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ASSESSING HOUSE PRICE SUSTAINABILITY

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ASSESSING HOUSE PRICE SUSTAINABILITY

Miroslav Plašil, Michal Andrle[1]

This article sets out to present the CNB's approach to determining fundamental house prices. House price sustainability is assessed by calculating two indicators. The first is macroprudential in nature and measures attainable property price levels compatible with safe debt financing. The second indicator is based on asset pricing theory and assesses the benefits of property ownership relative to long-term renting and alternative investments. Both indicators show that residential property in the Czech Republic was overvalued by 10%–15% in the second half of 2018.

1. INTRODUCTION

Rapid growth in property prices coupled with increased interest of households in debt financing property purchases can lead to a surge in risks to financial stability. Systemic risk accumulates amid relaxed credit conditions and optimism about future income and interest rates. Such an environment may create an illusion that loans will be easy to service and may encourage households to take on more debt. Over-optimistic expectations about future growth in prices and rents can in turn make purchasing property for investment purposes more attractive and foster a spiral between property prices and property purchase loans.

The Czech National Bank (CNB) continuously assesses the property market and, where necessary, responds in a timely manner to risks arising by deploying appropriate macroprudential instruments (for more details, see Hejlová et al., 2018).[2] The assessment process includes an analysis of the degree to which property prices are overvalued. This helps the CNB better estimate their long-run sustainable (fundamental) levels. The difference between actual prices and fundamental values gives policymakers an idea of the possible magnitude of the price correction that would occur in the event of a change in the cycle and allows for better evaluation of the level of risk undertaken. Regular communication of fundamental values can help anchor the expectations of market participants (banks and households) regarding the future conduct of macroprudential policy, making that policy more transparent and easier to understand. The information can also be used by households in making investment decisions and assessing the benefits of home ownership.

This article sets out to inform market participants and the wider economic community about the CNB's approach to estimating fundamental residential property price levels and the corresponding degree of overvaluation. The CNB newly uses two independent but related approaches to determine the level of overvaluation: (i) one based on households' borrowing capacity (a *prudential* approach), and (ii) one based on asset pricing theory (a *valuation* approach).[3] The first measures the magnitude of overvaluation with respect to safe and sustainable servicing of the debt used to finance property purchases. It is thus primarily (macro)prudential in nature. The idea is to determine what property price levels are

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Michal Andrle, IMF Research Department. The views expressed herein are those of the author and should not be attributed to the International Monetary Fund, its Executive Board, or its management.
2 Information on the current settings of macroprudential instruments can be found on the CNB website: https://www.cnb.cz/en/financial_stability/macroprudential_policy/index.html/.
3 The overvaluation found using the two methods was publicly disclosed for the first time in the document *Risks to financial stability and their indicators – December 2018*, which is available on the CNB website: https://www.cnb.cz/en/financial_stability/risk_fs/index.html/.

compatible with a low risk of default in order to ensure that financial stability is not endangered. The second method adds the true valuation dimension to an analysis and assesses the benefits of property ownership relative to long-term renting and alternative investments. Under this approach, the value of a property is equal to the net stream of discounted rental income. The two indicators are easy to calculate and easy for the public to interpret.

The article is structured as follows. Section 2 presents an overview of the methods most commonly used by macroprudential authorities to assess property price sustainability and discusses their potential shortcomings. Section 3 describes the construction methodology for the indicators currently used at the CNB. Section 4 summarises the results of the application of those indicators using data for the Czech Republic. The final section provides a short summary and discusses potential extensions of the concepts used.

2. OVERVIEW OF THE MOST COMMONLY USED METHODS AND THEIR SHORTCOMINGS

There is an extensive literature on house prices analysis. In their assessments, however, macroprudential authorities generally rely on methods belonging to one of the following two categories (see, for example, Igan and Loungani, 2012, ECB, 2015, and Philiponnet and Turrini, 2017). The first category involves constructing a regression model in which house price movements are explained by several fundamental factors. These generally include variables such as income, short-term and long-term interest rates and demographic characteristics. Sometimes the model is expanded to include credit and financial indicators. The part of the price variability that is not explained by these factors is regarded as the deviation from economic fundamentals indicating overvaluation or undervaluation. An alternative to the regression model is to use housing "affordability" measures. These are based on the price-to-income or price-to-rent ratio, which is adjusted for the long-run trend. The long-run levels are captured using the historical averages of these ratios or simple statistical techniques (such as the Hodrick-Prescott filter). As with the regression model, deviations from the long-run level are interpreted as an estimate of the degree of overvaluation or undervaluation.

Despite their popularity, both categories of approaches suffer from some conceptual and practical shortcomings. From the conceptual perspective, the fact that both measures are backward looking and derive the property value from currently observed and past data may be problematic. The value of a property as an asset should be derived primarily from expectations about future conditions. This applies both from the macroprudential perspective, where there is a need to ensure safe debt servicing over the entire life of the loan, and from the valuation perspective, where the asset value is determined solely by the expected future stream of income arising from ownership of the property (regardless of past returns).

However, there are also other issues associated with the approaches used to determine the extent of overvaluation. Regression models are generally only loosely motivated by economic theory as regards both the structural characteristics of the model and the choice of variables. The factors included in the analysis often explain both fundamental and temporary price swings, which means their effects are hard to disentangle. In regression models, moreover, the levels of the explanatory variables are automatically treated as equilibrium levels, which may not hold in reality. The absence of an economic structure makes the model parameters harder to interpret and makes it difficult to perform meaningful sensitivity analyses and counterfactual scenarios that may help measure the impacts of introducing macroprudential instruments. Estimation of the parameters of the regression model additionally necessitates

long time series (optimally over several cycles). Otherwise, the parameters are very unstable over time and take values that are not consistent with economic intuition. The estimate of the degree of undervaluation and overvaluation is thus subject to sizeable revisions (see, for example, Hejlová et al., 2017). However, sufficiently long time series are not available for many countries. Last but not least, if properties are often overvalued but rarely undervalued, regression analysis does not allow us to obtain a useful estimate of the deviation from fundamentals because the regression model assumes that the residuals measuring overvaluation and undervaluation always sum to zero.

The long-run levels of housing affordability indicators are hard to determine and thus often chosen arbitrarily. If historical averages are used, the analyst has to assume a mean reversion in the given ratio. This, however, cannot be automatically guaranteed in the case of a long-running decline in the nominal interest rate, for example. This can give rise to significant distortions in assessments of sustainability. Trend modelling, which enables the effect of a persistently falling interest rate to be eliminated, is often based solely on statistical criteria lacking economic justification.

Macroprudential authorities less commonly use other methods as well. Structural DSGE models (Iacoviello and Neri, 2010) and structural VAR models (Iacoviello, 2002) are sometimes used for certain analyses. These models allow for the estimation of structural shocks driving property prices. They can be used primarily for performing counterfactual analysis and testing alternative economic scenarios. On the other hand, both type of models can be quite complex and require strong assumptions to identify the structural shocks and significant effort to be used in real-time house-price assessment.

3. THE PRUDENTIAL AND VALUATION INDICATORS

Given the above shortcomings of the traditionally used methods, the CNB favours two indicators with a clear economic interpretation for assessing the sustainability of property prices. These indicators offer different but complementary views of the deviation of observed prices from the fundamental value. Both are forward-looking and estimate future developments on the basis of the CNB's official forecast. Both approaches work with prices in monetary units, not with dimensionless indices. The latter allow the dynamics of actual prices to be captured but lack information on price levels, which complicates the estimation of undervaluation or overvaluation.

3.1. The borrowing capacity of households

The first approach is inspired by the online mortgage calculators widely available to prospective house buyers. The borrowing capacity indicates the maximum size of property purchase loan that households can safely borrow given the expected evolution of income and interest rates. Combined with their available down payment, the mortgage loan indicates how much housing households can afford.[4] It can be assumed that households will try to leverage their borrowing capacity to the full and choose a property that maximises their utility given the funds available to them.[5]

4 It is assumed that the average household is liquidity-constrained and the property purchase must be largely debt-financed.
5 Given that properties are in limited supply, their prices will to a large extent be as high as households are willing to pay for them subject to their budget constraints (borrowing capacity).

Borrowing capacity is a (macro)prudential approach, not a valuation approach, to determining the fundamental value of property and its undervaluation or overvaluation. Growth in actual prices above the value so obtained will not necessarily trigger a financial crisis. It does indicate, however, that systemic risks are building up in the economy. The use of households' borrowing capacity to determine fundamental property prices can be likened to a road speed limit. Going just above the speed limit may not lead to an accident, just like driving below it does not guarantee complete safety. Nonetheless, speed limits are a widely recognised prudential measure for systematically reducing the number of accidents. Likewise, the borrowing capacity concept provides information on the sustainable property price level, i.e. the level associated with a low level of systemic risk, a low probability of default and a sufficiently resilient financial sector. Regular communication of this indicator in relation to actual prices can thus raise the awareness of the public and market participants about the current level of systemic risk.

Indicators based on the borrowing capacity concept can be specified in a number of variants differing in the degree of how forward-looking they are. Although the basic – static – form only takes account of current market conditions, it is useful for understanding the more advanced dynamic variants and the fundamental properties of the overall approach. We assume that a household can allocate a proportion, α, of its current income, Y_t, to cover the monthly instalment, A_t:

$$A_t = \alpha Y_t. \tag{1}$$

The size of the monthly instalment (which can be capped by macroprudential measures) coupled with the monthly rate on housing loans, i_t^m, and the duration of the mortgage in years, N, determines the maximum attainable loan, L_t. It can be expressed by the relation:

$$L_t = \alpha Y_t \left[\frac{z_t(1 - z_t^{N\times 12})}{1 - z_t}\right], \qquad \text{where} \quad z_t = \frac{1}{1 + i_t^m}. \tag{2}$$

The attainable mortgage loan, L_t, plus the household's down payment, D_t, determine the fundamental property price, PH_t:

$$PH_t \equiv P_t^h \times H_t = L_t + D_t, \tag{3}$$

where P_t^h denotes the price per square metre and H_t the floor area of the property. The size of the down payment is known at the household level but has to be related either to past and present income or to the loan size for the aggregate-level analysis. Given the observed loan-to-value ratios (LTV), expression (3) can always be rewritten as:

$$PH_t \equiv P_t^h \times H_t = \frac{1}{LTV} \times L_t. \tag{4}$$

Calculating indicator (4) for each quarter allows us to compare its values with actual prices and check to what extent the price dynamics are in line with fundamentals. It is worth noting that in the borrowing capacity case, fundamental property values are fully explained by two main factors (households' disposable income and interest rates). The specific attainable property price level then depends on the values of three structural parameters with a clear economic

interpretation: the loan duration, the debt service-to-income (DSTI) ratio and the loan-to-value ratio (N, α and LTV).[6]

The static version (4) is useful for understanding the dynamics of fundamental property values. Relations (2) and (4) imply that when interest rates and the DSTI ratio are constant, fundamental values will rise at the same rate as households' incomes. It is also evident that the effect of interest rate changes on the size of the attainable loan (and hence on property prices) is non-linear, with the non-linearity increasing with increasing loan duration N. Given the long-term nature of mortgages, the strength of the non-linear effect is significant and we cannot abstract from it. Even small interest rate movements can imply relatively large changes in attainable property prices.

A disadvantage of the static version of the borrowing capacity approach is its large sensitivity to present interest rate and income levels. Its behaviour can therefore be strongly procyclical and can lead to overoptimistic estimates of fundamental prices when a future increase in interest rates and/or deterioration in the income situation of households give rise to an excessive debt service burden. The dynamic version of the approach tries to eliminate this shortcoming and find the loan size for which the risk of excessively high debt service in the future is limited.

The computation of the dynamic version is an optimisation problem where the attainable mortgage is maximised subject to the constraint that instalment A_t cannot exceed a fixed proportion α of income Y_t in any future period. The construction of the repayment schedule reflects the forecast for future interest rates and the way they are refixed. The future expected instalment is compared with future expected income, which also reflects the CNB's official forecast. If the forecasted income is not sufficient to cover the future growth in interest rates and leads to limit α being exceeded at some future point in time, the present loan size must be reduced commensurately.

The dynamic version of the borrowing capacity approach is an asymmetric indicator, as it always takes values that are equal to or lower than the static version (never higher). If a decline in rates and favourable income dynamics are expected, the dynamic version still prevents households from taking out a larger loan, as that would mean the fixed instalment-to-income ratio, α, being exceeded at present.[7] If, on the other hand, the growth in expected income is not sufficient to cover the projected increase in interest rates, the dynamic version will lead to lower attainable loan sizes than the static version. Differences between the static and dynamic versions can thus be expected to arise primarily at times when interest rates are predicted to rise sharply from very low levels.

3.2. The valuation approach

The valuation approach defines the fundamental value of a property as the present value of the future stream of rental income on the property. This relationship is based on the assumption that the household has no subjective preference between owning and renting and

6 Changes over time can be considered for all three structural parameters. In the following analysis, however, we keep the parameters fixed. Both LTV and α have a direct linkage to macroprudential instruments in the form of LTV and DSTI limits.

7 The degree of prudence of the macroprudential authority can matter here. If, for example, interest rates are expected to fall appreciably, the macroprudential authority can temporarily permit a slightly higher DSTI ratio, as the ratio is expected to fall sharply in the future.

only compares the financial flows associated with the two options (see, for example, Himmelberg, Mayer and Sinai, 2005). In the first case, the household can invest its savings, D_t, at the interest rate, i_t^e, and simultaneously pay rent, R_t. In the second case, it will use its savings, D_t, together with a mortgage, L_t, to buy a property. Besides debt service, purchasing a property entails a duty to pay property taxes and maintenance and insurance costs. On the other hand, the interest payments are tax deductible.

The practical application of this relationship is conditional on several assumptions – assumptions that may match the behaviour of institutional investors but that are unrealistic for normal households. In particular, it is assumed that the investor maintains a constant level of debt and pays a loan of infinite duration. By contrast, households can be expected to want to pay off the mortgage in full and their total debt can be expected to fall over time. The realistic implementation of the valuation principle is therefore based on several modifications.

The indicator used is defined as the *net* present value of future income and is based on a model that takes account of the cyclicality of rent (income) and interest rates and the possibility of fixing rates for a longer period. Specifically, the model assumes that the interest rate on a housing loan of N years' duration is re-fixed every $K \leq N$ years. Under these conditions, the valuation model is composed of at least three terms[8] describing the size of the regular instalments in different periods. In years 1 to K, the loan instalment is constant and is derived from the current interest rate for the given fixation period. Assuming that the interest rate attains its long-run equilibrium level after K years and then stays constant, the instalment is constant from then to maturity. Its size depends on the equilibrium interest rate chosen. In the final phase, when the mortgage has been paid off in full, the rental income is no longer adjusted for debt service.

$$
\begin{aligned}
V_{t|t} = & \sum_{i=0}^{K-1} \frac{(1-\tau)R_{t+i|t} - A_{t+i|t} + \tau U_{t+i|t}}{\prod_{j=0}^{i}\left(1+i_{t+j|t}^{e}\right)} \\
& + \sum_{i=K}^{N-1} \frac{(1-\tau)R_{t+i|t} - A_{t+i|t} + \tau U_{t+i|t}}{\prod_{j=0}^{i}\left(1+i_{t+j|t}^{e}\right)} \\
& + \frac{1}{\prod_{j=0}^{N}\left(1+i_{t+j|t}^{e}\right)} \frac{(1+gn)\times(1-\tau)R_{t+N|t}}{i^{e}-gn}
\end{aligned}
\tag{5}
$$

The first and second terms are identical in structure, differing only in the size of the expected instalment, $A_{t+i|t}$. In this period, households on the one hand amortise the debt with regular instalment payments and on the other hand receive expected rent, $R_{t+i|t}$, net of income tax, τ, expressed as a percentage rate. At the same time, they can deduct part of the interest paid, $\tau U_{t+i|t}$, from their tax base. To obtain the present value of future net income, the expression is discounted by the interest rate on an alternative investment, i_t^e. The final term, now containing no instalments, expresses the sum of the (infinite) series of future expected income. It is assumed that rental income after the loan has been paid off rises at a constant equilibrium year-on-year rate, gn, and its sum total can be obtained using the formula for the sum of an

8 In what follows, we assume that the mortgage rate is typically re-fixed every five years and that in five years' time the interest rate will have reached its long-run equilibrium level. In this case, it is sufficient to use three terms. Modifying the calculation for other assumptions and extending it to include more terms is trivial but involves more complicated notation.

infinite geometric series. For the sake of clarity, indicator (5) is written at annual frequency, but all instalments are calculated monthly and their annual sum is used.

In the practical implementation of (5), we assume that growth in rents is equal to growth in households' disposable income, i.e. that rents and income cannot diverge over time in the long run.[9] As with the borrowing capacity approach, the fundamental property value depends on the evolution of income and interest rates on housing loans. However, it additionally depends on the rate of return on the alternative investment, i_t^e. The lower is the required or actually attainable rate of return on the alternative investment, the more attractive investing in property will be to households and the higher the price that they are willing to pay for it will be.

4. THE USE OF THE PRUDENTIAL AND VALUATION INDICATORS IN THE CZECH REPUBLIC

Both the valuation approach and the prudential approach can be used at the household and property level. For the purposes of macroeconomic analysis, however, we need to work with average or aggregate data – with all the risks that such simplification entails. The aggregate indicators for the Czech Republic thus do not allow for identification of property market segments that may be much more strongly overvalued, nor can they characterise the situation of every household.[10] Nonetheless, capturing the aggregate tendencies is essential to understanding the overall dynamics of actual property prices.

4.1. Input data and calibration

Disposable income per capita is used for household income in the construction of the overvaluation indicators. It is multiplied by a coefficient of 1.65. This adjustment corresponds to the relationship between disposable income and the median net income given in loan applications. The CNB takes the latter from a survey of new loans secured by residential property (referred to below as the "survey"). The greater-than-unity coefficient reflects the fact that banks take more than one income into account on average when providing a loan (for example when both spouses declare their income) and the average income of loan applicants is generally higher than the national average.

The prudent DSTI ratio, α, is set at 35%. Keeping the ratio of housing expenditure to income at around one-third is considered a sensible rule of thumb in most advanced countries. Previous CNB analyses have identified loans with a ratio of greater than (or equal to) 40% as risky and credit institutions should be particularly cautious when providing them (see Hejlová et al., 2018, CNB, 2017, and CNB, 2018). The loan-to-value ratio, LTV, is set at 80%. The chosen α (DSTI) and LTV values are consistent with the data reported in the survey and can be regarded as appropriate aggregate characteristics of the set of loan applicants in the Czech Republic. Choosing different values would affect the absolute level of fundamental prices but not their dynamics. The typical mortgage duration, N, is considered to be 25 years and the

9 Growth in rents and disposable income can differ in the short run, but for simplicity we keep the rent-to-income ratio constant in the projection. The calculation can easily be modified to incorporate rent growth data and short-term rent projections if reliable information is available.

10 The CNB also performs internal calculations of the indicators for Prague. The higher property prices in Prague can be explained largely by the income level there, which is 30% higher than the national average, and by the interest rates offered on housing loans, which are slightly lower. The overall extent of the overvaluation in Prague is therefore not significantly greater than that for the Czech Republic as a whole. However, apartment prices in Prague alone display sizeable differences across districts. The overvaluation in certain parts of Prague is thus substantially higher.

typical re-fixing period 5 years. The level of interest rates on housing loans corresponds to the average rates on new mortgages with a re-fixing period of 1–5 years.

The required nominal rate of return on the alternative investment, i_t^e, which plays a large role in the valuation approach, is considered to be constant over time and equal to 6.5%. The choice of this value reflects, among other things, the fact that maintenance and costs and wear and tear are not explicitly considered in the calculation. Their annual level is estimated at 1.5%–2.5% of the price (Himmelberg, Mayer and Sinai, 2005; Fox and Tulip, 2014). Property tax is not directly taken into account in the calculation either.

For the first three years, expected income and interest rates are based on the CNB's official forecast. In the subsequent period, the official forecast is extended using an AR(1) model with an autoregressive parameter of 0.25 on data with annual frequency such that they converge to their predefined equilibrium steady-state levels. The assumed steady-state year-on-year growth in disposable income is 4% and the steady-state interest rate on housing loans is 5%.

After the two indicators have been calculated, the results can be compared with actual property prices and their degree of overvaluation or undervaluation can be determined. Detailed price data are only available for apartments, so we limit ourselves to apartment prices when assessing property market developments. In line with the observed data, we assume an average floor area of 68 square metres in the calculation of actual prices. The average price per square metre is taken from data published by the private company Společnost pro cenové mapy ČR. The time series of absolute prices is extended before 2015 using the aggregate property price index published by the Czech Statistical Office. For ease of comparison of the two approaches, the rent level is also set at 35% of adjusted disposable income

4.2. Results and degree of overvaluation

The results based on the two approaches show that fundamental apartment values have been rising steadily since 2008 (see Chart 1) due to growth in disposable income and a gradual decline in interest rates on housing loans. The degree of overvaluation fluctuated between 10% and 15% in the course of 2018 and was thus substantially lower than at the time of the previous price peak in 2008 (see Chart 2). Most of the time, the static and dynamic versions of the borrowing capacity (prudential) approach did not differ from each other. The only exception was the short period from mid-2016 to mid-2017, when the forecasted growth in income did not allow for safe coverage of the increase in debt service associated with the expected rapid growth in interest rates (see Chart 1).

The significant effect of interest rates on the borrowing capacity of households and the fundamental value of apartments is illustrated by an alternative scenario in which it was assumed that interest rates on housing loans stayed at the level of the first quarter of 2014 (see Chart 2). Although the difference between the interest rate levels in 2018 Q3 (3.24%) and 2014 Q1 (2.58%) was less than one percentage point, *ceteris paribus* the degree of overvaluation would have increased by approximately 10 percentage points.

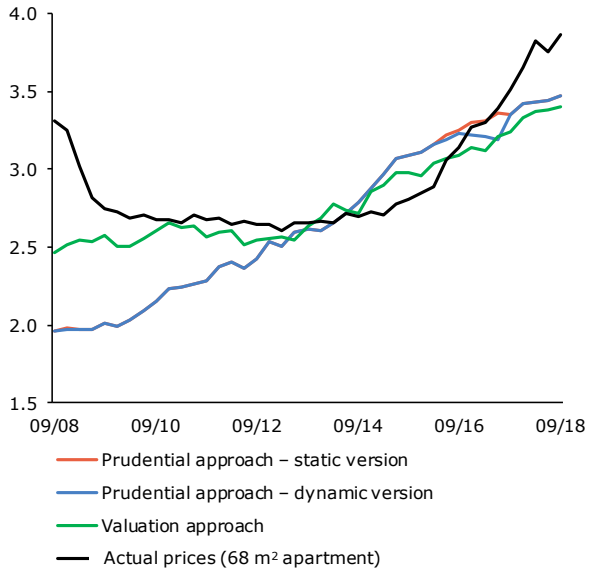
The fundamental property prices obtained using the prudential and valuation approaches differ from each other. This is not surprising, because the two indicators define the fundamental value differently and answer different questions. At the same time, though, they display numerous similarities as regards the evolution of overvaluation and undervaluation and virtually always move in the same direction as regards the closing and opening of the deviation

of actual prices. The two approaches also both indicate that property prices tend to be often overvalued and rarely undervalued.

CHART 1

Comparison of fundamental property values with actual apartment prices

(CZK millions)

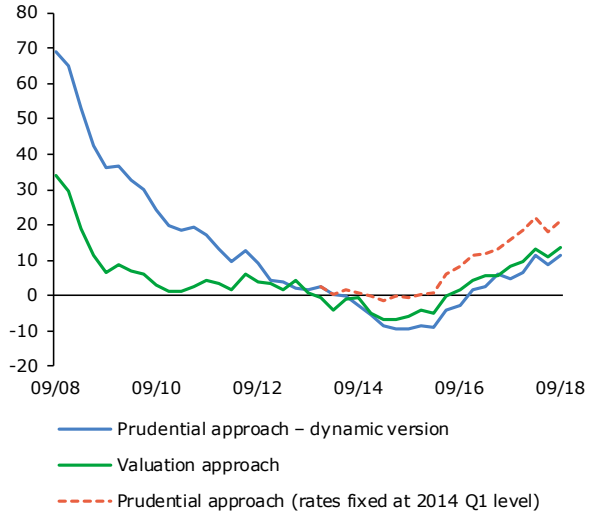


Source: CNB, authors' calculations
Note: Actual apartment prices assume a 68 m² floor area.

CHART 2

Estimated deviation of actual apartment prices from their fundamental values

(%)



Source: CNB, authors' calculations
Note: The red dashed line indicates the magnitude of the potential property overvaluation if interest rates on housing loans remained fixed at the 2014 Q1 level.

5. CONCLUSION

This article presented the two approaches the CNB currently uses to analyse fundamental prices of residential property. The deviations of actual prices from their fundamental values indicate the extent of overvaluation or undervaluation and allow us to evaluate the size of the systemic risks associated with this market. The prudential approach is based on the borrowing capacity of households and seeks attainable price levels compatible with safe debt financing of property purchases. The valuation approach compares the benefits of investing in property with other investment opportunities and correspondingly defines the fundamental value as the discounted stream of net expected income generated by the property. Both approaches are forward-looking, work with property prices in absolute terms and do not require past observations for determination of the current degree of overvaluation or undervaluation.

The indicators calculated using data for the Czech Republic show that apartment prices were overvalued by 10%–15% in 2018. The magnitude of the overvaluation is not insignificant but is still well below the previous price peak recorded in 2008. This is due to relatively dynamic growth in households' disposable income and a marked decline in interest rates on loans for house purchase.

The proposed indicators can be used to analyse prices not only at the aggregate level, but also at the level of regions or even specific households and properties. The choice of parameters can take account of national specifics and the degree of prudence of the competent macroprudential authorities.

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