

# Thematic Article on Financial Stability ——— 1/2022

Setting the upper LTV limit at the CNB

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Czech National Bank ——— Thematic article on financial stability ——— 1/2022

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## SETTING THE UPPER LTV LIMIT AT THE CNB

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*This article presents the CNB's approach to setting the LTV limit. It recalls the main objective of applying this macroprudential instrument – to increase the resilience of domestic mortgage lenders – and summarises the positive and undesirable side-effects associated with calibrating the limit, changing it, and timing its introduction. The main part of the article employs a set of macrofinancial scenarios to analyse the effect of variously stringent LTV limits on property prices and credit losses. The aim is to find the optimum LTV limit, that is, the one which strikes the right balance between making the Czech financial system sufficiently resilient to risks stemming from the mortgage market and minimising the potential negative effects associated with applying the instrument. The analyses reveal that an LTV limit of 80%–85% appears to be optimal in a situation of large excess demand for property. Limits below 80% do not contribute significantly to increasing the resilience of domestic mortgage lenders and do not have a countercyclical effect on domestic residential property prices.*

### I. INTRODUCTION

An amendment to the Czech National Bank Act extending the CNB's power to set legally binding LTV limits took effect on 1 August 2021.<sup>2</sup> The Act does not regulate the specific level of the limit but provides that it be set in relation to the identification of systemic risks associated with the provision of consumer loans secured by residential property.<sup>3</sup> At least once every six months, the CNB must carry out a review of the current limit and, where necessary, may change it or completely cancel it. When making its decision, the CNB is required to take account of fundamental changes in the expected evolution of a set of macrofinancial factors defined in the Act.

The European Systemic Risk Board has also recommended that EU Member States apply an LTV limit as a macroprudential instrument (see 1 in ESRB, 2013). According to the ESRB recommendation, the macroprudential authority of the relevant country should use this instrument to mitigate excessive credit growth undertaken by institutions, especially in the expansionary phase of the credit cycle. The LTV limit should lower banks' vulnerability to credit risk by reducing the amount of mortgage loans with excessively risky characteristics and should additionally increase banks' resilience by reducing credit losses in the event of default. According to the ESRB recommendation, this instrument is effective at the individual country level,<sup>4</sup> but its application is not harmonised across the EU. The decision on whether to apply the LTV limit statically (at the same level across the credit cycle) or in a time-varying way (depending on the phase of the credit cycle) therefore remains within the competence of the Member States' authorities. Likewise, when setting LTV limits, individual countries can decide autonomously whether to apply different approaches to mortgage loans for first-time buyers and other clients, for the purchase of property in particular towns only, for different applicant age categories and so on. When applying the instrument, emphasis should be placed on its effectiveness in achieving its objectives and its efficiency in doing so at minimum total cost to the economy. In this regard, it is recommended to combine macroprudential policy instruments. Specifically for the LTV limit, mention is made of applying it in parallel with limits on income-based credit ratios (LTI/DTI or LSTI/DSTI)<sup>5</sup> or the countercyclical and/or sectoral capital buffer.

Following the adoption of the amendment to the CNB Act and the aforementioned ESRB recommendation, the need arises to raise public awareness of the CNB's decision-making process for setting the specific LTV limit. This will help enhance transparency and predictability in the area of macroprudential policy. This article sets out to describe the principles applied in setting the upper LTV limit in more detail, to explain the main objective of applying the limit and to document its positive and negative side-effects. The list of potential impacts should help give the public an insight into how the CNB views the

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<sup>2</sup> Article 45b(1) of [Act No. 6/1993, on the Czech National Bank](#). Article 45a(5) of the Act defines three credit ratios: (i) the ratio of the consumer's total debt arising from consumer loans secured by the same residential property to the value of the collateral (the LTV ratio), (ii) the ratio of the consumer's expenditure arising from the consumer's total debt to the consumer's income (the DSTI ratio), and (iii) the ratio of the consumer's total debt to the consumer's income (the DTI ratio).

<sup>3</sup> Unless specified in more detail in the text, property refers to residential property and mortgage loan refers to a consumer loan secured by residential property.

<sup>4</sup> The LTV limit should be less prone to regulatory arbitrage that shifts business abroad or to the shadow banking system (ESRB, 2013).

<sup>5</sup> LTI (DTI) refers to the ratio of the size of the loan (debt) to the mortgage applicant's net income. LSTI (DSTI) refers to the ratio of the amount of debt service associated with the loan (debt) to the mortgage applicant's net income.

LTV limit in analytical and methodological terms, what factors it considers when deciding on its level, and what approach to calibration it regards as optimal.

The article is structured as follows. Section II takes a brief look at the application of LTV limits in the countries of the European Economic Area (EEA). Section III describes the objective and main potential effects of introducing the instrument. Section IV examines the impacts of LTV limits on the residential property market and the mortgage market and analyses the potential losses of the banking sector in various scenarios with various LTV limits. Section V looks at the implications of these analyses for the optimum configuration of the LTV limit. The final section summarises the main conclusions.

## II. APPLICATION OF LTV LIMITS IN EUROPE

LTV limits were applied in 23 countries of the EEA as of December 2021.<sup>6</sup> Owing to the institutional differences across these countries and their different positions in the credit cycle, the limits lay in a wide range of 35%–100%. National authorities set limits depending mainly on the specific loan type and the nature of the collateral. Substantially lower LTV limits are applied to loans for the purchase of second and subsequent residential properties, loans secured by commercial property, loans in foreign currencies, loans for buy-to-let purposes and loans for other properties in areas with high property prices. By contrast, the LTV limits for domestic currency mortgage loans for first-time buyers for owner-occupied purposes range between 80% and 100%. High levels within this range and exemptions from the limits often apply to loans falling under various government programmes.

The approaches to setting LTV limits vary across the EEA countries. It would appear from the countries' behaviour during the coronavirus pandemic that most of them regard LTV limits primarily as a structural measure, that is, a measure which ensures that institutions lend with sufficient prudence (and hence preserves the resilience of the financial system) over the entire credit cycle. All the countries were hit by significant market uncertainty and a deep economic decline during the coronavirus pandemic, but only two of them relaxed their LTV limits in this period. Before the pandemic, a time-varying approach to setting LTV limits was partially applied, although this was probably done in order to gradually reach a target level rather than to automatically link the limit to preselected macrofinancial indicators reflecting the current credit cycle or the property market situation. A number of international studies have found that the introduction of LTV, DTI or DSTI limits can in certain circumstances curb excessive growth in leverage and, to some extent, property prices (for example, Jácome and Mitra, 2015; Cerutti et al., 2015; Tressel and Zhang, 2016, 2017; Shim and Kuttner, 2016; Zhang and Zoli, 2016; Vandenbussche et al., 2015). In advanced economies, however, relaxing these limits in a period of stress has not been found to have a significant effect on the said variables. This conclusion may have been affected to a large extent by the low number of crises and recessions in the sample examined. The period of frequent application of LTV limits as a prudential instrument in the EEA is not yet long enough to make a robust conclusion on the preferred approach to setting them. Moreover, there were no major shocks to financial systems during the coronavirus pandemic. On the contrary, property prices and household leverage in the EEA increased on the whole, as a result of low interest rates and other financial benefits (such as tax cuts affecting the net disposable income of households; Frait and Malovaná, 2021).

The authorities of EEA countries have tended to talk in only general terms in their communications on the impacts of introducing or changing LTV limits on macrofinancial conditions. The expected extent of the slowdown or acceleration in credit activity resulting from a change in the configuration of the instrument – like the foreseen size of the fall or rise in household leverage and property prices – thus tends not to be published, and it is not even clear what methods are used to study the impacts of changes in the limits in individual countries.<sup>7</sup> A review of the macroprudential instruments applied in the member countries in the period under review (ESRB, 2021)<sup>8</sup> merely reveals that the authorities of those countries follow the ECRB recommendations and prefer to use a mix of various macroprudential instruments to achieve their objectives effectively. Most of the countries applying an LTV limit simultaneously also use a DSTI limit, and several others also apply a DTI/LTI limit or capital buffers.

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<sup>6</sup> Austria, Belgium, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Hungary, Iceland, Ireland, Latvia, Lichtenstein, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia and Sweden; see [National measures of macroprudential interest in the EU/EEA](#).

<sup>7</sup> Although curbing excessive growth in household debt, mortgage loans and property prices tends to be mentioned most frequently in the justifications for introducing or reducing LTV limits, explicit quantifications of the impacts and descriptions of the method used to determine them are the exception rather than the rule: [New instruments are needed to rein in household debt](#), [The Swedish Mortgage Market 2013](#).

<sup>8</sup> [National measures of macroprudential interest in the EU/EEA](#).

### III. THE OBJECTIVE AND EFFECTS OF INTRODUCING AN LTV LIMIT

The purpose of collateral is to give the lender sufficient protection against the risk of credit losses if the borrower is unable to repay the loan in full. The global financial crisis nonetheless revealed that under certain circumstances, systemic risk can increase against a background of idiosyncratic individual borrower risk seemingly covered by collateral.<sup>9</sup> However, lenders are not necessarily capable of fully recognising that risk and hence adequately assessing it and reflecting it in their risk premia. In a situation of a significant economic slowdown and high financial stress, the financial system as a whole may thus not be sufficiently resilient. Macroprudential authorities should therefore react to potential threats to financial stability by deploying instruments such as upper LTV limits.

From the CNB's perspective, the main objective of having a binding LTV limit is to limit systemic risk by enhancing the resilience of mortgage lenders. In addition to the primary objective, introducing or changing LTV limits can also contribute to the stability of the financial system through positive side-effects even though the use of the instrument is not primarily targeted at achieving them. The CNB is meanwhile aware that when deciding on the LTV limit, it also needs to take account of cases where inappropriate calibration or an inappropriately timed change to the limit could have adverse consequences for the financial system and the real economy (see Table 1). For the sake of clarity, the main channels leading to increased resilience and accompanying positive and negative effects are analysed in more detail below.

**Table 1: Objective and consequences of introducing an LTV limit**

<b>Primary objective: To increase the resilience of mortgage lenders</b>	
<b>Potential side-effects of applying the instrument</b>	
+	restriction of excessive growth in mortgage loans
+	restriction of excessive risks in lenders' balance sheets by cutting off funding to highly risky households
+	a reduction in household leverage and an improvement in other risk characteristics of mortgage loans
+	an increased incentive for households to repay loans by requiring them to part-finance property purchases
–	frontloading, in the sense of increased borrowing by households with risky characteristics in the period between the announcement and the date of effect of the LTV limit
–	a surge in excessive property price growth in a situation of low property supply
–	less affordable housing for a potentially large proportion of households over a long period of time
–	households using their financial reserves for down payments, leading to them being more sensitive to future drops in income
–	greater property price volatility in the event of default on loans secured by multiple properties pledged as collateral
–	a reduction in consumption through an increase in some households' propensity to save in an effort to make down payments

Source: Authors, with partial use of ESRB (2014)

A prudent LTV limit gives mortgage lenders greater certainty that the loan will be repaid in full in the event of default, as the sale of the collateral will enable them to cover the outstanding amount even if the price trend on the property market reverses and prices start to fall back to sustainable levels across the board. Such a limit also enables lenders to cover the administrative expenses associated with collateral enforcement and debt recovery. In addition, introducing an LTV limit can contribute to reducing the liquidity risk associated with property pledged as collateral, as it increases the probability of a quick sale because banks can satisfy their claims where necessary by reducing the selling price without incurring additional losses. This means that a prudently set LTV limit can help to minimise credit losses over the financial cycle (see section IV) and increases banks' resilience to property price shocks.

Besides minimising credit losses on mortgage portfolios, the introduction of an LTV limit can indirectly increase lenders' resilience by reducing the amount of mortgage loans bearing increased risks at loan origination. The existence of an LTV limit in combination with other instruments limits the ability of individuals with highly risky profiles to apply for mortgage loans, which in turn can suppress excessive credit growth. The part-financing requirement also increases the incentive for borrowers to repay mortgage loans properly, because if they default they could lose not only the property, but also the money they put into the purchase. Mortgage lenders are exposed to lower loan delinquency rates as a result of these factors.

In certain circumstances, however, applying an LTV limit can potentially have unintended negative effects, some of which could have a long-term structural impact on the entire economy. Frequent changes to upper LTV limits could to some extent make the market environment less predictable and impede long-term planning by mortgage lenders and applicants.

<sup>9</sup> Systemic risk may increase in its cyclical component if market agents live in the illusion of constantly rising property prices and collectively underestimate the related risks. This is associated primarily with relaxation of LTV ratios and overoptimistic collateral valuation. Nonetheless, the cross-sectional (structural) component of the risk can also grow if exposure to the property market gradually increases across the entire financial system amid rising leverage of sectors of the economy.



A systemically less significant but visible potential effect of changing the LTV limit is “frontloading risk”. This is a situation where some mortgage lenders, fearing a loss of market share or profit, start to provide mortgage loans in the period between the announcement and the date of effect of the LTV limit to risky applicants who would not be able to meet the new limit. As a result, these lenders may be more vulnerable, because they are potentially exposed to the risk of higher loan delinquency in the future.

Another potential unintended consequence of having too low an LTV limit is that it can make credit for property financing unaffordable for quite a wide range of households. Among other things, this could change the structure of property owners in the economy in favour of non-residents or institutional investors and make property prices more sensitive to adverse economic shocks.<sup>10</sup> An LTV limit that is too low can also potentially have an impact on the size of applicants' financial reserves, as it may force them to spend all their savings on down payments to meet the limit. This may reduce their ability to bridge potential drops in their income when repaying the loan (for example as a result of loss of employment or a sizeable decrease in earnings) and increase their sensitivity to economic downturns. In the case of people with low initial financial reserves, an overly high down-payment requirement could temporarily increase their propensity to save and reduce their consumption or lead them to take on additional or even excessive debt in order to maintain their existing level of consumption. They may also try to adjust to the LTV limit by using more than one property to collateralise mortgage loans. If this form of adjustment were to predominate on the mortgage market, the enforcement of collateral on loans in default could necessitate the sale of many more properties. This could contribute to greater property price volatility, especially during a crisis.

A less intuitive but potentially serious consequence of an upper LTV limit, especially if it is inappropriately calibrated, is that in certain circumstances it can foster further growth in property prices. This situation, which runs contrary to the original objective of macroprudential policy, can occur when property is in short supply and when a reduction of the LTV limit would go significantly beyond mortgage lenders' existing practices and would thus in fact mean tighter lending conditions on the market (see section IV). Given the downward rigidity of property prices in such a situation, this could make housing less affordable for a larger group of households for longer. As growth in property prices usually feeds through to the level of rents, a tightening of the LTV limit could also have a broad impact on the rental market and tenants.

## IV. THE EFFECT OF LTV LIMITS ON SELECTED VARIABLES

This section examines the effect of LTV limits on property prices and credit losses. Macroprudential authorities often refer to property price growth in the context of introducing or changing this instrument, while the size of credit losses relates directly to the main objective of the existence of a regulatory limit. Both property prices and credit losses are meanwhile easy to measure and interpret, and the impacts of various LTV limits on each of them can be investigated using relative simple structural models.<sup>11</sup> The parameters of these models have an intuitive interpretation and make it possible to conduct a sensitivity analysis of the impacts on a wide range of scenarios.

### IV.1 THE EFFECT OF LTV LIMITS ON PROPERTY PRICES

The concept of borrowing capacity (Andrle and Plašil, 2019a,b) is used to assess the effect of LTV limits on property prices. This concept is based on the assumption that properties are purchased primarily by liquidity-constrained households who have to use mortgage loans in addition to their own funds in order to finance property purchases. It is also assumed that this type of household has a significant influence on prices in the property market.<sup>12</sup> When buying property, households try to obtain the largest possible loan subject to prudential limits on debt service and total debt, flexibly adjusting the required down payment to the attainable loan where possible. The sum of the attainable loan and the down payment determines the maximum safely affordable property price.

Applications to real data show that the assumptions of the borrowing capacity model are fairly realistic in practice and that the safely affordable property price determines the long-run behaviour of transaction prices. Affordable property prices meanwhile represent the lower bound on market prices. This means that in some periods, households become less prudent and, on average, buy properties at higher prices than those consistent with their safe borrowing capacity. By contrast, purchasing below the safely affordable level is very seldom seen on the housing market. Efforts by households to reach

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<sup>10</sup> Foreign investment funds and banks are highly sensitive to global asset price movements and often cause cross-border transmission of large market swings.

<sup>11</sup> The aim of these models is not to determine the exact size of the impact but to provide sufficient economic intuition and a general idea of the possible effects of applying an LTV limit in various property and mortgage loan market conditions and in a wide range of macrofinancial scenarios.

<sup>12</sup> In simple terms, this assumption says that the proportion of properties bought with the aid of mortgage loans is so large that it can influence property prices at any given level of supply and demand on the market.

for the largest possible loan are confirmed by surveys (cf. CMHC, 2018). Property developers themselves say that any growth in the borrowing capacity of households passes through quickly to market prices (see, for example, the “Help to Buy” programme in the United Kingdom; Collison, 2017; Hammond, 2019).

Under the aforementioned assumptions, the affordable price,  $P_t$ , can be expressed as the attainable loan,  $L_t$ , plus the down payment,  $D_t$ , or as the inverse of the LTV limit times the attainable loan:

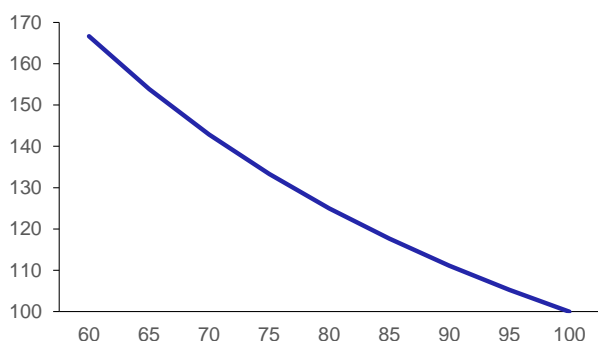
$$P_t = L_t + D_t \equiv \frac{1}{LTV_t} \times L_t \equiv f(Y_t, i_t; LTV_t, DSTI_t, DTI_t, N_t). \quad (1)$$

The affordable price,  $P_t$ , is a function of households’ disposable income,  $Y_t$ , interest rates on new mortgage loans,  $i_t$ , the average mortgage maturity,  $N_t$ , and the LTV, DSTI and DTI limits.

Equation (1) implies that the affordable property price increases as the LTV ratio decreases<sup>13</sup> (see Chart 1). The effect of this parameter is non-linear – affordable property prices go up increasingly quickly as the LTV ratio falls. For quantifying the effect of a regulatory upper LTV limit on property prices, however, this view is highly simplified. This is mainly because of the potentially limited flexibility of many households to put together the necessary down payment and move up the curve in a short period of time.<sup>14</sup> Anecdotal evidence suggests that households try hard during the expansionary phase of the cycle to obtain the necessary down payment and meet the tighter regulatory LTV limit, but even so, a sizeable reduction in the LTV limit may force some households to adjust the loan size and buy a cheaper property.<sup>15</sup>

**Chart 1 Theoretically affordable property price for various LTV limits**

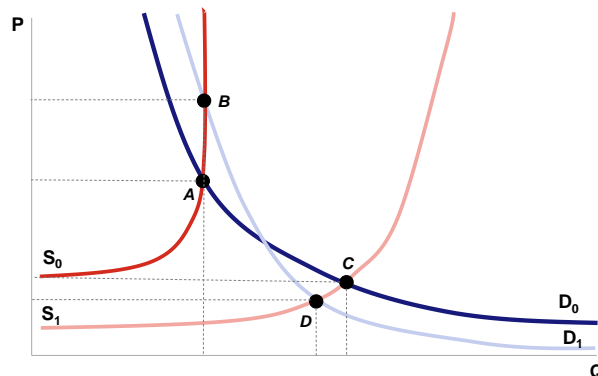
(x-axis: LTV in %, y-axis: price, price for 100% LTV = 100)



Source: Authors

**Chart 2 Demand for property from the perspective of affordable prices and market equilibrium**

(x-axis: quantity supplied and demanded; y-axis: property prices)



Source: Authors

How a reduction of the regulatory LTV passes through to property prices depends on the rate of adjustment of households to the new limit and on the current supply and demand situation on the property market. The logic of the following analysis is described schematically in Chart 2, which shows stylised demand ( $D_0$ ,  $D_1$ ) and supply ( $S_0$ ,  $S_1$ ) curves for the property market.<sup>16</sup> The starting point for the analysis is the demand curve  $D_0$ , which shows the quantity demanded ( $Q$ ) from the perspective of affordable prices ( $P$ ). If property prices are very low, a large proportion of households will be able to afford them and the quantity demanded will be high. As property prices rise, though, the effective demand will be created solely by higher income groups and the quantity demanded will fall. At very high prices, only households in the highest income percentiles will be able to afford to buy property.

<sup>13</sup> The impacts of changes in other limits on the affordable property price are described in more detail in Andrlé and Plašil (2019a,b).

<sup>14</sup> Account should also be taken of the initial difference between mortgage lenders’ internal LTV limits and the binding regulatory limit. If, for reasons of prudential risk management, lenders apply sufficiently stringent upper LTV limits themselves, the introduction of a binding limit may have no real effect on property prices.

<sup>15</sup> This mainly concerns low-income households with a low propensity to save, often accompanied by low initial financial reserves. Households of young applicants with higher incomes may also have low initial financial reserves, as they may have been unable to create sufficient financial reserves due to their shorter time spent on the labour market.

<sup>16</sup> Although this is a stylised graph, calculations on Czech data show that the main features of the presented demand curves and the way they change in response to a reduction in the upper LTV limit are close to reality. All the analysis in the text that follows is performed ceteris paribus, that is, assuming other variables are constant.

In the event of a reduction in the regulatory LTV limit, the lowest-income groups of households, because of their low (or zero) propensity to save and limited financial reserves, are unable to raise the extra funds they need in a short period of time and therefore have to reduce the size of the loan they take out to the necessary extent. This reduces the affordable property price for low-income groups (curve  $D_1$  falls below curve  $D_0$  in the right-hand part of the chart). However, for higher levels of income, which are accompanied by a rise in the propensity to save and growth in disposable financial reserves, the ability of households to adjust to the lowered limit increases. Households will thus reduce the size of the loan they apply for to an ever decreasing extent. High-income households are thus able to adjust to the reduced LTV limit in a relatively short period of time with no great difficulty. Assuming that households take out the largest attainable mortgage loan, this causes the demand curve for the highest-income groups to shift upwards (demand curve  $D_1$  moves above demand curve  $D_0$  in the left-hand part of the chart).<sup>17</sup>

The final impact of the lowered regulatory LTV limit on property prices then depends on the shape of the supply curve and the point at which it intersects the demand curve. The supply curve  $S_0$  corresponds to a situation of very limited property supply on the market. The quantity supplied is minimal at very low prices and increases naturally as prices go up. Above a certain quantity, it is no longer realistic to supply more properties to the market in a short period of time, and the same quantity continues to be supplied despite an increase in prices (or the supply curve is at least very steep). In this situation, the demand and supply curves intersect in the left-hand part of the chart and lowering the LTV limit would mean a pick-up in transaction prices, with the quantity of properties sold remaining broadly unchanged (shift from A to B). In the short term, the size of the price increase depends on the specific point of intersection of the curves (the extent of supply-side constraints), the degree to and speed at which households adjust to a lower LTV limit, but also the size of the reduction in the LTV limit, with the risk of a sizeable property price increase becoming higher as the extent of the decrease rises.

The situation of sufficient supply relative to demand is captured by the supply curve  $S_1$ . In this case, the supply and demand curve may intersect in an area where the demand curve  $D_1$  has shifted downwards at least temporarily (shift from C to D). That would mean that in addition to enhancing the resilience of mortgage lenders, the lowered regulatory LTV limit would lead to a decrease in property prices and the quantity of properties sold. However, in the expansionary phase of the financial cycle, when the macroprudential authority may be considering a reduction in the LTV limit, markets are mostly characterised by significant excess of demand over supply. Therefore, it is generally not very realistic to expect high property price growth to weaken or the number of transactions to decline (fostering lower growth in loans for house purchase) as a result of a lower LTV limit. On the contrary, there may be a risk of a further escalation of the rapid growth in prices. When considering a significant decrease in the LTV limit, it is therefore prudent to take account of the fact that the new calibration of this instrument could act in a procyclical way amid insufficient property supply. In the absolute extreme case of very limited property supply and rapid adjustment of households, relationship (1) represents the limit on the contribution of the lowered LTV limit to property price growth (see Chart 1).

## IV.2 THE EFFECT OF LTV LIMITS ON CREDIT LOSSES

Loss given default on a mortgage loan occurs when the sale of the collateral does not cover the outstanding principal of the loan. Therefore, the size of credit losses naturally declines as the LTV limit decreases (*ceteris paribus*). The lender would record no loss if the price decrease at the time of the sale was lower than the over-collateralisation of the mortgage loan under the relationship  $(100\% - \text{LTV at the time of the mortgage loan default in } \%)$ . An approach comparing the estimated degree of overvaluation of property prices with the size of over-collateralisation may therefore seem a logical and simple way of setting the regulatory LTV limit. However, in the CNB's opinion, deriving the upper limit on LTV in a mechanistic way on the basis of the rule:  $\text{LTV limit} = (100\% - \text{estimated overvaluation in } \%)$  is not the optimal approach to setting the limit for several reasons.

The estimate of property price overvaluation regularly published by the CNB (Plašil and Andrlé, 2019) does not serve as an estimate of a future price decrease in the short or medium term (Plašil, 2021).<sup>18</sup> Estimating the size of a potential drop in property prices on the basis of the degree of property price overvaluation is in fact quite difficult or even impossible. Other methods may be better suited for this purpose. Although affordable property prices are the lower bound on property transaction prices, this threshold is usually not reached through a fall in prices. In response to an adverse shock, property prices often fall only partially and subsequently stagnate until the fundamental factors recover and affordable property

<sup>17</sup> This holds true assuming that high-income households are forced to adjust as a result of the lower LTV and their naturally applied LTV is not below the newly set limit. In the case of separate property markets for high- and medium-income households (different quality and size of property in individual social groups), higher-income households may also adjust to the stricter limit by moving to a less lucrative market (e.g. smaller apartments), which affects property price growth in that segment.

<sup>18</sup> The prudential approach to determining overvaluation indicates above all how much applicants, on average, must exceed the prudential limits to attain the observed prices given their income and interest rates. From this point of view, the degree of overvaluation in the shorter term mostly indicates the increasing sensitivity of households to adverse shocks and the rising risk of default rather than the size of the price decrease itself.



prices converge back to transaction prices. The price gap thus tends to fully close due to convergence “from below”, i.e. when the growth rate of affordable prices exceeds property transaction price growth.

Moreover, the degree of overvaluation estimated by the CNB model does not take into account expenses associated with debt recovery and collateral enforcement, the total amount of which cannot be fully anticipated either. Even if property prices did fall by the full amount of overvaluation, banks would still suffer a loss due to the administrative expenses incurred. When setting LTV limits, political risk cannot be completely ignored either. This occurs when a large number of borrowers are suddenly unable to repay their mortgage loans due to an adverse shock and governments decide to pass on the financial burden to creditors or the state in an effort to mitigate the social impact of people losing their homes (for more details, see e.g. Frait et al., 2019). Recent experience with the mortgage crises in Ireland and Greece has shown that a suitable way of countering political risk is to maintain a prudent LTV limit even in cases of low (or negative) estimated overvaluation. This is both in view of the favourable effects of this instrument on loan delinquency (cutting off high-risk households from financing, increasing the incentive for households to repay their loans by requiring the use of their own funds), as well as with regard to the weak link between the degree of overvaluation and the size of a future decrease in prices.

However, the key problem of the above-mentioned mechanistic rule for setting the LTV limit is a mismatch between the scope of the instrument, which is applied to new loans only, and the size of credit losses, which are generated across the whole mortgage loan portfolio. If property prices increase over time and loans are duly repaid, the current LTV value for older loans will be lower than at the time of their provision, owing to a gradual decline in the outstanding principal (the numerator of the ratio) and, above all, to a rise in the price of property pledged as collateral (the denominator of the ratio). The current LTV values for older loans may thus represent a sufficient buffer to cover credit losses even in a situation where the selling price at the time of collateral enforcement indeed falls by the entire overvaluation, or even in a situation where the LTV ratio at the time of provision of the loan is assessed as insufficient or risky. Precipitous growth in property prices therefore increases the potential future decline in these prices, which may exacerbate losses on loans provided in the recent past. At the same time, however, such growth helps reduce credit losses on older loans. These two effects tend to balance each other out to some extent, so the final size of credit losses depends on the macrofinancial scenario and the specific level of the upper LTV limit.

For a closer look at this issue, we can use the traditional equation for the calculation of credit losses,  $EL$ :

$$EL = PD \times LGD \times EAD, \quad (2)$$

where  $PD$  is the probability of default (or the default rate in the scenario),  $LGD$  is loss given default and  $EAD$  is the total mortgage exposure at default. The existence of the upper LTV limit is reflected in the final size of the losses especially through the  $LGD$  parameter, and therefore we focus mainly on this parameter in the following text. However, we will also examine other factors using various scenarios and a sensitivity analysis. The scenarios are simplified considerably for the purposes of the analysis. The horizon of all scenarios is set to 25 years.<sup>19</sup> The developments in the first 20 years are the same across all scenarios, so the scenarios differ only in the pace of the expansionary phase of the financial cycle in the last five years. Credit defaults are assumed to occur at the end of the scenario as a result of an adverse shock. The nature of the expansionary phase of the cycle and the subsequent severity of the crisis in terms of the observed default rate can be changed using a set of basic parameters (see Table 2). The price decline in the crisis period is set at 20% in the baseline scenario, which may appear to be a relatively strict calibration given the observed house price developments in the Czech Republic to date. However, the CNB prefers to apply a prudential approach in a situation of low predictability of the potential size of a future price decline (and of the conditions under which it would occur). This approach assumes a slightly higher decline than has historically been observed in the Czech Republic, so it should provide a safe enough buffer.<sup>20</sup>

Other scenario parameters include growth in property prices, growth in new mortgage loans, fixed expenses associated with collateral enforcement and debt recovery, the probability of default ( $PD$ ) and the decay factor. The latter determines how probabilities of default differ depending on the date of loan provision. For a decay factor of one, the probability of default is constant throughout the entire lifetime of the loan. By contrast, a decay factor nearing zero would imply the

<sup>19</sup> The length of the scenario is determined by the assumed mortgage maturity. After 25 years, the loan is fully repaid, is no longer part of the mortgage portfolio and therefore generates no credit losses.

<sup>20</sup> In practice, all scenarios thus assume that 75% of the current price of the property (before the price shock) would always be enough to fully settle the claim. It is not important how much is contributed by the price decline and how much by the administrative expenses associated with collateral enforcement and debt recovery (20% + 5%).

assumption that only loans provided over the past year will default.<sup>21</sup> Other parameters of the model include the average interest rate on mortgage loans and their average maturity, but given the negligible effect of their changes on the size of losses within an economically meaningful range, their values are kept fixed in all scenarios.

**Table 2: Scenario parameters and their baseline settings**

Parameter	Baseline scenario (last 5 years)	Baseline scenario (first 20 years)
Year-on-year growth in property prices	10%	5%
Year-on-year growth in new mortgage loans	15%	8%
Size of cyclical decline in property prices	20% of current prices	
Fixed costs associated with collateral enforcement	5% of current prices	
PD	3%	
Decay factor for PD	0.8	
Interest rates on mortgage loans	2.5%	
Mortgage loan term	25 years	

Source: Authors

The size of losses implied by each scenario is presented below in relative terms per unit of newly provided loans. The impact of the baseline scenario (see Table 2) on the size of credit losses for various levels of the LTV limit is illustrated in Chart 3 (upper left-hand part). It shows that, given the assumed decline in property prices and the amount of fixed expenses associated with debt recovery, losses would equal zero in the baseline scenario at an LTV limit below 75%. However, the size of credit losses for a higher LTV limit rises only slowly at first, and losses only subsequently record a non-linear increase. In this case, the slope of the curve changes approximately at an LTV limit of 85% and again just above 90%. The difference between the size of credit losses at limits of 80% and 100% is roughly ninefold. The non-linear profile of losses relative to the LTV limit is typical of all the scenarios tested.

The size of losses increases as the assumed cyclical decline in property prices rises or as growth in property prices slows (*ceteris paribus*). By contrast, the curve may shift to the right in the case of a lower cyclical downturn (see Chart 3, upper right-hand part). In reality, however, the size of the decline in property prices usually depends on the degree to which their previous growth was excessive, so their impacts cannot be assessed in isolation. For example, if property prices increased 2 pp slower than in the baseline scenario over the last five years (i.e. by 8%) and the cyclical decline was therefore 18% instead of 20%, the credit loss curve would remain almost unchanged compared with the baseline scenario (see Chart 3, upper right-hand part, blue versus green line).

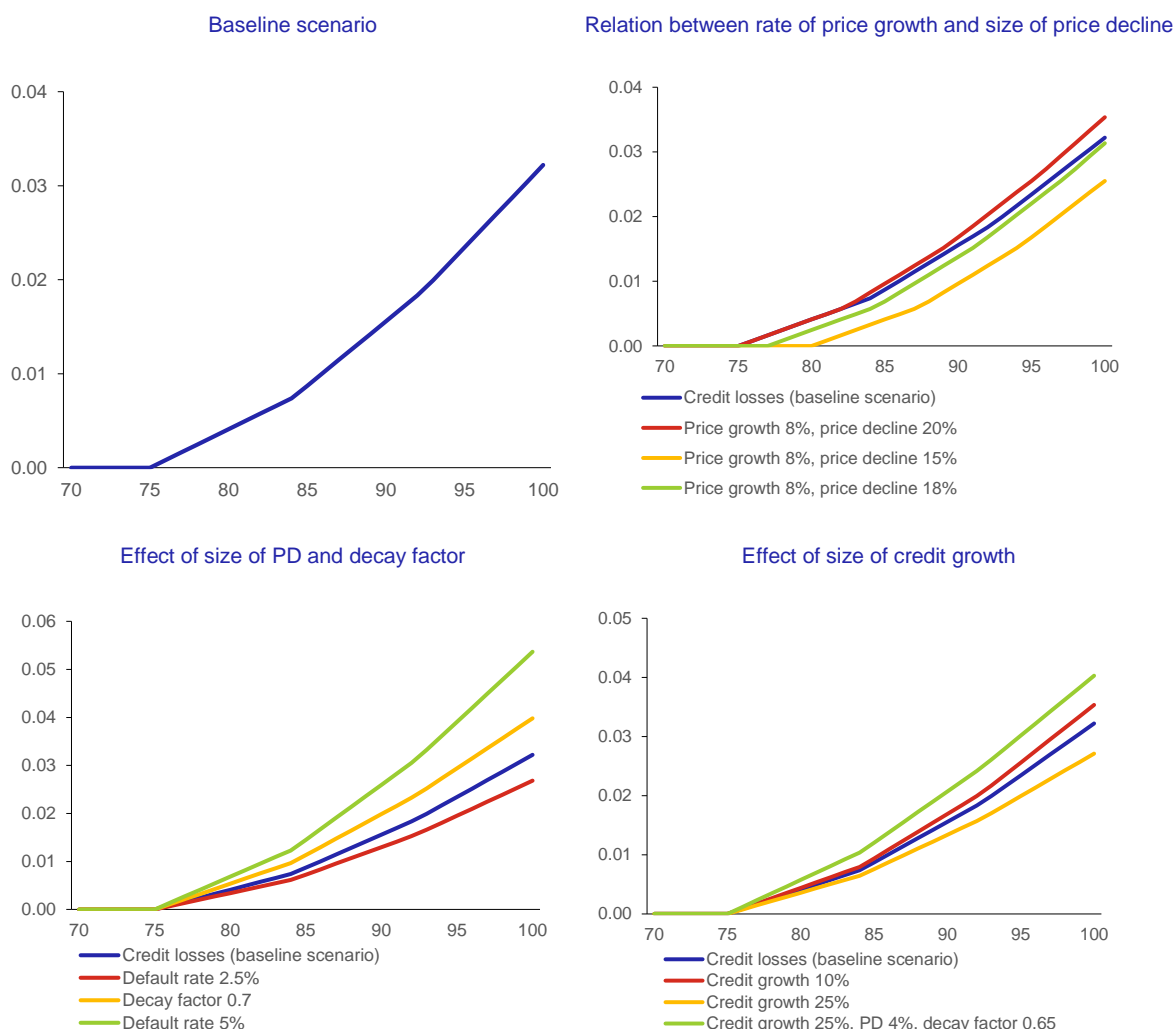
The profile of the credit loss curve is also significantly affected by the size of the default rate in reaction to the adverse shock and its distribution in terms of the date of provision (see Chart 3, lower left-hand part). The higher the default rate due to an adverse shock, the higher the credit loss curve will lie (i.e. the steeper it will be). Similarly, the higher the share of defaulting loans provided in recent years – for which repayments and property price growth have not yet been able to lead to a sufficient drop in the current LTV – the higher the credit loss curve will shift (see Chart 3, lower left-hand part,

<sup>21</sup> Specifically, the decay factor shows how many times the probability that a loan provided in year  $t-1$  will default is lower than the probability that a loan provided in year  $t$  will default. The decay factor of 0.8 in the baseline scenario ( $PD = 3\%$ ) implies a default rate of over 8% for loans provided over the past year, whereas the default rate for loans provided more than 15 years ago is almost zero.

yellow line). The size of the losses starts to differ significantly only for higher values of the LTV limit. Up to 85%, the differences between losses remain relatively small despite the different scenarios.

### Chart 3 Size of credit losses in various scenarios

(x-axis: upper LTV limit in %; y-axis: credit losses per unit of newly provided credit)



Source: Authors

From the perspective of the pace of credit growth accompanying property price growth, higher losses per unit of new loans provided occur if the amount of new loans is broadly balanced across the years and the growth rate is lower (see Chart 3, lower right-hand part). If new loans grow rapidly, the volumes previously provided are relatively low. As a result, their contribution to relative losses is also low and the curve shifts downwards. The situation is the opposite from the perspective of absolute credit losses, as the size of the total mortgage portfolio, i.e. the value of the *EAD* parameter, increases with faster growth. In this case, the order of the credit loss curves is the opposite, but the main conclusions remain valid and the differences between the curves are still relatively small for the lower values of the LTV regulatory limit (see Chart 4). No significant differences between the curves occur for absolute and relative losses, even in the case of less favourable values of the other parameters (a rise in the default rate, a higher share of defaulting loans in recently provided loans – see Chart 3, lower right-hand part, green line, and Chart 4, green line).

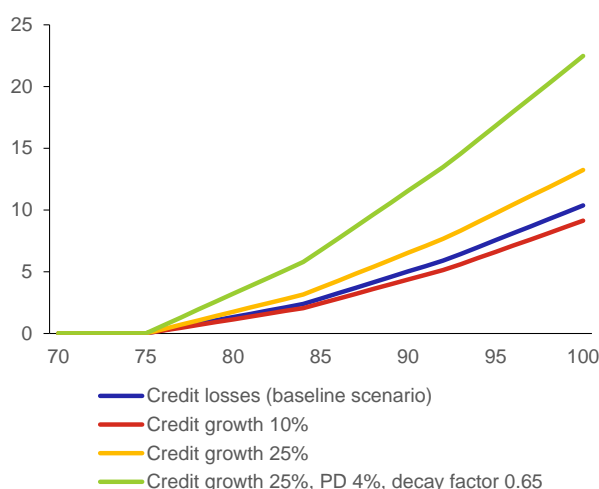
Overall, the simulations suggest that achieving zero credit losses would require setting regulatory LTV limits at a relatively low level that would imply considerable regulatory hardship and be well below the level voluntarily observed by mortgage lenders. However, setting the LTV limit at a higher level than the one ensuring full safety does not initially generate high losses. The differences in the size of the losses are initially very small as the limit increases. For LTV limits of up to about

85%, credit losses do not differ much even if we change the other parameters considered that characterise the various severe scenarios.<sup>22</sup> By contrast, the differences are high for LTV limits nearing 100%.

The results obtained from the scenarios considered generally indicate that there is a close relationship between credit losses, the LTV limit and the size of the decline in property prices, but it cannot be reduced to the simple rule: optimal LTV limit = (100% – degree of overvaluation in %), and not even to the rule: LTV limit = (100% – expected cyclical house price decline in %).<sup>23</sup>

**Chart 4 Size of absolute credit losses**

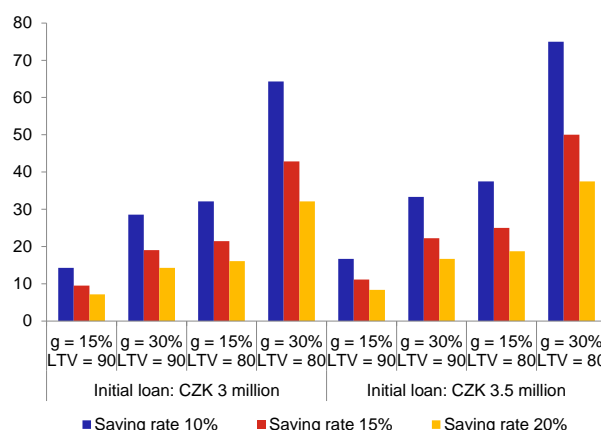
(x-axis: upper LTV limit in %; y-axis: credit losses in CZK billions)



Source: Authors

**Chart 5 Time needed to make up down payment given change in affordable loan**

(in months)



Source: Authors

**Note:** The g parameter indicates a percentage increase in the initial size of the loan, which is reflected in a proportionate increase in property prices. The net income of the applicant(s) of CZK 35,000 is assumed to be constant over time and down payment is assumed to be attainable for the initial loan. It is also assumed that the increase in down payment as a result of the rise in property prices is covered solely from savings from current income.

## V. THE CNB'S APPROACH TO SETTING THE LTV LIMIT

The CNB aims to set the LTV limit in a prudent manner so as to maintain the resilience of mortgage lenders and the financial system as a whole to adverse shocks. However, this does not mean that the CNB would favour regulatory strictness when setting the limit, which would lead to zero credit losses in all macroeconomic scenarios.<sup>24</sup> The presented analyses show that the size of credit losses differs significantly for different LTV limits across various macrofinancial scenarios. However, it no longer differs significantly below a certain threshold of the LTV limit as the limit decreases. A further decline of the limit below this point therefore no longer leads to a fundamental increase in financial system resilience, even with a prudent assumption regarding a potential decrease in property prices. On the contrary, an overly strict initial limit could lead to the negative side effects discussed above (see section III, Table 1). This also applies to repeated decreases in the regulatory LTV limit below the level voluntarily maintained by mortgage lenders.

The CNB generally aims to set the upper LTV limit so that it represents a suitable combination of sufficient prudence and minimal side-effects. On the basis of the analysis, an LTV limit of 80–85% appears to be optimal in various scenarios for the selected financial variables. Within this range, credit losses are still limited and the differences between losses in the various scenarios remain low. In accordance with the ESRB recommendation, they could be potentially covered by the

<sup>22</sup> The parameter of fixed expenses associated with debt recovery is an exception, as its change causes the entire credit loss curve to shift to the right or left. If average expenses rise relative to the current price of the property, the curve shifts to the left and banks incur credit losses even at lower (stricter) levels of the LTV limit. The losses would then not differ much in size for lower LTV limits.

<sup>23</sup> This would apply even if the CNB were able to accurately estimate the size of the cyclical decline at the time of the adverse shock and it would therefore hold true that the expected size of the cyclical decline corresponds exactly to the actual size of the cyclical decline.

<sup>24</sup> Moreover, excessive regulatory hardship could limit competition between banks' business models, which is not the intention of macroprudential policy.

macroprudential capital buffers.<sup>25</sup> Limits below 80% would not contribute significantly to increasing resilience. At the same time, the share of own funds of 15–20% should provide sufficient incentive for borrowers to duly repay their mortgage, especially for properties intended for owner-occupied housing. This should reduce excessive loan delinquency and potential related sell-offs of property pledged as collateral, and therefore also the volatility of property prices. Lower volatility in collateral prices in turn has a favourable effect on total credit losses.

In the light of the above considerations, linking the LTV limit to the size of credit losses on mortgage loans which does not jeopardise financial stability, might seem to be optimal.<sup>26</sup> With every increase in estimated credit losses above some pre-specified threshold, the CNB could then lower the upper LTV limit. However, this approach has a number of pitfalls. First, it is difficult to estimate the size of a potential future decline in property prices, and the path of other variables on which estimates of credit losses on mortgage loans depend (such as PD) is also subject to great uncertainty. In reality, it would therefore be very difficult for the CNB to meet the targeted size of credit losses. Second, such an approach would probably require frequent changes to the limit, with a decrease in the LTV limit always being accompanied by efforts to adjust to the new conditions. As described above, some forms of adjustment may be undesirable and lead to unintended adverse effects. We note that many of these effects are linked to a change (decrease) in the LTV limit, not to its very existence (see section III, Table 1).

In some cases, national macroprudential authorities may be motivated to change the LTV limit to counter cyclical developments on the mortgage market and reduce the extent of cyclical fluctuations in mortgage lending. In this context, it is worth noting that even “merely” keeping the LTV limit constant over the cycle is not neutral from the point of view of potential applicants’ constraints and acts in a largely countercyclical manner. If property prices rise more quickly than applicants’ income, the requirement for the down payment increases disproportionately relative to income. The time needed to make up the down payment then increases even at a constant LTV limit and places increasing constraints on potential applicants (see Chart 5). Property price growth is usually higher than income growth in the expansionary phase of the financial cycle, which is characterised by relaxed financial conditions and credit standards and hence greater availability of debt financing. The expansionary phase therefore often involves a combination of several factors such as a decrease in interest rates on mortgage loans, the provision of loans with rising DSTI and DTI ratios, the provision of loans with an increasing average maturity and overly optimistic expectations regarding future growth in income or housing prices. A constant LTV limit may fulfil a stabilising (countercyclical) function in all these cases, as easier availability of higher loan amounts is offset by a stricter requirement for the absolute level of own funds. The very existence of the LTV limit, even without a change over time, ensures that the riskiest entities are excluded from the mortgage market, as they do not obtain a loan due to the increasing difficulty of putting together the down payment.

## VI. CONCLUSION

The August 2021 amendment to the Act on the CNB extended the CNB’s power to set legally binding LTV limits. The CNB sets this limit to bolster the resilience of mortgage lenders and the Czech financial system using two main channels: (1) lower credit losses on outstanding mortgage loans and (2) a lower amount of mortgage loans with risky characteristics. In line with the fulfilment of its objective, when deciding on the specific LTV limit, the CNB always sees to it that the limit is set in a sufficiently prudent and predictable way and with minimal negative impacts on the financial system and the real economy.

Besides the main benefits of applying the regulatory LTV limit, such as restricting the provision of mortgage loans with risky characteristics, lowering households’ leverage and strengthening the incentive for borrowers to repay their mortgage, the article points out potential unintended effects connected with this instrument and its settings. They may include undesirable reactions of economic agents to the introduction of an overly strict LTV limit or its frequent changes, such as the frontloading effect, upward pressure on property prices amid insufficient supply and lower long-term affordability of housing for a broader group of households. However, these effects can be largely prevented if the instrument is set in a judiciously prudent manner.

Using analyses of the effect of LTV limits on property prices and the size of credit losses based on a number of macrofinancial scenarios, this article seeks to determine the desirable range for the LTV limit in the Czech financial system. According to the analyses, an LTV limit of around 85% or slightly below this level is optimal for striking a balance between the favourable and unfavourable effects of this instrument. Moreover, keeping a stable LTV limit close to 85% appears to

<sup>25</sup> If mortgage loans rise strongly in the expansionary phase of the cycle, the resilience of the financial system may be bolstered by creating a countercyclical capital buffer (see e.g. <https://www.cnb.cz/en/financial-stability/macprudential-policy/the-countercyclical-capital-buffer/>).

<sup>26</sup> Credit losses that can be easily covered by banks’ current income or one of the buffers created for this purpose (capital buffers or provisions) can be regarded as acceptable (not jeopardising financial stability).



be a sufficiently prudent approach on a mortgage and property market with large excess demand for property over supply, even in cases where the future path of property prices and the financial situation of households is difficult to predict.

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