 EU countries were using macroprudential tools targeted at real estate exposures as of the end of 2017. Fifteen of them were using LTV caps. The first EU country to introduce LTV caps was Lithuania in 2007. Such limits were applied even earlier in Hong Kong in 1997. The effectiveness of this instrument in reducing systemic risks associated with the cyclicity of house prices is documented by, for example, Wong, E., et al. (2011): *Loan-to-value ratio as a macroprudential tool – Hong Kong's experience and cross-country evidence*, Hong Kong Monetary Authority.

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CHART 1

COMPONENTS OF THE FINANCIAL CYCLE INDICATOR RELATING TO PROPERTY MARKETS AND LOANS TO HOUSEHOLDS (%)

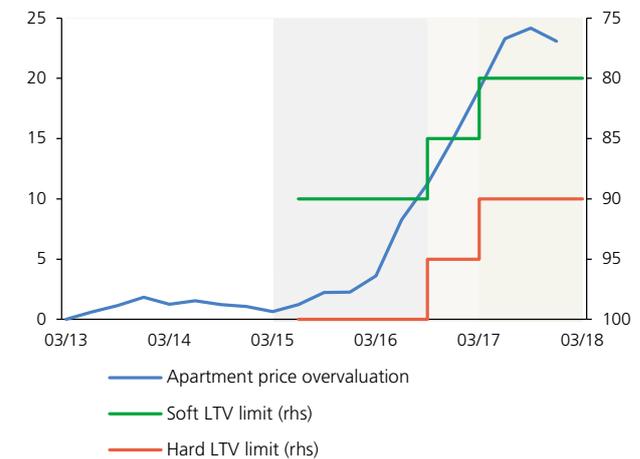


Source: CNB

Note: GDI stands for gross disposable income. Credit conditions applying to households are quantified as the spread between interest rates on loans to households and the PRIBOR.

CHART 2

DIFFERENCE BETWEEN GROWTH IN APARTMENT PRICES AND INCOMES AND LTV LIMITS SET IN THE CNB RECOMMENDATION (overvaluation in %; rhs: LTV in %)



Source: CZSO, CNB, CNB calculation

Note: Difference between growth in apartment prices and incomes since 2013 Q1, when apartment prices last hit a low. This indicator of apartment price overvaluation assumes that prices were at equilibrium at the low point. This is a cautious assumption, because prices might have been undervalued at that point and hence may not reverse their entire growth in the event of stress. The grey areas indicate, respectively, the phases of the entry into force and tightening of the recommended LTV limits in the CNB's June 2015 and June 2016 Recommendation on the management of risks associated with the provision of retail loans secured by residential property.

6. ILLUSTRATIVE CALIBRATIONS

The aim of the calibration is to restrict loans with LTV, DSTI and DTI levels that could lead to credit losses that would not be absorbed by lenders' capital. However, the potential losses that would be generated by a sustained spiral between house prices and house purchase loans are hard to estimate. For this reason, the CNB determines risky credit ratio levels on a relative basis. This approach involves seeking the thresholds at which the risk of default or the loss rate starts to increase substantially. Higher LTV levels (i.e. lower collateralisation) almost always imply a higher loss given default. For the DSTI and DTI ratios, the probability of default depends on a whole range of factors, such as the borrower's income and age, the nature of the household and the probability of loss of income. The illustrative determination of risky LTV, DSTI and DTI levels in sections 6.1–6.3 draws on granular data on loans secured by residential property provided by banks in the second half of 2017.

6.1 LTV

The determination of risky LTV levels is derived from the method used by lenders to determine collateral value. Under the regulations currently in force, the collateral value can be determined as an estimate of the market price of the property¹⁷ and can thus contain the cyclical component of such prices.¹⁸ To determine risky LTV levels, the CNB therefore primarily monitors the estimated overvaluation of house prices (see Chart 2). This determines the degree of overcollateralisation needed to restrict the credit losses given default and given a decline in house prices. The degree of overcollateralisation is equal to $(100\% - LTV)$. The risky LTV levels (LTV_R) are thus given by:

$$LTV_R \geq 100\% - \text{overvaluation} \quad (3)$$

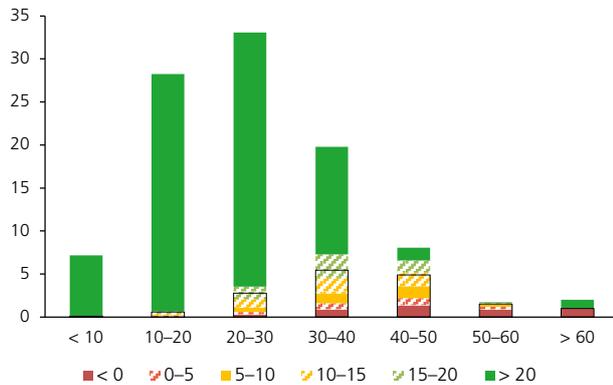
¹⁷ See Articles 124(1) and 229(1) of the CRR.

¹⁸ In Article IV(4) of the Recommendation, the CNB therefore states: "Lenders should apply a conservative approach to determining the value of collateral for the purposes of calculating LTV and take the risk of house price overvaluation into account".

CHART 3

DISTRIBUTION OF LOANS BY LSTI AND FINANCIAL RESERVE UNDER STRESS

(x-axis: LSTI in %; y-axis: share of loans in %; reserve in % of net income; 2017 H2)



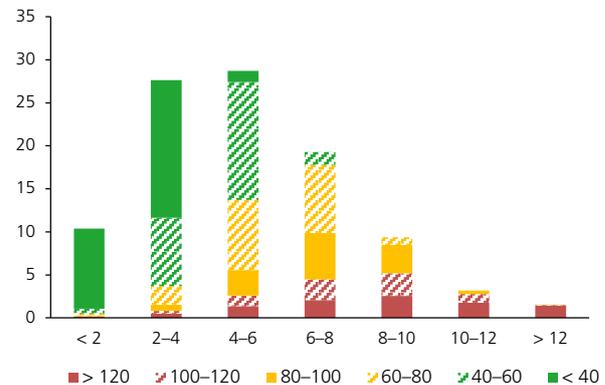
Source: CNB

Note: Risky LSTI levels are determined using the financial reserve under stress for individual new loans reported in the Survey. Risky LSTI levels are those for which a significant proportion of new loans have a reserve below the threshold. Those loans are indicated with a frame.

CHART 4

DISTRIBUTION OF LOANS BY LTI AND RATIO OF THE LOAN PROVIDED TO THE HYPOTHETICALLY REPAYABLE LOAN UNDER STRESS

(x-axis: DTI in %; y-axis: share of loans in %; ratio in %; 2017 H2)



Source: CNB

Note: Risky LTI levels are determined using the hypothetically repayable loan under stress (the loan size with the longest permissible maturity and the highest permissible ratio of instalments to income) for individual new loans reported in the Survey, which is compared with the actual loan size. Risky LTI levels are those for which a significant proportion of new loans exceed the hypothetically repayable level.

6.2 DSTI

The CNB determines risky DSTI levels using the concept of the *financial reserve under stress* (FRs):

FR_s

$$= \text{net income}_s - \text{other living costs} - \text{loan repayments}_s - \text{prop. maintenance costs} \quad (4)$$

This reserve denotes the consumer's net income minus the subsistence level, loan repayments and property maintenance costs under the simulated stress (the variables in Equation (4) subject to the stress are indicated by the subscript "s"). Subsistence costs are based on the values set by the Ministry of Labour and Social Affairs for the first and other persons in the household and take into account the number of borrowers and their dependants for loans reported in the Survey. The true repayments of these loans are used as the loan repayments. Property maintenance costs are set at 1.5% of the collateral on these loans per year. The stress consists in a 10% decrease in income – expressing the probability of loss of employment or a drop in income for a certain period of time – and a steady rise in interest rates of 0.6 pp a year for five years (i.e. a cumulative increase of 3 pp). The impact of the interest rate stress respects the fixation and repayment periods of the individual loans reported in the Survey. So, if the loan has a fixation period of five years, the interest rate increase will happen all at once in the fifth year and will affect subsequent instalments only up to the amount of the

unrepaid part of the principal. If such a loan has a maturity of five years, the rise in interest rates will not affect it at all. FR_s levels lower than the financial reserve threshold (FR_{TH}) are deemed risky. The CNB applies a threshold of 10% of net income,¹⁹ or CZK 5,000. The requirement for a minimum absolute FR_s serves to cover sudden necessary expenditures, which to some extent are independent of income level. This test is always conducted on a sample of newly provided loans reported in the Survey on the basis of the calculation of LSTI ratios for individual loans.²⁰ The share of loans provided in 2017 H1 for which FR_s falls below the reserve threshold (and those loans thus have excessive LSTI levels) increases significantly for loans with an LSTI ratio above 40% (see Chart 3). Such loans are currently regarded as risky.^{21,22}

19 Threshold of 10% is roughly the average long-term household saving rate observed in the Czech Republic. CZK 5,000 is 10% of the average income documented by applicants for new loans (according to the Survey).

20 The CNB has information only on new loans, not on the total debt of applicants for such loans. For this reason, the risky levels are determined on the basis of data on LSTI ratios, not DSTI ratios.

21 Other macroprudential authorities have arrived at similar figures (see, for example, https://www.esrb.europa.eu/national_policy/shared/pdf/overview_macroprudential_measures.xlsx).

22 Given the different levels of house prices in relation to income in various regions of the Czech Republic, the riskiness of loans with a given LSTI level – like that of loans with a given LTI level in section 6.3 – differs slightly across those regions. Under the methodology presented here, however, these loans are regarded as risky in all regions.

6.3 DTI

To determine risky DTI levels, the CNB uses the concept of the hypothetically repayable loan under stress (HRL_S):

$$\text{HRL}_S = \frac{(1 - \text{FR}_{\text{TH}}) \cdot (\text{income}_S - \text{property maintenance costs} - \text{other necessary costs})}{\text{max maturity}} \quad (5)$$

HRL_S represents the biggest loan the consumer would be able to service over the longest possible maturity if her monthly repayments were at the maximum possible level. After paying such instalments, the consumer would be left at the financial reserve threshold (FR_S = FR_{TH}). The consumer's remaining period of economic activity up to the age of 65, or 30 years, whichever is the shortest, is taken as the longest possible maturity.

The HRL_S of individual consumers are compared with the size of the loans actually provided to them. The CNB thus monitors the share of loans (L) which are larger than those which consumers would, under stress, be able to service over their period of economic activity (L > HRL_S or also L/HRL_S > 100%). This test is again conducted on a sample of newly provided loans reported in the Survey on the basis of the calculation of LTI ratios for individual loans. The share of loans provided in 2017 H1 with L > HRL_S increases significantly for loans with an LTI ratio above 8 (see Chart 4). Such loans are therefore currently regarded as risky.

6.4 Relationship between DSTI and DTI limits

It is apparent from the HRL_S expression that determining DTI limits is quantitatively equivalent to determining DSTI limits and maximum maturity. This is because DSTI limits perform the function of regulatory maximum instalments in relation to income in the HRL_S expression:

$$\text{HRL}_S = \text{max maturity} \cdot \underbrace{(1 - \text{FR}_{\text{TH}}) \cdot (\text{income}_S - \text{property maintenance costs} - \text{other necessary costs})}_{\text{maximum debt service}} \quad (6)$$

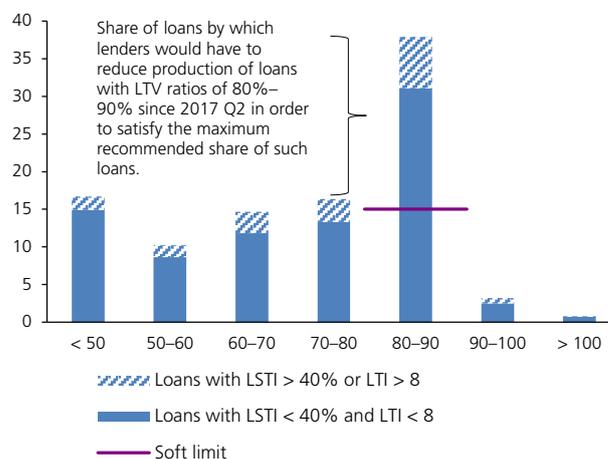
The determination of risky DTI levels using findings about risky DSTI levels guarantees that the resulting risky DTI levels take into account the level of interest rates and the possibility of rates increasing, even though the DTI ratio does not contain this information directly.

6.5 Example of parallel use of multiple instruments

The CNB set quantitative LTV limits in its June 2015 Recommendation. The June 2016 Recommendation introduced a phased tightening of these limits. As from

CHART 5

DISTRIBUTION OF NEW LOANS BY LTV, LTI AND LSTI IN 2017 Q1
(x-axis: LTV in %; y-axis: share of loans in %)



Source: CNB

2017 Q2, it is recommended that loans with LTV ratios of 80%–90% should account for no more than 15% of the volume of new loans per quarter. In 2017 Q1 (i.e. before the latest tightening of the LTV limits entered into force), such loans accounted for 30% of credit production. The June 2017 Recommendation subsequently stated that lenders should be particularly cautious when providing loans with DSTI ratios of over 40% or DSTI ratios of over 8, especially within the permitted 15% of the volume of loans with LTV ratios of 80%–90%. Loans exceeding the aforementioned levels for at least one of the ratios have accounted for around 15% of credit production for as long as the Survey has been conducted. In 2017 Q1, roughly half of these loans had LTV ratios above 80% (see Chart 5).

It can be illustrated using this example that the introduction DSTI or DTI limits in excess of the LTV limits would not necessarily imply any further significant constraints on the total volume of loans provided, but would only enhance the credit characteristics of those loans. Take, for example, DSTI or DTI caps imposed on top of the existing soft LTV limit (i.e. an LTV cap of 90% and an aggregate LTV cap of 80% with 15% of credit production permitted to exceed that level). If, for example, the caps were set at 40% and 8 respectively, with loans having ratios in excess of these levels allowed to account for no more than 5% of credit production, lenders would probably have reacted as follows during the most recent tightening of the LTV limits. They might have first reduced the share of loans with LTV ratios of 80%–90% by 7 pp by restricting the provision of loans with higher DSTI/DTI levels, because in the process of

reducing the volume of loans in response to the tighter LTV limits they would thus have directly fulfilled these hypothetical DSTI/DTI limits. The permitted 5% of credit production would have roughly covered the remaining 8% of the volume of loans with LTV ratios below 80% that were provided with LSTI ratios above 40% or LTI ratios above 8.²³

7. CONCLUSION

The CNB assesses risks associated with exposures secured by residential property by evaluating the degree of overvaluation of house prices, the easiness of credit standards and the evolution of new loans. Overvalued prices and easy credit standards are indicators of the riskiness of new loans. Together with the volume of new loans, they indicate the total size of the risks associated with the provision of new loans.

LTV caps can limit loss given default, while DTI or DSTI caps can reduce the probability of default. DSTI caps can reduce the probability of default with respect to the chosen repayment schedule, while DTI caps can reduce the probability of borrowers failing to repay over their remaining period of economic activity (i.e. even after the loan has been restructured). Nonetheless, the caps themselves cannot substitute for financial institutions' internal risk management systems or for individual supervisory work (nor are they intended to). Likewise, they cannot substitute for borrowers' own responsibility and realistic estimation of their future debt servicing capacity.

The CNB determines risky LTV levels on the basis of the estimated overvaluation of house prices, taking into account the share of loans with currently risky DSTI and DTI levels. It determines risky DSTI and DTI levels using the concepts of the financial reserve under stress and the hypothetically repayable loan under stress respectively. To do so, it uses anonymised data on all newly provided loans. In order to respond to emerging risks in a preventive and timely manner, the CNB monitors the DSTI and DTI thresholds at which the probability of default increases significantly. The results of this analysis could be used to set caps on both ratios.

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²³ Owing to data unavailability, the ratios presented here (as in the previous subsections) relate to newly provided credit (LTI/LSTI), not total debt (DTI/DSTI).