

# Big shocks to the economy have fuelled house prices

Recent years have seen unusual shocks to the economy that caused fluctuations in house prices. First came the corona pandemic, followed by a period of high inflation and the highest interest rates seen in decades. Understanding the dynamics and gaining a better understanding of how these shocks have affected the housing market is essential for assessing economic development, among other things. The effect of the shocks to the economy are now estimated to have roughly translated into house prices. In absence of new shocks to the economy it is expected in the coming years, that future developments in fundamental factors such as interest rates and incomes will drive the development of house prices.

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## Time consumption

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### Inflation and rising interest rates pushed down house prices

The corona pandemic was followed by a period of high inflation, which caused real incomes to fall and led to higher nominal interest rates. This led to a drop in house prices. In 2023, the trend reversed again, with significant wage increases and falling inflation contributing to rising house prices.



### New housing taxes, increased working from home and mortgage regulations have impacted the housing market

A number of structural changes have affected the housing market in recent years. For example, the new housing tax system will reduce future house price fluctuations, the increase in working from home has boosted house prices, and new lending rules since the financial crisis contribute to lower interest rate sensitivity.



### The effects of the economic shocks of recent years have roughly been reflected in house prices

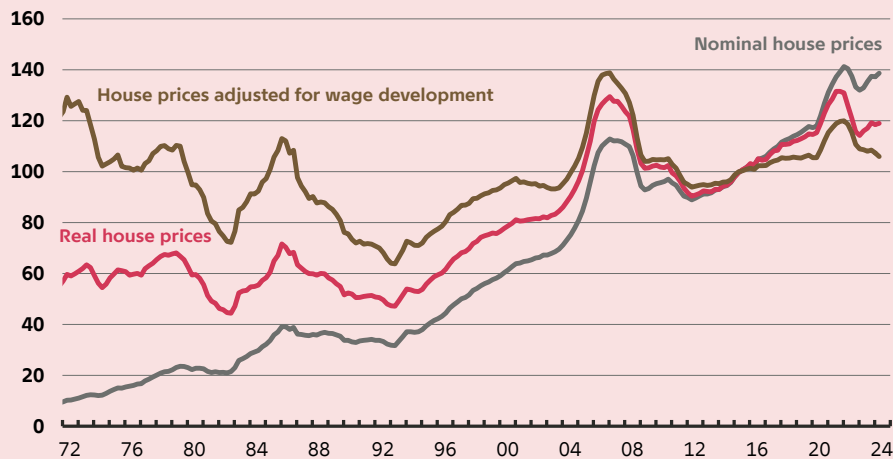
It is estimated that the effects of the economic shocks of recent years have played out and are roughly included in house prices. Overall, the development of fundamental factors such as interest rates and income are expected to drive house prices.

## Why is it important?

It is important to understand the driving forces behind the housing market development in recent years, as the housing market both reflects and influences the development of the Danish economy. Fluctuations in house prices affect household wealth and spending power and can test the resilience of credit institutions. A solid understanding of the driving forces behind developments in the housing market is therefore central to the overall assessment of developments in the Danish economy and macroeconomic and financial stability.

## Main chart: House prices have risen since the beginning of 2023, especially nominal prices

Single-family house prices, index, 2015 = 100



Note: Real house prices are deflated with consumer prices and all series are seasonally adjusted. House prices are from Statistics Denmark until Q1 2024 and are extended with data from Boligsiden in Q2 2024.

Source: Statistics Denmark, Boligsiden, Macrobond.



## Keywords

Housing market

Danish economy

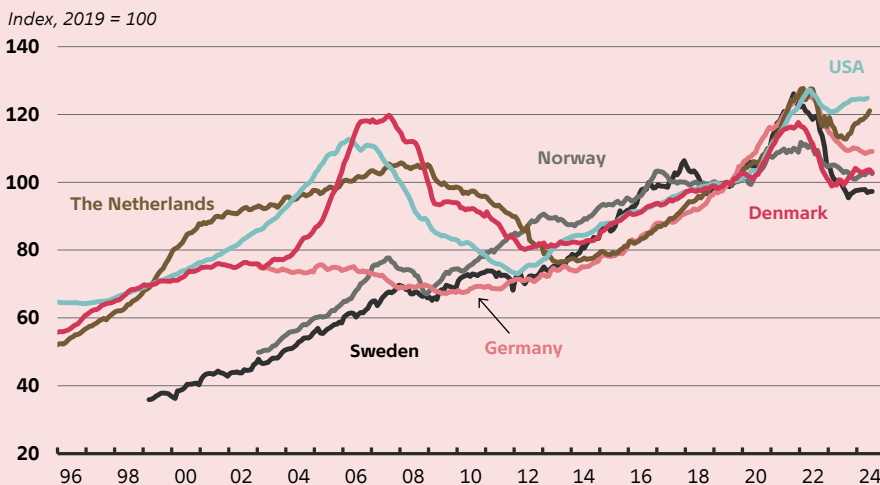
Outlook for the Danish economy

# 01 House price fluctuations in the light of major global events

The housing markets in Denmark and abroad have seen significant fluctuations since the outbreak of the corona pandemic in 2020. This is in contrast to the period from 2013 to 2019, which saw more stable growth.<sup>1</sup> House prices first rose sharply during the pandemic in 2020-21 and then fell significantly in 2022, especially in real terms when inflation was high. Since the beginning of 2023, house prices have increased again in several countries, albeit at a slower pace than during the pandemic, see chart 1. In several countries, fluctuations in house prices have been similar to – and in some cases even greater than – those during the financial crisis.

CHART 1

**Real house prices in several countries have been marked by significant fluctuations in recent years**



Note: The chart shows real house prices. The chart covers all housing types for Norway and the US. All series are seasonally adjusted. Consumer price indices are used to deflate nominal house prices. House prices for Denmark up to 2009 are from Statistics Denmark, and data from 2010 onwards is from the Danish online property platform Boligsiden.

Source: Macrobond, Boligsiden, Statistics Denmark.

## Global housing markets were affected by a series of shocks

The significant fluctuations in housing markets are related to the unusual macroeconomic shocks that hit the global economy in recent years. These

<sup>1</sup> This analysis concentrates solely on the owner-occupied housing market and does not cover developments in the commercial property market.

include the corona pandemic, during which house prices soared despite economic setbacks. This development differs from previous crises, which have typically been associated with falls in house prices.<sup>2</sup> That may be because it was a pandemic and not economic imbalances that triggered the downturn. It was therefore not the ability of homebuyers to finance and thus purchase homes that was reduced, as seen in previous crises. House prices during the pandemic were also buoyed by very low interest rates, a significant increase in household savings and increased appreciation of homes as a result of lockdowns and the ability to work from home.<sup>3</sup>

Russia's invasion of Ukraine has also had an impact on the large fluctuations in the housing markets. The invasion, along with the pandemic and the related easing of fiscal and monetary policy, pushed inflation to very high levels,<sup>4</sup> which eroded the purchasing power of homebuyers. The high inflation has also led to significant monetary tightening, which increased the cost of housing finance. House prices have probably also been dampened by the phasing out of a number of government measures that supported housing markets during the pandemic in several countries, such as temporary deferment on mortgages.<sup>5</sup>

### **Housing markets across countries are developing more uniformly**

Housing markets across countries are moving more in sync than ever before. A number of analyses indicate that the increased convergence in house prices can be attributed to several factors: Firstly, housing markets in individual countries have become more exposed to global shocks.<sup>6</sup> For example, changes in global commodity prices can affect construction costs and therefore house prices. Secondly, fundamental factors such as economic activity, inflation and interest rates have moved more in the same direction as a result of globalisation. For example, low interest rates in the US have formed the basis for large joint movements in international capital flows for a period of time. This has influenced asset prices, which can also affect housing.<sup>7</sup>

### **Cyclical and structural factors both affect the housing market**

The analysis highlights the driving forces behind the development of the Danish housing market in recent years to improve the basis for Danmarks Nationalbank's house price forecast. To a large extent, recent developments in the housing market can be explained by changes in cyclical factors such as inflation, interest rates and income, which are discussed in more detail in chapter 2. A number of structural changes have also affected the housing market in recent years, as discussed in chapters 3 to 5. This includes the introduction of the new housing tax system at the beginning of 2024, whereby housing taxes will henceforth follow house prices. These will reduce fluctuations in house prices. Increased remote work during the corona pandemic has also raised house prices. Working from home is not expected to lead to further increases or

<sup>2</sup> Reinhart and Rogoff studied every major financial crisis since World War II and concluded that real house prices fell by an average of 36 per cent from peak to trough. See Carmen M. Reinhart and Kenneth S. Rogoff, *The Aftermath of Financial Crises*, *American Economic Review*, vol. 99(2), 2009.

<sup>3</sup> See Simon Thinggaard Hetland, Simon Juul Hviid, Jesper Pedersen and Adrian Michael Bay Schmith, *Housing market robustness should be strengthened*, *Danmarks Nationalbank Analysis*, no. 16, June 2021.

<sup>4</sup> See Morten Spange and Thomas Harr, *Inflation - why did it rise and what are the drivers ahead?*, *Danmarks Nationalbank Economic Memo*, no. 3, February 2023.

<sup>5</sup> Temporary housing loan forbearance became a common instrument to support housing markets during the pandemic in many European countries, including Germany, France, Italy and Spain.

<sup>6</sup> See IMF, *House price synchronization: what role for financial factors?*, *World Economic Outlook*, April 2018; BIS, *Property price dynamics: domestic and international drivers*, *Committee on the Global Financial System Paper*, no. 64, February 2020; John V. Luca, *Making sense of increased synchronization in global house prices*, *Federal Reserve Bank of Dallas Working Paper*, no. 1911, October 2019; and Stefano Corradin and Alessandro Fontana, *House price cycles in Europe*, *ECB Working Paper*, no. 1613, November 2013.

<sup>7</sup> See Hélène Rey, *Dilemma not trilemma: the global financial cycle and monetary policy independence*, *NBER Working Paper*, no. 21162, February 2018, and Oliver J. Grinderslev, Paul L. Kramp, Anders Kronborg and Jesper Pedersen, *Financial cycles: what are they and what do they look like in Denmark?* *Danmarks Nationalbank Working Paper*, no. 115, June 2017.

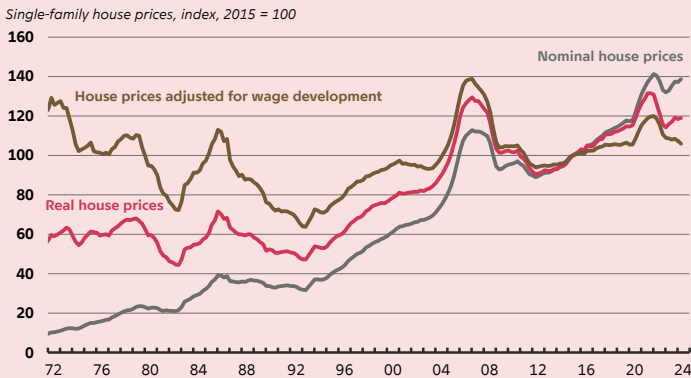
decreases in housing demand in the coming years. Finally, the introduction of borrower-based regulation may have helped limit interest rate sensitivity in the housing market.

# 02 Inflation, interest rates and income have affected housing prices

The corona pandemic led to an increase in housing demand in Denmark, causing house prices to rise. Subsequently, high inflation and the resulting rise in interest rates caused housing demand to fall, leading to a drop in nominal and real house prices, see charts 2 and 3. As early as 2023, house prices started to rise again due to rising real wages, high employment, and the prospect of falling interest rates. Adjusted for consumer prices, house prices are still significantly lower than the level of early 2022, when they last peaked. The same applies to house prices adjusted for wage growth, where the level is in line with the years before the corona pandemic. The downward effect of high inflation and higher interest rates is estimated to have filtered roughly through to house prices by now. To the extent that there are now new unforeseen shocks to the economy, the development of fundamental factors such as interest rates and income are therefore expected to drive housing prices.

CHART 2

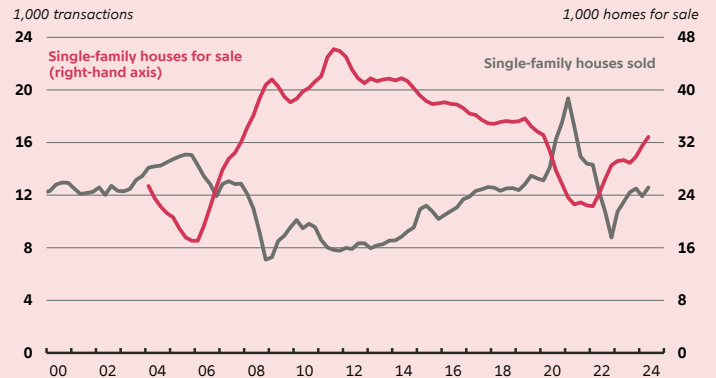
### House prices have risen since the beginning of 2023, especially nominal prices



Note: Real house prices are deflated with consumer prices and all series are seasonally adjusted. House prices are from Statistics Denmark until Q1 2024 and are extended with data from Boligsiden in Q2 2024.  
Source: Statistics Denmark, Boligsiden, Macrobond.

CHART 3

### Trading activity in the house market has increased since the beginning of 2023



Note: Transaction data are from Statistics Denmark until Q1 2024 and are extended with data from Boligsiden in Q2 2024. The series are seasonally adjusted.  
Source: Finance Denmark, Boligsiden, Macrobond.

### House prices are determined by fundamental factors

To assess how house prices have developed in recent years, and in particular why prices started to rise in early 2023, it is necessary to look at the underlying factors driving the housing market. As with most other markets, house prices are determined by supply and demand. The supply of housing is fixed in the short term, as it takes time to plan and execute construction projects and change the housing stock. The development in demand is therefore what mainly drives

house prices in the short term. In the longer term, supply will adapt to changing conditions, which will meet changing demand. It is important to understand the dynamics of the housing market, as the market itself can amplify fluctuations in the economy, for example through private consumption. In other situations, it is the development of economic conditions that drives the housing market.

Household demand for housing is determined by a wide range of fundamental factors that can be divided into cyclical and structural factors. Cyclical factors include things like income, interest rates, and inflation, and are illustrated by the fact that housing prices adjusted for inflation or income develop more steadily than nominal housing prices, as shown in chart 2. Read more about nominal and real house prices and interest rates in box 1. Structural changes such as changes in lifestyle, demographics, taxes, or regulation can also affect demand. Among other things, housing taxes, working from home and regulation are considered to have affected the housing market over the past decade, as discussed further in chapters 3-5. Demographics are not considered to have been a significant factor nationally in recent years, as the number of homes nationwide has followed the development in the number of families. However, there can be regional shifts in housing demand due to population movements from the countryside into towns, for example.

#### BOX 1

##### **Real house prices reflect developments in housing demand**

House prices can be calculated in several ways and there are significant differences in interpretation of the different calculations. House prices are observed nominally, in monetary terms, and it is the nominal house prices that are directly involved in many housing-related decisions. They are also the ones for which forecasts are ultimately reported. However, house prices are modelled in real terms, where they are compared to consumer prices, and it is largely real house prices that are ultimately relevant to the decisions of both home buyers and owners.

##### **Housing consumption should be seen in relation to other consumption**

Nominal house prices rise on average over time, as do the prices of most other consumer goods and assets.<sup>1</sup> This is, firstly, a consequence of inflation, which most countries – directly or indirectly – aim to keep positive, but low and stable. Inflation expectations affect wage formation, and therefore incomes increase due to inflation among other things, which ultimately leads to real household income being what is negotiated in collective bargaining. Secondly, wages in a market economy will typically reflect the development of productivity, so nominal wages increase more than inflation when there is positive productivity growth. The driving forces behind wage development are important for the housing market, as income development plays a central role in price formation in the housing market. This is because the demand for housing reflects a trade-off between how much households are willing to spend on other consumption versus housing. There can be considerable variation in how much of their income households want to spend on housing, and if housing is a luxury item, they will spend an increasing proportion of income on housing over time.

When determining housing demand, both current and future housing consumption and other consumption are taken into account. If housing consumption increases today, it will mean that, all else being equal, consumption options will be reduced in the future. The cost of moving home consumption forward in time is the interest rate after tax. If the cost is to be calculated in future consumption equivalents, the price is the real interest rate after tax, which takes into account that other consumption in the future is expected to be more expensive than today. Therefore, real house prices and real interest rates after tax are what will be interesting for household behaviour and thus for housing demand.

##### **Inflation has a direct impact on house prices**

When inflation develops steadily and in line with expectations, it will lead to higher house prices in nominal terms, but not in real terms. House prices only increase in real terms if there is positive productivity growth or other factors that cause real incomes to rise, or if there are changes in other factors that affect housing demand. However, if there are large, unexpected fluctuations in inflation, inflation itself can contribute directly to the development of real house prices. This is because unexpected inflation shifts the relationship

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between the relative prices of housing and other consumption. A supply shock that drives up inflation will reduce overall consumption options for households as real incomes fall. To the extent that housing is a luxury item and other consumption is a necessity, it will reduce the relative demand for housing and thus real house prices. There may also be actual or psychological costs associated with downgrading other consumption that leads to a reduction in housing demand and prices.

Inflation and productivity developments cause house prices to be modelled econometrically in real terms and in changes for statistical reasons. This is because the two factors lead to house prices having two so-called stochastic trends, which are ultimately consequences of monetary policy and technological development. Stochastic trends mean that conclusions cannot be drawn from an econometric house price model unless they are addressed directly. Modelling real house prices eliminates the trend from monetary policy and modelling the changes (growth) handles technological developments. This naturally has implications for the interpretation of the model's estimated parameters; for example, interest rate sensitivity should be interpreted as the effect on real house prices.

<sup>1</sup> Housing can be seen both as a durable consumption good, which mainly applies to the building that depreciates over time if not maintained, and as an asset, particularly in relation to the land.

Developments in the housing market are ultimately a consequence of individual decisions made by buyers and sellers. In this way, general optimism or pessimism can also influence house price movements beyond what fundamental factors can explain. This happened before the financial crisis, when overoptimism led to a house price bubble.<sup>8</sup> This trend is reflected in the housing cost burden, which measures how much a fully debt-financed homebuyer needs to spend on average from their income to pay for a house (hereafter referred to as the stylised housing cost burden).<sup>9</sup>

Danmarks Nationalbank has developed a new calculation of the actual housing cost burden for homebuyers back to 2009 based on data for individual homebuyers, see box 2. The actual housing cost burden differs from the stylised housing cost burden in that it shows the proportion of homebuyers' income that they actually choose to spend. There are many possible explanations for why the actual and stylised housing cost burdens differ from each other in level and development. One explanation is as an example that there are various compositional effects, meaning that the average homebuyer is not expected to be similar to the average household in terms of income, and that homebuyers do not fully finance their home purchases through debt.

Data in the new analysis of actual housing cost burden only partially covers the recent period of rising interest rates, but overall, the actual housing cost burden indicates that rising interest rates have caused homebuyers to as an example adjust down payments or home size, so the impact on budgets is limited. In particular, homebuyers who are paying off their housing debt dedicate a stable share of their income to housing. Homebuyers who do not pay off their mortgage debt are more likely to follow the development of the path seen in the stylised housing cost burden.

<sup>8</sup> See Simon Juul Hviid, A leading indicator of house-price bubbles, *Danmarks Nationalbank Working Paper*, no. 114, April 2017.

<sup>9</sup> See box 5.4 in Danmarks Nationalbank, Developments in the Market for Owner-Occupied Housing in Recent Years – Can House Prices be Explained?, *Danmarks Nationalbank Monetary Review Part 2*, Q1, March 2011.

BOX 2

**The new calculation method shows that homebuyers who pay off mortgage loans spend a stable share of their income on home purchases**

To determine how much of a household's disposable income goes towards financing a home, the *housing cost burden* is calculated. This figure is used to provide insight into whether homes have become more or less expensive over time, taking into account changes in interest rates, house prices, taxes and income. Normally, a *stylised housing cost burden* is calculated on macro-figures, based on the financing and tax payment of a fully mortgaged average house in relation to the average disposable income nationwide. This method has the advantage that the housing cost burden can be calculated with only a quarter's delay and thus be reasonably current.

To get a better insight into how homebuyers actually act, Danmarks Nationalbank has calculated the *actual housing cost burden* for single home purchases based on micro-data from Statistics Denmark's register data. The results show that homebuyers' actual housing cost burden differs from the stylised housing cost burden when they buy a home financed with a repayment mortgage, see chart A. The actual housing cost burden is relatively smooth, indicating that homebuyers respond to changes in input variables. For a given income, this means that homebuyers will either buy a cheaper home or take on less debt and use other assets in the purchase. In addition, the actual housing cost burden is lower than the stylised one, for example indicating that homebuyers are not fully mortgaging their home. However, it should be added The difference is also due to that disposable income used in the stylised housing cost burden is being an average income for all households, while the income in the actual housing cost burden only applies to homebuyers.

Homebuyers who use deferred amortisation have a lower and more uneven actual housing cost burden that more closely resembles the stylised one, see chart B. This is natural, as the interest rate on a loan with deferred amortisation is included 1 to 1 in the loan payment, which differs from a repayment mortgage, where a higher interest rate will result in a lower instalment and thus a relatively lower increase in the monthly payment. The housing cost burden includes the monthly payment, even though instalments are not a cost but savings.

The calculation of the actual housing cost burden includes ordinary freehold property transactions in the period 2009-22 where mortgage loans were taken out. These sales are cross-referenced with a number of other registers so that the calculation includes data on mortgages on the home, homebuyers' income, land tax payments and property valuation. Based on mortgage information, a mortgage financing cost is estimated, and a distinction is made between loan types. Due to lack of information on bank financing, it is assumed to be a 20-year annuity loan with an interest rate that corresponds to the average lending rate of banks at macro-level. Next, the property value tax is estimated based on valuation information. This gives the following formula for the housing cost burden for each home purchase,  $i$ .<sup>1</sup>

$$\text{Actual housing cost burden}_i = \frac{\text{mortgage funding}_i + \text{bank funding}_i + \text{land value tax}_i + \text{property value tax}_i}{\text{disposable income}_i}$$

The new tool gives an indication of how much homebuyers actually react to changes in interest rates, for example. It also makes it possible to highlight differences in geography, age, housing type and loan type, which provides new opportunities to identify risks in the housing market.

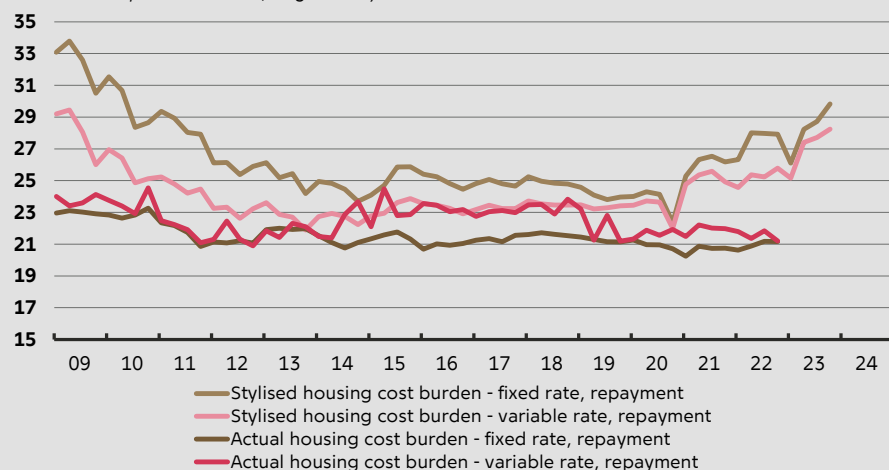
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CHART A

Homebuyers spend a fairly fixed proportion of their income on housing when they have a repayment mortgage...

Per cent of disposable income, single-family houses



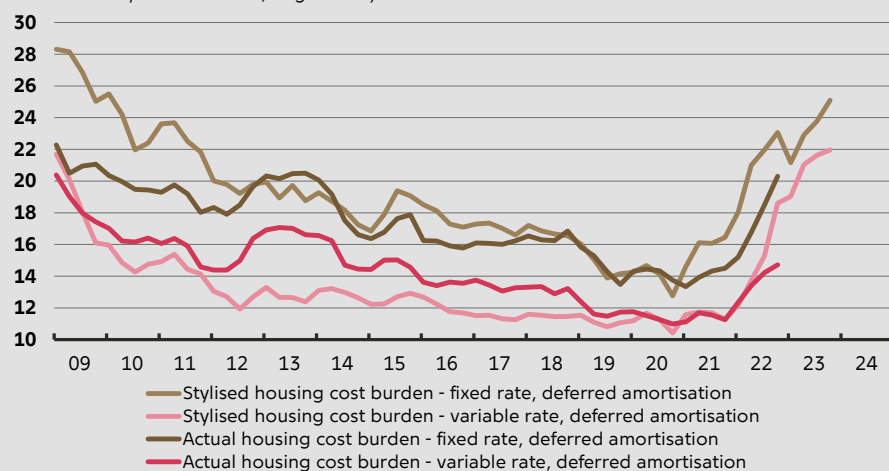
Note: Actual housing cost burden is the average value within each loan type. If a home is financed with several different types of loans, the purchase is categorised as variable-rate if at least one loan is variable-rate. The same applies to deferred amortisation. Stylised housing cost burden shows the cost of buying an average house up to the loan limit as a percentage of average disposable income. The series are seasonally adjusted.

Source: Own calculations based on register data from Statistics Denmark.

CHART B

... while homebuyers with deferred amortisation spend a more varied share of their income

Per cent of disposable income, single-family houses



Note: See note to Chart A.

Source: Own calculations based on register data from Statistics Denmark.

<sup>1</sup> To filter data for extreme and negative values, home purchases made by self-employed families and families with a gross income below kr. 50,000 have been removed. In addition, transactions for which the mortgage is taken out more than 30 days from the time of acquisition have been disregarded, as this can also result in extreme values – especially if it goes beyond the year-end. These are probably new builds or major renovations where intermediate financing is used for the home purchase. Finally, some minor adjustments have been made to the data, such as removing cases where the homebuyers’ ownership percentage does not add up to 100 per cent.

### **Direct and indirect effects from inflation were the main reason why house prices fell after the pandemic**

Towards the end of 2021, inflation gradually increased due to the pandemic lockdowns, economic policies, pressure on supply chains and reduction in the supply of natural gas from Russia, among other things.<sup>10</sup> In Q1 2022, inflation rose further, especially in connection with Russia's attack on Ukraine, after which house prices began to fall. Rising inflation affects house prices in the short and long term.

In the long term, all else being equal, nominal house prices will rise at the rate of inflation if price inflation is otherwise consistent across goods and services.<sup>11</sup> It can also be seen that there is a positive correlation between house prices and consumer prices in level. However, in the short term, inflation can have a negative impact on housing demand and therefore also nominal house price growth, especially when wage increases are more sticky than price increases, despite the positive effect in the long term. Indirect effects from high inflation such as rising interest rates will also drag down housing demand.

Inflation peaked in 2022 at a high of over 10 per cent, affecting homebuyers' budgets. Very high energy prices in particular made the cost of living in one's home more expensive, while overall inflation eroded purchasing power as wage increases did not immediately follow. Consumers therefore had less money left to spend on housing once the weekly shopping was paid for. It was also uncertain whether this was a permanent or temporary decline in households' real wages. This suppressed housing demand and contributed to a decline in house prices in real and nominal terms.

To provide further insight into the role of inflation in house price movement, house prices are broken down into different drivers, see chart 4.<sup>12</sup> The breakdown shows that it was mainly inflation – including the subsequent impact on interest rates – that pulled down house prices in 2022. The effect of inflation in the breakdown includes the direct effect, in which inflation mechanically pulls down real house prices, the effect of reduced purchasing power, and finally the indirect effect through the subsequent interest rate increases. The negative contribution from inflation contrasts with the previous 10 years, when it was modest due to the low and stable inflation level, see chart 4.<sup>13</sup> House price movements during this period were mainly driven by real income and wealth, as measured by GDP and equity growth, interest rates and non-cyclical factors, such as increased home appreciation towards the end of the period due to the pandemic, which may have led to higher demand for housing.<sup>14</sup> Towards the end of 2022 and through 2023, inflation fell sharply, helping to ease the downward pressure on the housing market. The drop in inflation was due to monetary policy tightening and especially the sharp falls in energy prices since the peak in autumn 2022, where the latter probably played a major role in mitigating the fall

<sup>10</sup> See Morten Spange and Thomas Harr, Inflation – why did it rise and what are the drivers ahead?, *Danmarks Nationalbank Economic Memo*, no. 3, February 2023.

<sup>11</sup> See box 4 in Danmarks Nationalbank, The pressure on the economy should be eased, *Danmarks Nationalbank Analysis (Outlook for the Danish Economy)*, no. 11, September 2022.

<sup>12</sup> See Jakob Roager Jensen and Jesper Pedersen, Macro-financial linkages in a SVAR model with applications to Denmark, *Danmarks Nationalbank Working Paper*, no. 134, January 2019. Part of the inflationary effect on house prices comes from changes in interest rates due to monetary contractions implemented in response to inflationary developments. It is not possible to separate the direct and indirect inflation effects through interest rates. This is because a shock to both inflation and interest rates is primarily considered an inflationary shock because inflation is placed before interest rates in the macroeconomic model. It is standard practice in this type of model to place variables with the fastest response to shocks, such as interest rates, last in the model.

<sup>13</sup> Inflation naturally appears in the denominator on the left-hand side, which means there may be concern that the results reflect a mechanical relationship. However, a similar model with nominal house prices leaves the same impression, so the concern is limited. But modelling nominal house prices leads to other statistical concerns about the movement of nominal house prices, which is why the breakdown of real house prices is used here.

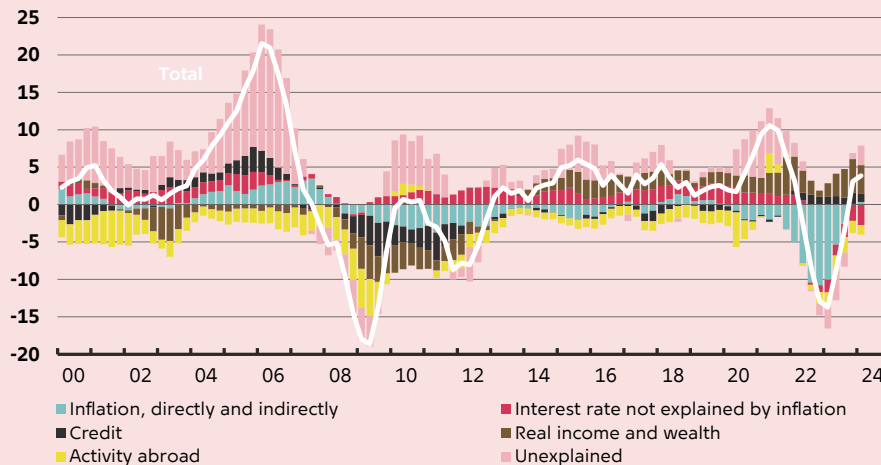
<sup>14</sup> See Simon Thinggaard Hetland, Simon Juul Hviid, Jesper Pedersen and Adrian Michael Bay Schmith, Housing market robustness should be strengthened, *Danmarks Nationalbank Analysis*, no. 16, June 2021.

in house prices as a major uncertainty among households was significantly reduced.

CHART 4

**Inflation shocks have directly and indirectly dragged down house prices**

Contribution to year-on-year changes in real house prices, percentage points



Note: The chart shows the contribution to annual change in real house prices from shocks to inflation (including oil prices), mortgage rates, credit, real income, and wealth (measured by GDP and equities), foreign activity and other factors (unexplained). The contribution from inflation covers the direct effect of inflation and oil prices on house prices and the indirect effect through higher interest rates, see more in footnote 12. The contribution from interest rates should thus be seen as the effect of interest rate changes that are not due to the development of inflation. The calculations are based on a macroeconomic model that largely corresponds to Jakob Roager Jensen and Jesper Pedersen, Macro-financial linkages in a SVAR model with applications to Denmark, *Danmarks Nationalbank Working Paper*, no. 134, January 2019.

Source: Statistics Denmark and own calculations.

**Rising real wages push up house prices**

Household income is another important factor in the movement of house prices. Income is made up of multiple elements, including not only wages, but also employment. Higher income will allow for more home consumption, and it is likely that an increase in income will lead to a slightly larger increase in house prices, meaning that housing is to some extent a luxury item. High inflation caused real wages to fall significantly in the latter part of 2021 and through 2022 as inflation picked up, and it wasn't until the collective labour agreements in 2023 that real wages really started to rise again. Since then, real wages have risen above pre-inflation levels, see chart 5.

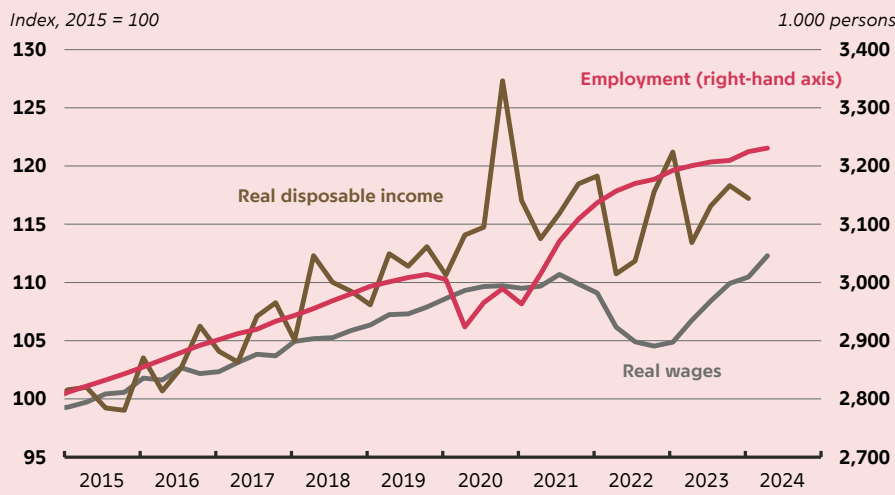
Prices in the housing market are also linked to overall employment, which lifts overall income. In the years following the financial crisis, employment increased steadily until the corona pandemic, when employment fell significantly, see chart 5. After the pandemic, employment has increased significantly. The increase in employment is a result of a structural increase in labour supply and a relatively low price of labour for a period of time.<sup>15</sup> These factors increase overall household income and thus contribute to higher house prices. Employment

<sup>15</sup> See Andersen, Bonin, Borgensgaard, Dahl-Sørensen, Darougheh, Grenestam, Hansen, Hviid, Jensen, The pressure on the labour market has eased after a job-intensive expansion, *Danmarks Nationalbank Analysis*, no. 4, March 2024.

growth has been surprisingly strong and may be one of the reasons why house prices have increased more than expected since the beginning of 2023. The structural increase in labour supply and its effect on employment is an independent contribution to housing demand that is not directly related to inflation.

CHART 5

**Real wages have increased since the beginning of 2023**



Note: Latest observation is Q2 2024 for employment and real wages, and Q1 2024 for real disposable income. Real wage is measured by the wage statistics from the Confederation of Danish Employers.

Source: Statistics Denmark, Confederation of Danish Employers, own calculations.

**Interest rate rises have suppressed house prices**

Interest rates play an essential role in the demand for housing, partly because home purchases are usually financed by loans to a significant extent. All else being equal, an increase in interest rates increases the user price of housing, which lowers demand and is reflected in lower house prices in the short term.<sup>16</sup> The opportunity cost also increases at a higher interest rate level, so there may be a substitution towards other investments.

In response to rising inflation, central banks around the world have raised monetary policy interest rates, and market interest rates were already rising in anticipation. The European Central Bank, ECB, began raising interest rates in the summer of 2022 and continued with gradual rate hikes until autumn 2023, totalling 4.5 percentage points. Similarly, monetary policy interest rates in Denmark have increased by 4.2 percentage points. Monetary policy interest rates have since been reduced by a total of 0.5 percentage points by the ECB and in Denmark in June and September 2024. Anticipation of the monetary policy reaction led to longer term mortgage rates already starting to rise before the first increase in short-term monetary policy interest rates. Overall, this has led to an interest rate level that is higher today than it has been for many years, see chart 6. The interest rate on a 30-year fixed-rate mortgage has increased by around 3 percentage points since 2019. However, included in this is that interest

<sup>16</sup> See James Poterba, Tax subsidies to owner-occupied housing: an asset market approach, *The Quarterly Journal of Economics*, Vol. 99, no. 4, November 1984.

rates have fallen by approximately 1 percentage point since autumn 2023 and that the interest deduction offsets some of the increase in interest rates, so the increase after tax is just over 2 percentage points.<sup>17</sup>

In addition to the interest deduction, the annuity principle, which is a fundamental part of the Danish mortgage system, can play a role in the effect of rising interest rates. Danish repayment mortgage loans are largely annuity loans where the payment is fixed over the term of the loan. When interest rates rise, the payment will not increase accordingly, as the instalment will decrease, when mortgages are being amortised. This means that the payment on new mortgages increases significantly less than interest rates, and to the extent that homebuyers react to the payment rather than the interest rate, it can minimise the effect of rising interest rates.<sup>18</sup>

A change in interest rates must be seen in the context of the development and expectation of inflation, which is reflected in the so-called real interest rate. It is mainly real interest rates after tax that should influence housing demand, see box 1. Real interest rates are not directly observable as they depend on the yield curve and inflation expectations over the same time horizon.<sup>19</sup> In chart 6, interest rates minus Danish households' inflation expectations one year ahead are illustrated as a rough proxy for real interest rates.<sup>20</sup> Since 2019, after-tax interest rates have increased less when inflation expectations are deducted, see chart 6. However, when comparing interest rates *after* tax and inflation expectations to nominal interest rates *before* tax, which are the interest rates usually mentioned in the media and observed by homebuyers, pre-tax interest rates have increased by 1.7 percentage points more since 2019. This difference may partly explain why nominal interest rate increases have not had a greater impact than seems to be the case.

However, nominal interest rate increases in themselves can potentially reduce housing demand through a liquidity effect for an otherwise unchanged real interest rate or through money illusion when consumers focus too much on nominal values and not on the purchasing power of those values. In addition, lending rules introduced after the financial crisis may have led to a slight decrease in the interest rate sensitivity of housing demand, see chapter 5 below.

<sup>17</sup> A tax deduction of just under 34 per cent has been used to calculate the interest after tax, which does not take into account that the actual tax deduction may decrease when interest rates increase as a result of the break in the interest deduction, where the interest deduction drops by 8 percentage points on interest payments above kr. 50,000 per person. At the low interest deduction, the increase since 2019 is approximately 2.3 percentage points. The interest deduction has not changed since 2019, when it had been gradually lowered over several years, and therefore is not considered to have had a significant impact on price dynamics in recent years.

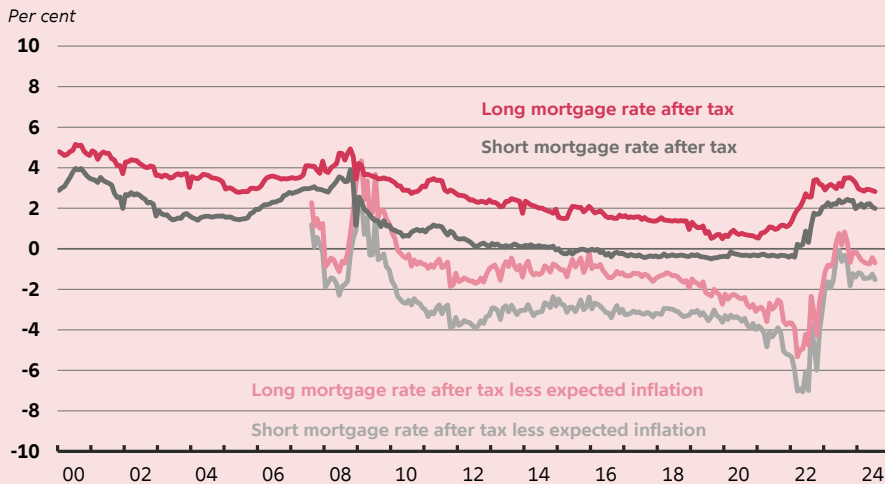
<sup>18</sup> See Danmarks Nationalbank, Economic implications of interest-only mortgages combined with high leverage, *Danmarks Nationalbank Analysis*, no. 8, April 2024

<sup>19</sup> Data is available for one-year inflation expectations for Danish households, but when looking at long-term mortgage rates, it is insufficient to determine the actual real interest rate. There are no financial instruments in Denmark from which market inflation expectations can be derived.

<sup>20</sup> Inflation expectations are household questionnaire-based inflation expectations for the next 12 months weighted by the difference between actual and perceived inflation, i.e. that households which neither overestimate nor underestimate the actual price increases are given a higher weight.

CHART 6

**Since 2019, after-tax interest rates have risen less when inflation expectations are deducted**



Note: Latest observation is July 2024.  
Source: Finance Denmark, Statistics Denmark, and own calculations.

To assess how the dynamics of house prices can be expected to develop after an interest rate increase, a statistical model is used to analyse the relationship between house prices and interest rate changes, see box 3. The model indicates that the interest rate pass-through on house prices takes around 6 quarters to be fully phased in. Today, more than 8 quarters have passed since the first and more than 4 quarters since the last interest rate hikes; interest rates have fallen slightly again over the past year; and market expectations point to further interest rate falls. Against this background, the overall effect of monetary contractions since 2021 is estimated to have more or less materialised in house prices. There is significant uncertainty in the estimation results regarding the magnitude of the effect of an interest rate increase on house price movement, but the results indicate that a nominal after-tax interest rate increase of 1 percentage point typically leads to a nominal decrease in house prices of 10 per cent, all else being equal.<sup>21</sup>

As mentioned earlier, after-tax interest rates have risen by around 2 per cent in recent years, and according to the model, this would lead to a price drop of around 20 per cent, relative to the counterfactual scenario for house prices where interest rates had not been raised in response to inflation. This is significantly more than the actual decline in nominal house prices of 6.5 per cent through 2022 and a total of 1.8 per cent up until Q2 2024. The difference between the actual development and the model's results should be seen in light of several factors. Firstly, the results are measured relative to what would have happened in the absence of interest rate increases and not relative to the start time, all other things being equal. Since the beginning of 2022, wages have increased by 11.2 per cent, which will largely provide a similar boost to house prices in the short term. Employment increased by 3 per cent, which also boosts house prices through higher income. Secondly, the 20 per cent also includes indirect effects from the interest rate increases through decreases in economic

<sup>21</sup> The size of the effect is roughly consistent with the relationship between interest rates and house prices in Danmarks Nationalbank's macroeconomic model, MONA.



activity and inflation compared to a scenario where interest rates did not rise. Thirdly, the new housing tax system is expected to have caused house prices to rise in the run-up to its implementation, as property taxes have generally fallen for houses and risen for owner-occupied flats.<sup>22</sup> Fourthly, as mentioned earlier, the effect of interest rate increases is mitigated by the fact that the annuity principle in instalment mortgages means that the increase in payments is smaller than the increase in interest rates, and that the loan rules introduced after the financial crisis may have led to a slight decrease in interest rate sensitivity.

**BOX 3**

**Interest rate sensitivity of house prices**

Since mid-2022, monetary policy interest rates have increased significantly in a relatively short time. The same trend has been seen in mortgage interest rates, with first long-term and then short-term interest rates rising. In light of the large increases, it is relevant to assess what effect the higher interest rates have on house prices and how long interest rates can be expected to affect house prices. This can be done with a dynamic correlation analysis (*local projection model*).<sup>1</sup>

The idea is to estimate what changes in interest rates now mean for house prices in future quarters using different horizons. In practice, the following equation is estimated for each horizon,  $h = 0, \dots, 8$ :

$$\ln H P_{t+h} - \ln H P_{t-1} = \beta_1^h \Delta \text{interest}_{t-1} + \sum_{i=1}^8 \beta_2^i X_{t-i} + \varepsilon_{t+h}$$

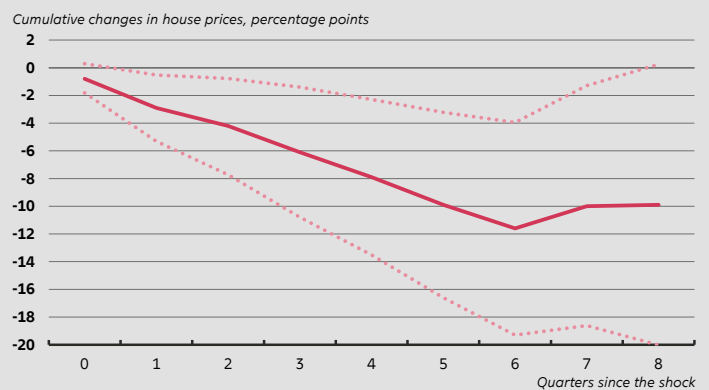
The left-hand side variable,  $\ln H P_{t+h} - \ln H P_{t-1}$ , is the accumulated change in nominal house prices measured in per cent between time  $t - 1$  and time  $t + h$ . The projection horizon is set to 8 quarters into the future. In the model, the change in the 30-year mortgage rate after tax over a quarter,  $\Delta \text{interest}_{t-1}$ , is used as a proxy for the change in housing financing costs.  $X_{t-1}$  is a series of control variables which include 8 lags of the left-hand side variable, house price growth, real GDP growth, changes in unemployment and inflation. Data covers the period from Q1 1993 to Q4 2023 and is drawn from the MONA databank. Newey-West standard errors are used to correct for any residual autocorrelation.

The results from the estimation of the model indicate that there is a significant decrease in house prices when interest rates rise, as it becomes more expensive to buy a home. A 1 percentage point increase in the nominal interest rate after tax is associated with a decrease in the nominal house price of around 8 per cent after one year and up to 10 per cent after two years, see chart. The maximum effect seems to have been realised after about a year and a half. The size of the effect is roughly consistent with the elasticity in the Danmarks Nationalbank's macroeconomic model, MONA.

<sup>1</sup> See Òscar Jordá, Estimation and inference of impulse responses by local projections, *American Economic Review*, vol. 95, no. 1, March 2005.

**CHART**

**House prices fall relatively quickly when interest rates rise**



Note: The solid line indicates the cumulative changes in nominal house prices from a 1 percentage point increase in the 30-year mortgage rate after tax. The dotted lines indicate 90 per cent confidence intervals.

Source: Danmarks Nationalbank and own calculations.

**Developments in interest rates and income will drive house prices going forward**

In recent years, the housing market has been driven largely by large shocks to the economy, and to a lesser extent the other way around. Overall, the downward pressure on house prices in 2022 was mainly driven by high inflation, and the subsequent rising interest rates on home loans. This eroded homebuyers' purchasing power and made it more expensive to finance a home, pushing down house prices. However, the impact of these shocks was mitigated by a sharp drop in inflation from late 2022. A significant recovery in real wages helped to counteract the short-term negative effect of inflation on house prices.

<sup>22</sup> Previous calculations have indicated a house price effect of 2.3 per cent, see the chapter, The decline in the housing market is affected by multiple factors, in Danmarks Nationalbank, Declining, but still high inflation, *Danmarks Nationalbank Analysis (Outlook for the Danish economy)*, no. 4, March 2023.

A slight decrease in interest rates since autumn 2023 and continued employment growth in the economy are helping to counteract the impact of negative demand shocks. Overall, the effect of the shocks of recent years is estimated to be roughly reflected in house prices today. Overall, it is expected that the future development of fundamental factors such as interest rates and income will drive house prices.

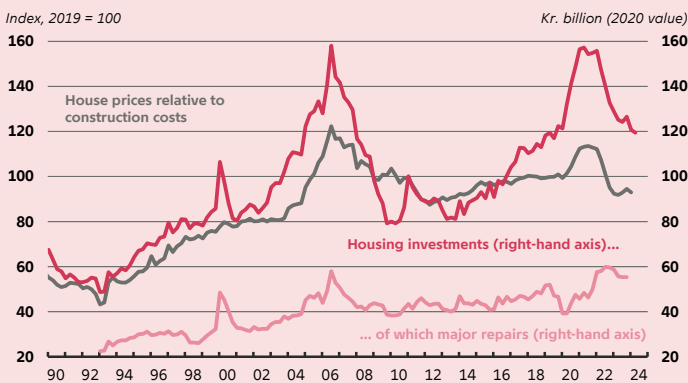
**Housing supply adjusts with a delay**

Over time, shifts in housing demand can be accommodated by adjusting the supply of housing, but adjusting the housing stock can be a time-consuming process. Changes in housing supply are determined by the relationship between sales prices and construction costs among other things. When house prices are high compared to construction costs, more construction typically starts, while the opposite leads to less construction until house prices adjust to supply. During the pandemic, when house prices soared, housing investment was also further fuelled, see chart 7. This increase in construction can help reduce house price growth in subsequent years. Since then, however, housing investment has declined, which is reflected in residential construction, see chart 8. Falling house prices and rising construction costs caused the ratio between the two to fall in 2022, which, all things being equal, reduces the incentive to build and may help to lift house prices in term.

Investments in the existing housing stock also affect house prices. Unlike an increase in housing stock, an improvement will lead to higher house prices. Since the pandemic, investments in major repairs to existing homes have increased, see chart 7. This contributes to boosting house prices.

CHART 7

**Construction costs have risen more than house prices in recent years**

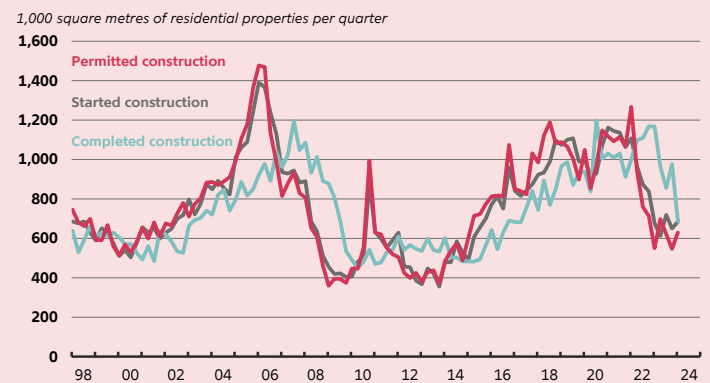


Note: Data is seasonally adjusted, and the latest observation is Q1 2024. The series for repairs is a special extract from Statistics Denmark and is subject to uncertainty. House price relative to construction costs is also called Tobin's Q.

Source: Statistics Denmark and own calculations.

CHART 8

**Residential property construction has declined**



Note: Data is seasonally adjusted. Statistics Denmark corrects construction data for delays via an estimation model due to delayed reporting. The data series should therefore be interpreted with caution, as the data foundation is uncertain when it comes to the most recent figures.

Source: Statistics Denmark.

## 03

# New housing taxes have affected housing demand

An essential element in the user cost of housing and thus the demand for housing is property taxes. In early May 2017, the government and a broad majority in the Danish parliament reached an agreement on housing taxation, initially from 2021, but implementation was later postponed to 1 January 2024 due to the postponement of property valuations. The implementation means that housing taxes will once again follow house prices, with an aim of stabilising the movement of house prices. Previous analyses have described the expected effects of implementing the new housing taxation system, and it is now possible to shed light on the immediate consequences of the implementation.<sup>23</sup> However, effects that can be linked to the time of implementation will only make up part of the overall effect of the housing taxation system. This is because to the extent that homebuyers and owners are forward-looking, some of the impact of the housing taxation agreement will already have had an effect on the housing market before implementation. Similarly, spillover effects from the rest of the economy can also affect the housing market.

### **The housing taxation agreement has stimulated price movement for some homes but suppressed it for others**

Property taxation consists of two separate taxes: property value tax and property tax (land tax). The housing taxation agreement changes both taxes. Existing homeowners who will have higher total property taxes as a result of the taxation agreement will be compensated via a tax rebate from the time of implementation. The rebate is set in nominal terms so that total housing taxes will not increase upon implementation for homeowners who purchased their home before 1 January 2024. However, from this year, homebuyers will no longer be eligible for a discount and will have to pay the new property tax.

To the extent that changes in housing taxes are capitalised in house prices, the agreement up to implementation should support house prices in the areas where housing taxes have been reduced the most, which are largely houses outside the major cities. In and around the larger cities and especially owner-occupied flats, where property taxes have increased more, house prices should, all else being equal, fall or rise less than they otherwise would have done around implementation. Whether changes in housing taxes have actually affected housing demand around implementation can be illustrated by looking at movements in trading activity and house prices around implementation. Here we are considering the four months window just before and just after the new taxation scheme was implemented. In the parts of the housing market where housing tax has increased, it is clear that trading activity has decreased on average after 1 January 2024 relative to in the parts where housing tax has been reduced, see chart 9. The effect of the relatively lower trading activity can also be seen in house prices, where rising property taxes in that part of the housing market are linked to a relatively lower price movement in the first half of 2024, see chart 10. There may be a wide range of other local or national factors that affect the housing market during the same period, but the actual movement is

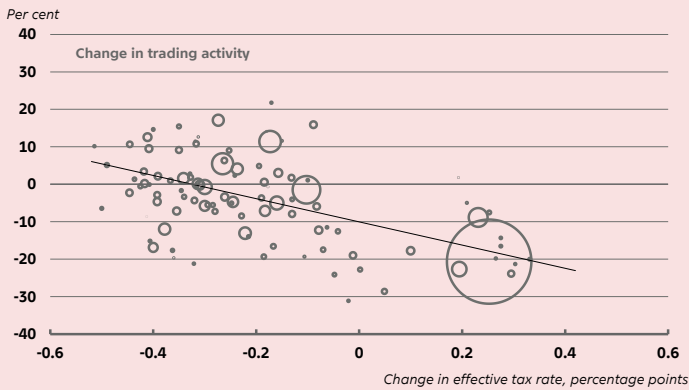
<sup>23</sup> See Simon Juul Hviid and Paul Lassenius Kramp, Housing taxation agreement stabilises house prices, *Danmarks Nationalbank Analysis*, no. 14, September 2017, and Simon Juul Hviid and Sune Malthe-Thagaard, The impact of the housing taxation agreement on house prices, *Danmarks Nationalbank Analysis*, no. 6, March 2019.

generally in line with expectations. The slope of the trend line in chart 10 indicates that an increase in the effective tax rate of 1 percentage point leads to a fall in house prices of 4,4 per cent.<sup>24</sup> The effect is comparable to the (after tax) interest rate sensitivity, which is estimated to be around double the size. The difference should be interesting in light of the fact that the implementation of the new housing taxation scheme has been known a long time prior to the actual implementation and, hence, parts of the effect can be capitalised in house prices even before the implementation.<sup>25</sup>

CHART 9

**Trading activity has decreased slightly in municipalities where property taxes have increased**

Change in trading activity from before to after housing tax reform implementation across municipalities and property types



Note: Each circle in the chart represents houses or flats in one of the country's municipalities. There are 84 municipalities for houses and 14 municipalities for flats with sufficient data. The horizontal axis shows the change in the effective tax rate for the typical home in that group of homes as a result of the transition to the new housing taxation system. The typical home is defined by the Danish Ministry of Taxation. The vertical axis shows the percentage change in trading activity (left) and housing prices (right), respectively, from four months before to four months after the implementation of the new housing taxes. The diameter of the circles is proportional to the trading activity within the residential group in 2023. The solid line shows a linear regression between the change in the effective tax rate and the change in trading activity (left) and housing prices (right) weighted with the trading activity from 2023.

Source: Boligsiden, Ministry of Taxation and own calculations.

CHART 10

**Prices have increased slightly more in municipalities where property taxes have decreased**

Change in house price from before to after implementation of housing tax reform across municipalities and housing types



**The tax rebate has not significantly accelerated home purchases**

For most homebuyers, there has been no financial incentive to bring forward home purchases to before implementation just to get a tax rebate. This is because, all else being equal, house prices should fall more upon implementation than the value of the tax rebate until the house is sold again. Therefore, it is typically not financially advantageous to bring forward home

<sup>24</sup> The results are based on a regression, where each municipality-/housing type is weighted by the trading activity in 2023. The results are significant at a 1-percentage level. Robust standard errors have been applied.

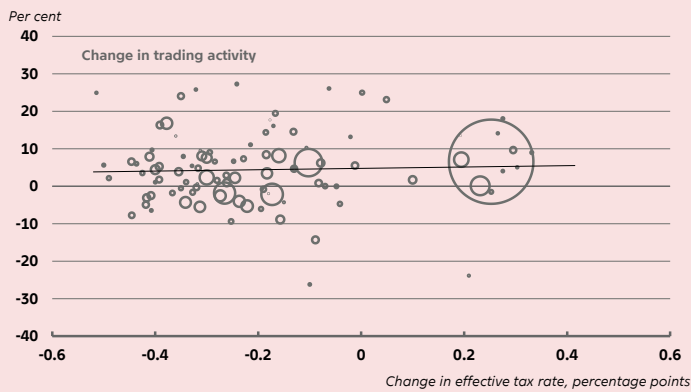
<sup>25</sup> See Simon Juul Hviid and Paul Lassenius Kramp, Housing taxation agreement stabilises house prices, *Danmarks Nationalbank Analysis*, no. 14, September 2017.

purchases just to get the tax rebate.<sup>26</sup> For homebuyers who expect to stay for a very long time, the value of the discount may be greater than the expected negative effect on the house price. However, this requires a certain amount of capitalisation to be done before implementation. The benefit disappears completely if buyers bid up the price of the home prior to implementation. Looking at the period leading up to the implementation, there is a no significant relation between the future tax rebate and trading activity or house price growth, see charts 11 and 12.<sup>27</sup>

CHART 11

### No correlation between trading activity and tax rebates prior to the implementation of the new property taxes

Change in trading activity up to implementation of housing tax reform across municipalities and property types



Note: Each circle in the chart represents houses or flats in one of the country's municipalities. There are 84 municipalities for houses and 14 municipalities for flats with sufficient data. The horizontal axis shows the change in the effective tax rate for the typical home in that group of homes as a result of the transition to the new housing taxation system. The typical home is defined by the Danish Ministry of Taxation. The vertical axis shows the percentage change in trading activity (left) and housing prices (right), respectively, from May to August 2023 to the four months before the implementation of the new housing taxes (September to December). The diameter of the circles is proportional to the trading activity within the residential group in 2023. The solid line shows a linear regression between the change in the effective tax rate and the change in trading activity (left) and housing prices (right) weighted with the trading activity from 2023

Source: Boligsiden, Ministry of Taxation and own calculations.

CHART 12

### The prospect of a tax rebate has not led to rising prices before the implementation of the new property taxes

Change in house price up to implementation of housing tax reform across municipalities and housing types



### Property taxes will dampen fluctuations in house prices

From this year, property taxes will once again suppress fluctuations in house prices and thus also the economy more generally.<sup>28</sup> This is an important automatic stabiliser in the Danish economy, which benefits macroeconomic and financial stability in Denmark. Current housing taxes will now once again follow

<sup>26</sup> See Simon Juul Hviid and Paul Lassenius Kramp, Housing taxation agreement stabilises house prices, *Danmarks Nationalbank Analysis*, no. 14, September 2017.

<sup>27</sup> It should be noted that any acceleration of home purchases may have occurred over a longer period of time, especially given that housing taxes were announced well in advance of their final implementation.

<sup>28</sup> See Simon Juul Hviid, Tina Saaby Hvolbøl, Asbjørn Klein, Paul Lassenius Kramp and Erik Haller Pedersen, House price bubbles and the advantages of stabilising housing taxation, *Danmarks Nationalbank Quarterly Review*, Q3, September 2016.

house prices, so that taxes paid increase when house prices rise and conversely also decrease when house prices fall. This will serve the purpose of reducing housing demand when house prices rise, but supporting it when house prices fall. All things being equal, this will reduce fluctuations in house prices.

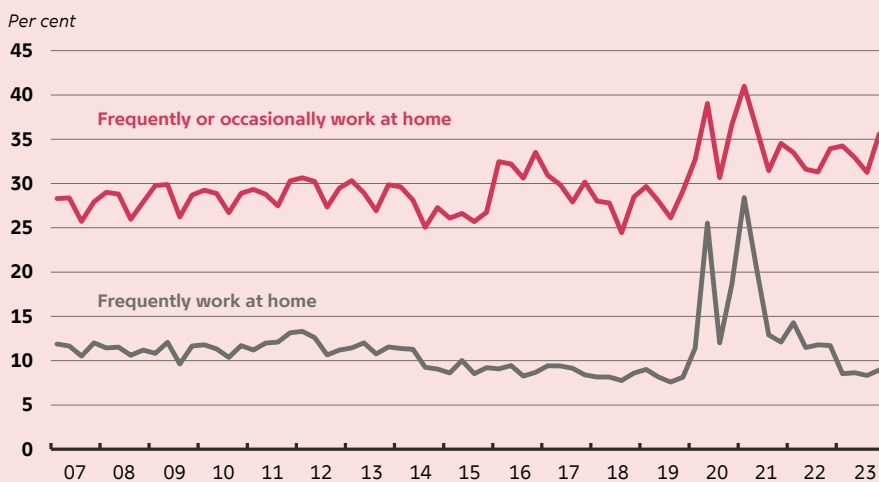
# 04 More working from home has increased housing demand

Working from home became more common during and after the corona pandemic. According to figures from Statistics Denmark, an average of around 34 per cent of employees worked at home during 2020-23. This is a significant increase compared to the years 2017-19, when the corresponding share was around 28 per cent, see chart 13. During the pandemic, there was a particularly significant increase in the proportion of people who frequently worked at home during lockdowns.

CHART 13

## Increased homeworking during and after the pandemic

Share of employees working from home



Note: Frequent home workers are people who work at home for at least half of their working hours. People who occasionally work at home are people who work at home for less than half of their working hours. Calculated based on micro-data from Statistics Denmark's Labour Force Survey (LFS).

Source: See upcoming Danmarks Nationalbank Working Paper by Kim Abildgren, Simon Juul Hviid and Andreas Kuchler.

## More working from home has changed housing needs

Working from home can create the need for a home office and increase the time spent at home. Therefore, all other things being equal, more homeworking could increase the demand for housing. The lockdowns during the pandemic may have broken down some formal and psychological barriers to working from home, thereby contributing to a more sustained increase in housing demand. Increased

homeworking may have contributed to upward pressure on house prices through its impact on housing demand.<sup>29</sup>

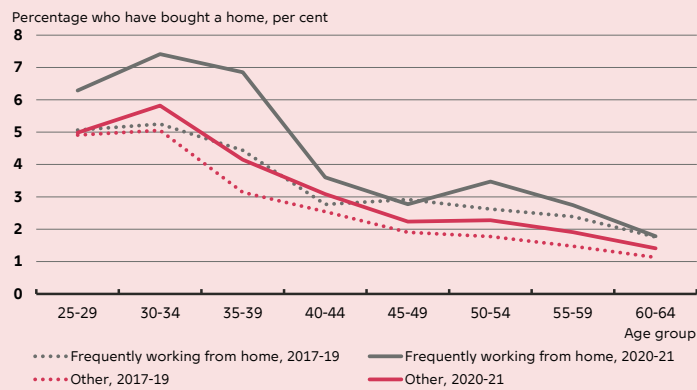
The hypotheses on increased homeworking are supported in an upcoming study from Danmarks Nationalbank on the impact of homeworking on housing demand during the pandemic.<sup>30</sup> The study is based on microdata from Statistics Denmark’s Labour Force Survey, which has been combined with other data from Statistics Denmark’s registers. The Labour Force Survey is based on interviews with around 50,000 people per year, and the interviewees are asked about how often they work from home, among other things.

The study shows that people who frequently work from home were more likely to buy a home during the 2020-21 pandemic. This was especially true for younger people in the 25-39 age group, see chart 14. There was also a tendency for younger people who frequently work from home to buy larger homes than they did before the pandemic, see chart 15. In 2022, younger people who frequently work from home were still more likely to buy a home than before the pandemic, but they no longer bought larger homes than they did before the pandemic. This may be because house prices soared during the pandemic.

CHART 14

**Younger people who frequently worked from home were more likely to buy homes during the pandemic**

Propensity to buy a home



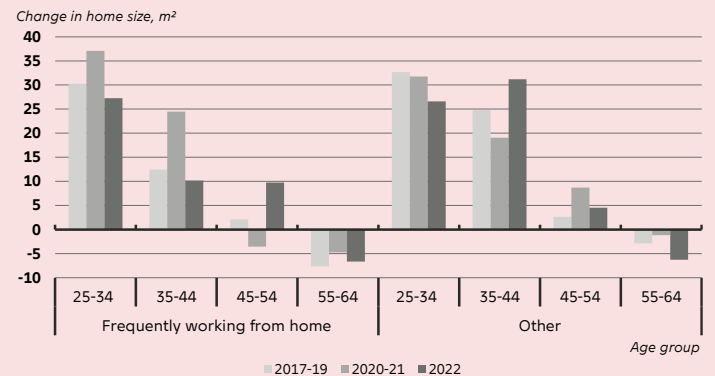
Note: Frequent home workers are people who work at home for at least half of their working hours. Calculated based on micro-data from Statistics Denmark’s Labour Force Survey (LFS).

Source: See upcoming Danmarks Nationalbank Working Paper by Kim Abildgren, Simon Juul Hviid and Andreas Kuchler.

CHART 15

**Younger age groups who frequently work from home bought larger homes during the pandemic**

Change in home size when moving to a new home



Note: The chart shows the difference between the size of a new owner-occupied home and the home being moved from. The vacated property can either be an owner-occupied home or a rental property. Frequent home workers are people who work at home for at least half of their working hours. Calculated based on micro-data from Statistics Denmark’s Labour Force Survey (LFS).

Source: See upcoming Danmarks Nationalbank Working Paper by Kim Abildgren, Simon Juul Hviid and Andreas Kuchler.

<sup>29</sup> See Simon Thinggaard Hetland, Simon Juul Hviid, Jesper Pedersen and Adrian Michael Bay Schmith, Housing market robustness should be strengthened, *Danmarks Nationalbank Analysis*, no. 16, June 2021.

<sup>30</sup> Upcoming Danmarks Nationalbank Working Paper by Kim Abildgren, Simon Juul Hviid and Andreas Kuchler.

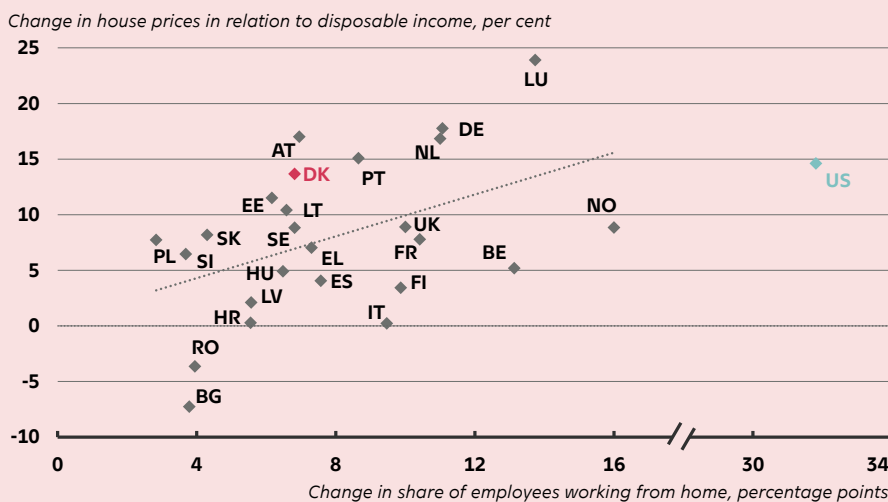


### Increased homeworking raised house prices during the pandemic

A recent study from the US has suggested that the rise in house prices during the pandemic can partly be attributed to increased homeworking.<sup>31</sup> There is also a broader trend across countries showing that housing prices during the pandemic rose the most relative to disposable income in those countries that experienced the greatest increase in remote work, see chart 16.

CHART 16

### House prices rose the most in countries with the largest increase in home working during the pandemic



Note: The x-axis shows the change in the share of employees working from home from 2017-19 to 2020-21. The y-axis shows the change in house prices relative to disposable income from H2 2019 to H2 2021. The regression line excludes the US, which is identified as an outlier. The slope coefficient in the regression line is significantly different from zero at a significance level of 5 per cent. Country codes in the chart correspond to the following: AT: Austria; BE: Belgium; BG: Bulgaria; DE: Germany; DK: Denmark; EE: Estonia; EL: Greece; ES: Spain; FI: Finland; FR: France; HR: Croatia; HU: Hungary; IT: Italy; LT: Lithuania; LU: Luxembourg; LV: Latvia; NL: Netherlands; NO: Norway; PL: Poland; PT: Portugal; RO: Romania; SE: Sweden; SI: Slovenia; SK: Slovakia; UK: UK; US: USA  
Source: OECD, Eurostat, WFH Research, Office for National Statistics.

The upcoming Danish study, like the American study, investigates whether there is a more direct correlation between the development in homeworking and house prices. This is done by comparing the increase in house prices in each municipality in the years 2019-21 to the increase in the same period in the proportion of people employed in the municipality who worked from home, see chart 17. The data shows a significant tendency that municipalities with the largest increase in home working were also those that experienced the largest increases in house prices. Such a significant trend was no longer seen in 2022, when the share of employees working from home decreased by around 3 percentage points compared to 2020-21, see chart 18.

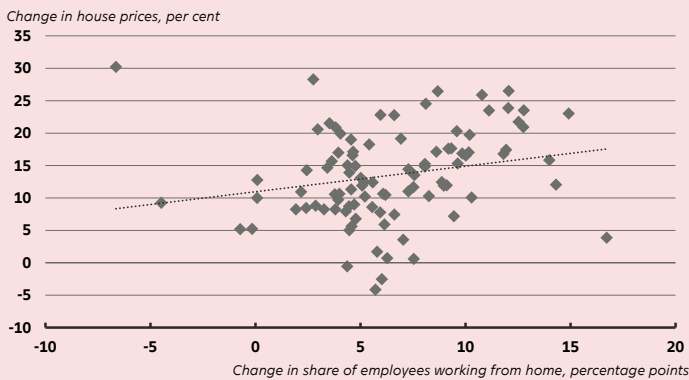
The correlation between the development of homeworking and house prices in municipalities during the pandemic can be summarised by the trend line in chart 17. It indicates that, all else being equal, a 1 percentage point increase in the

<sup>31</sup> See John Mondragon and Johannes Wieland, Housing demand and remote work, *Federal Reserve Bank of San Francisco Working Paper*, no. 11, May 2022.

share of people working from home has resulted in house price growth of around 0.4 per cent. The share of people working from home increased by around 7 percentage points on average from 2017-19 to 2020-21. This has meant an increase in house prices during the pandemic of almost 3 per cent if the correlation from the trend line in chart 17 can be used as a basis for assessment.

CHART 17

**The movement in house prices in each municipality was linked to the development of homeworking during the pandemic**

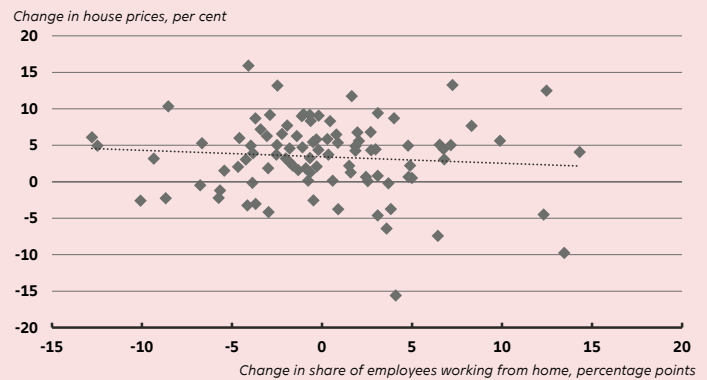


Note: The x-axis shows the change from 2017-19 to 2020-21 in the proportion of employees in the municipality of residence who worked from home. The y-axis shows the change in house prices in the municipality from H2 2019 to H2 2021. Calculations based on microdata from Statistics Denmark's Labour Force Survey (LFS) and wealth register. The slope coefficient in the regression line is significantly different from zero at a significance level of 5 per cent.

Source: See upcoming Danmarks Nationalbank Working Paper by Kim Abildgren, Simon Juul Hviid and Andreas Kuchler.

CHART 18

**House price movement in individual municipalities did not correlate with the development of homeworking in 2022**



Note: The x-axis shows the change from 2020-21 to 2022 in the proportion of employees in the municipality of residence who worked from home. The Y-axis shows the change in house prices in the municipality from H2 2021 to H2 2022. Calculations based on microdata from Statistics Denmark's Labour Force Survey (LFS) and wealth register. The slope coefficient in the regression line is not significantly different from zero at a significance level of 5 per cent.

Source: See upcoming Danmarks Nationalbank Working Paper by Kim Abildgren, Simon Juul Hviid and Andreas Kuchler.

**Working from home has led to a lasting increase in housing demand**

In summary, the Danish analysis indicates that, seen in isolation, increased homeworking put upward pressure on both housing demand and house prices during the pandemic. More generally, it is also conceivable that lockdowns and restrictions during the pandemic meant that households spent significantly more free time at home, which may have increased their appreciation of their home and thus also contributed to increasing their demand for housing.

The proportion of people working from home has remained fairly constant over the past few years at a level significantly above pre-pandemic levels. It is therefore reasonable to interpret the increase in homeworking during the pandemic as a one-off adjustment that provided a lasting boost to housing demand and an increase in house prices. This is consistent with the hypothesis in a previous analysis of the topic.<sup>32</sup> If the level of homeworking remains more or less unchanged in the future, homeworking will not be among the factors that influence movement in housing demand. In the longer term, the supply of housing is expected to adapt to the increase in housing demand due to homeworking.

<sup>32</sup> See box 1 in Simon Thinggaard Hetland, Simon Juul Hviid, Jesper Pedersen and Adrian Michael Bay Schmith, Housing market robustness should be strengthened, *Danmarks Nationalbank Analysis*, no. 16, June 2021.

# 05

## Mortgage rules limit housing market interest rate sensitivity

For most households, investing in a home is one of life's biggest financial decisions. Therefore, access to financing in the form of housing loans and other home loans plays a significant role in the overall demand in the housing market and can influence the level and movement in house prices.

In the wake of the financial crisis, where lenient credit terms contributed to the preceding housing bubble,<sup>33</sup> a number of tightened financial regulations were introduced, including the Executive Order on Good Practices for Mortgage Credit, the Supervisory Diamond and the Growth Guidelines. Most of the rules are based on the borrower's finances, as the loan rules are linked to, for example, the borrower's debt-to-income ratio and/or the loan-to-value ratio of the home.<sup>34</sup>

Overall, today's regulations are complex and cannot easily be reduced to a single measure that captures their common meaning for the housing market. By limiting homebuyers' loan composition and debt-to-asset ratio, the loan rules aim to reduce homeowners' vulnerability to falling house prices, rising interest rates and other economic fluctuations, thereby supporting financial stability.<sup>35</sup> By contributing to more robust home ownership, the loan rules may have helped to support housing demand and reduce homeowners' interest rate sensitivity.

### More homebuyers are choosing fixed-rate instalment loans

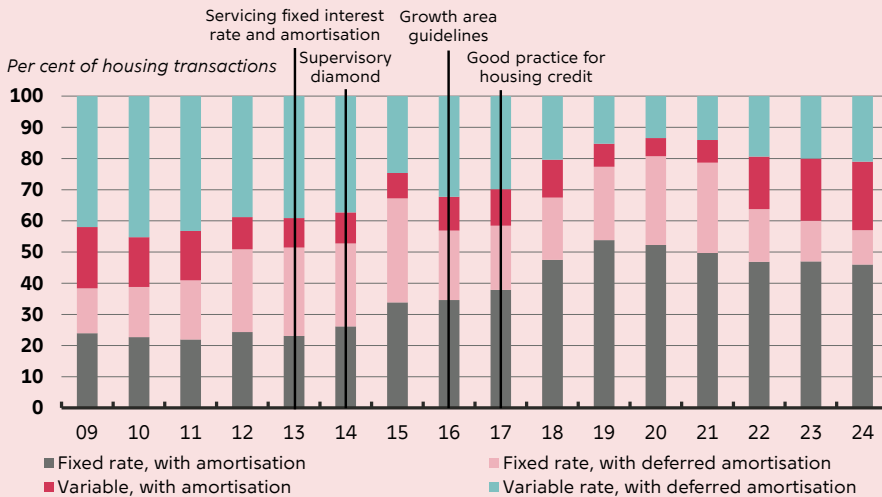
The loan rules include measures that reduce the use of interest-only and variable-rate loans for homeowners with the highest debt-to-income ratio. The aim is to reduce systemic risks to financial stability related to the most vulnerable homeowners. Before the introduction of the loan rules, around 40-45 per cent of homebuyers chose variable-rate loans without instalments, while 20-25 per cent chose fixed-rate loans with instalments, see chart 19. Since the loan rules were introduced, the share of fixed-rate instalment loans has increased significantly. There are several reasons behind this trend, including the development in the risk appetite of homebuyers, the lending policies of credit institutions and especially the yield spread between floating and fixed rate loans. However, the trend also coincides with the introduction of the loan rules.

<sup>33</sup> See Rangvid, Grosen, Østrup, Møgelvang-Hansen, Jensen, Thomsen, Schütze, Galbo, Ølgaard, Frederiksen and Poulsen, The financial crisis in Denmark: causes, consequences and lessons, *Ministry of Industry, Business and Financial Affairs Committee Report*, 2013, and Simon Juul Hviid, A leading indicator of house-price bubbles, *Danmarks Nationalbank Working Paper*, no. 114, April 2017.

<sup>35</sup> See The Systemic Risk Council's Recommendation, *Limiting risky loan types at high levels of indebtedness*, March 2017.

CHART 19

**The share of fixed-rate instalment loans increased after the introduction of loan rules**



Note: The chart shows the proportion of home purchases financed by fixed-rate and variable-rate loans, as well as loans with and without instalments. A home purchase is defined as ‘fixed-rate’ (‘variable-rate’) when the home purchase is financed using only fixed-rate loans (at least one variable-rate loan). Similarly, a home purchase is defined as ‘with instalments’ (‘without instalments’) when financed entirely by loans with instalments (at least one loan without instalments). Data for the years 2009-22 comes from register data from Statistics Denmark, and data for 2023-2024 comes from the Credit Register from Danmarks Nationalbank.

Source: Own calculations based on Statistics Denmark’s register data and Danmarks Nationalbank’s credit register data.

Variable-rate loans can offer a lower payment, as they usually have a lower interest rate than a fixed-rate loan, while instalment-free loans also have a lower payment, as the borrower only pays the interest on the loan. Both types of loans can cushion the impact of home purchases on household budgets. Especially in the most expensive parts of the housing market, the use of variable and interest-only mortgages can reduce any liquidity constraints for homebuyers and thus boost housing demand.<sup>36</sup>

As interest rates fell throughout the 2010s, demand for housing increased. As loan regulations limited the use of variable-rate and interest-only loans for less robust homeowners during this period, the loan composition requirements resulting from the loan regulations may have limited house price increases.<sup>37</sup>

**Mortgage rules can affect housing demand for the most vulnerable buyers**

Measures that limit homebuyers’ choice in terms of loan composition and loan size can lead to a decrease in housing demand when loan rules are binding. For example, the introduction of the so-called 4 per cent rule will limit borrowing for a proportion of homebuyers, as not all homebuyers who are able to buy a home with a variable rate loan will also be able to service a fixed rate loan with 4 per

<sup>36</sup> See Danmarks Nationalbank, Economic implications of interest-only mortgages combined with high leverage, *Danmarks Nationalbank Analysis*, no. 8, April 2024

<sup>37</sup> It should be noted that other factors, such as very low interest rates and credit institution lending policies, such as increasing and differentiated contribution rates, may also have contributed to the change in loan composition. However, lending rules play a fundamental role in limiting the use of variable-rate and interest-only loans to the most robust homeowners.

cent interest when interest rates are low.<sup>38</sup> Down payments and other restrictions related to home debt-to-asset ratios, which could reduce the ability of homebuyers to pay, will also reduce demand, especially for first-time buyers.<sup>39</sup>

Mortgage rules can also affect housing demand among existing homeowners. Especially among older homeowners, who typically have a lower income from a lifecycle perspective, the option of interest-only loans can mean they can stay in the housing market longer. On the other hand, the loan rules' incentive for longer fixed interest rates and more amortisation limits homeowners with high debt-to-asset ratios and could therefore reduce the demand for housing for this group in particular.

### **Mortgage rules limit homeowners' interest rate sensitivity**

Mortgage rules also affect homeowners' interest rate sensitivity. Several of the loan rules were introduced in a low interest rate environment. Before interest rates started to rise in 2022, homebuyers were more constrained by loan rules that reduced choice of loan type, such as the 4 per cent rule that limited the ability to borrow based on very low interest rates.<sup>40</sup>

As interest rates began to rise, it was the interest rates themselves rather than the lending rules that became the potential financial constraint for homebuyers. Interest rate rises in themselves suppress housing demand, but the impact of lending rules on the loan composition among homeowners may have meant that rising interest rates have had a smaller impact on housing demand than would otherwise have been the case.

Firstly, this is because an increasing share of fixed-rate loans has provided existing homeowners with partial insurance of equity against interest rate rises, as the market value of the remaining debt falls when interest rates rise. The equity can then be used for future home purchases, which counteracts the negative effect of rising interest rates on housing demand.<sup>41</sup> In addition, interest rate increases are generally seen to have a later and smaller impact on house prices when the proportion of fixed-rate loans is high.<sup>42</sup>

Secondly, the lending rules may have helped homebuyers with the highest debt-to-income ratios to avoid taking on as much debt as low interest rates would otherwise have enabled them to. This means they were less vulnerable to interest rate increases. This applies, for example, to the introduction of good practice and the 4 per cent rule, where homebuyers who want a variable interest rate are assessed based on a fixed interest rate.

Thirdly, the 4 per cent rule meant that the actual interest rate increase for some of the homebuyers was smaller, as the credit rating already took part of the interest rate increase into account. This effect is limited as it only covers a small proportion of the housing market. All other things being equal, the mortgage

<sup>38</sup> The 4 per cent rule is included in *Vækstvejledningen om forsigtighed i kreditvurderingen ved belåning af boliger i vækstområder (Growth Guidelines on prudence in credit assessment when mortgaging homes in growth areas, in Danish only)* and stipulates that borrowers in Aarhus and Greater Copenhagen who want a variable-rate loan are assessed based on the interest rate on a fixed-rate loan with instalments plus 1 percentage point, but at least 4 per cent.

<sup>39</sup> See Peter Birch Sørensen, *The Swedish housing market: trends and risks, Fiscal Policy Council Report*, 2013, and Michael Bergman, Bjørn Tangaa Sillemann and Peter Birch Sørensen, *House Prices in Denmark and Sweden*, chapter in *Reform Capacity and Macroeconomic Performance in the Nordic Countries*, Oxford University Press, 2015.

<sup>40</sup> See Christian Sinding Bentzen and Cecilie Walsted Gaarskær, *Lending rules in light of higher interest rates, Danmarks Nationalbank Analysis*, no. 10, May 2024.

<sup>41</sup> See Alessia De Stefani and Simon Juul Hviid, *Housing Collateral and Home-Equity Extraction, Danmarks Nationalbank Working Paper*, no. 135, February 2018, and Henrik Yde Andersen and Søren Leth-Petersen, *Housing Wealth or Collateral: How Home Value Shocks Drive Home Equity Extraction and Spending, Journal of the European Economic Association*, vol. 19(1), February 2021.

<sup>42</sup> See IMF, *Feeling the Pinch? Tracing the Effects of Monetary Policy through Housing Markets, World Economic Outlook*, April 2024.

rules may have meant that the average homeowner has become less sensitive to interest rate changes in recent years, which is reflected in lower interest rate sensitivity in house prices.<sup>45</sup>

<sup>45</sup> See Danmarks Nationalbank, Economic implications of interest-only mortgages combined with high leverage, *Danmarks Nationalbank Analysis*, no. 8, April 2024

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