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Monetary Review 1st Quarter Part 2

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The small picture on the front cover shows the "Banker's" clock, which was designed by Arne Jacobsen for the Danmarks Nationalbank building.

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Developments in the Market for Owner-Occupied Housing in Recent Years – Can House Prices be Explained?

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1. INTRODUCTION AND SUMMARY

The mid-2000s saw an unusual surge in owner-occupied house prices, followed by a sharp decline towards the end of the decade. The acceleration in house prices during the upswing fuelled a substantial increase in residential construction, which subsequently collapsed in response to the fall in house prices. This article analyses developments in the housing market in recent years, putting Denmark into an international perspective. Importance has been attached to explaining the factors driving the wave of price increases and the subsequent drop in prices.

In section 2, we describe developments in house prices in different parts of Denmark. Greater Copenhagen recorded a particularly strong increase during the upswing of 2004-06 and this area also experienced the most dramatic plunge during the subsequent downturn from the end of 2007 to the spring of 2009. Another significant feature was the speedy propagation of new types of home financing. Adjustable-rate loans caught on in earnest and deferred-amortisation loans, introduced in October 2003, quickly become very popular. By the end of the decade, deferred-amortisation adjustable-rate loans made up a significantly higher proportion of outstanding mortgage loans than traditional fixed-rate loans with amortisation. Residential construction also boomed, accounting for almost 8 per cent of total value added in the middle of the decade and thus vastly exceeding the long-term historical average.

We set up and estimate a new econometric relation in an attempt to explain residential investment. The econometric analysis shows that residential investment is driven to a great extent by house prices, as higher prices of the existing housing stock relative to construction costs trigger new construction. Although the estimated relation goes quite a long way

[1] The authors thank Heino Bohn Nielsen for valuable assistance in preparing the econometric analysis in this article. Any remaining shortcomings are the sole responsibility of the authors.

towards explaining developments in residential construction over an extended period, it has difficulty capturing the unusually large construction boom in the mid-2000s. One reason could be that the surge in house prices during this period seemed to attract a number of new professional property developers to the market in the expectation of harvesting healthy capital gains by constructing and selling new housing.

In section 3, we seek to explain the causes of house-price developments. The premise is that, in the short and medium terms, price developments are determined mainly by housing demand, given that growth in the housing supply in the form of new construction is slow. Housing demand is driven mainly by household disposable income and by short- and long-term interest rates after tax. For households with limited access to credit facilities – or a short-sighted approach – the size of first-year payments on mortgage loans also plays a key part in the house price they are able and willing to pay. Consequently, the size of the required mortgage repayments also impacts on demand. Based on these considerations, we set up and estimate an econometric relation for housing demand to explain the development in house prices from 1972 to 2010. In general, the explanatory power of the relation is good; e.g. it captures the full change in house prices occurring between 2000 and 2010.

The analysis shows that the increases in house prices during the upswing of the 2000s were extensively driven by developments in interest rates and disposable incomes, but the introduction of new loan types also had significant bearing on house prices. From the 4th quarter of 1999 to the 1st quarter of 2007, average real house prices for Denmark as a whole shot up by 71 per cent. Our analysis shows that up to 46 percentage points of this increase can be explained by the popularity of adjustable-rate loans and deferred-amortisation loans, the two loan types playing roughly equal parts. For Denmark as a whole, the freeze on property value tax played a relatively smaller part, explaining up to 14 percentage points of the price increase at the national level. However, the freeze clearly had a greater impact on price developments in large urban areas, particularly Greater Copenhagen, which experienced the steepest rise in house prices and where – in the absence of the freeze – large properties would have been subject to the progressive element of property value taxation. We conduct a more detailed analysis of regional distribution effects of the freeze on property value tax. This analysis shows that, in 2007, an average household in the environs of Copenhagen experienced a reduction in property value tax of approximately kr. 25,000 a year due to the freeze, while the reduction for an average household in Northern Jutland was less than kr. 5,000.

As stated above, our estimated house-price relation is able to explain the full change in house prices occurring between 2000 and 2010. However, the relation captures only part of the exceptionally steep increase in 2004-06. A "house-price bubble" is an appropriate term for developments during this period, in which prices were to a great extent decoupled from underlying economic fundamentals, to be driven instead by expectations of further price rises in the future – with accompanying capital gains. The subsequent price fall in 2008-09 was also steeper than predicted by the house-price relation, probably because overly optimistic expectations of price appreciation were replaced by very pessimistic expectations in the wake of the financial crisis.

Denmark was not the only country to experience rapidly escalating house prices in the early years after the millennium change. In section 4, we describe how the USA, the UK, France, Spain, Norway and Sweden also saw exceptional growth in real house prices in the period up to 2007, after which prices plummeted in most of these countries in the period up to 2009. However, in the Netherlands, prices increased only moderately up to 2008, and Germany stands in stark contrast to most other OECD countries with slightly falling house prices throughout the period. House prices in the individual countries extensively tracked cyclical movements, but generally culminated a couple of quarters before the peak in total output, which occurred in late 2007 and early 2008 in most countries. Thus, the turn in the housing market was one of the key triggers of the economic downturn, which started already before the global financial crisis fed through to the real economy in earnest in the autumn of 2008. In most countries, increases in house prices ahead of the turn were accompanied by a significant rise in the ratio of household debt to disposable income. In Denmark and the Netherlands debt increased more rapidly than in the other countries observed. The rise in debt was driven by falling interest rates in the period up to 2004. In most countries, new loan types and more lenient credit terms made it possible to borrow against increased property values during the upswing. The expanded credit facilities were the result, in part, of the gradual liberalisation of mortgage conditions throughout the 1980s and 1990s, but in some countries – notably the USA – the creditworthiness requirements for home buyers also seem to have been relaxed in the run-up to the financial crisis.

In the final section 5, we shift our focus back to Denmark where, despite the price drops in 2008 and the first part of 2009, real house prices are still higher than in the years ahead of the huge wave of price increases from 2004 to 2007. Against this backdrop, we ask the difficult question: "Are Danish house prices still overvalued?" In our attempt to

answer this question, we apply five different quantitative methods. One method is to compare the current house-price-to-rent ratio with the historical average for this ratio. Two other methods assess whether current prices of the existing housing stock appear to be sustainable in the long term when measured against the cost of new construction. The three methods all suggest that real house prices remain somewhat overvalued. However, the three methods share the problem that it is highly difficult to identify a "normal" long-term sustainable level for house prices relative to rents and construction costs. This speaks in favour of placing more emphasis on other methods.

Accordingly, we conduct a more detailed analysis of the housing burden, calculated as the sum of housing taxes and financing costs of a fully leveraged home purchase relative to average household disposable income. We calculate developments in the average housing burden for Denmark as a whole from 1971 until today. The calculations show that the current housing burden is roughly in line with the average level of the last 40 years. With the current level of interest rates, this does not indicate that a further decline in house prices is required. In general, this conclusion does not change when we conduct a more detailed analysis of developments in the housing burden in different parts of Denmark, using different loan types. But the analysis does show that the housing burden in Copenhagen and environs is moderately higher today than in early 2003, so that prices in Greater Copenhagen may be slightly overvalued.

In the final part of section 5, we use the house-price relation estimated in section 2 to assess the current level of house prices. We find that the current price level is lower than would be expected based on the house-price relation, which reflects average historical correlations between house prices, interest rates, incomes, etc. Against this backdrop, we project house prices through 2015 on the basis of expectations of macroeconomic developments over the coming years. To this end, we assume that interest rates will gradually rise from their current very low level to a level equivalent to the long-term historical average. Although interest rates will thus show a notable increase, our house-price relation does not entail any significant change in real house prices in the period up to 2015. Part of the explanation is that some degree of income growth is expected, which will offset the dampening effect of interest-rate rises on house prices. Furthermore, as already mentioned, house prices are currently lower than would be expected based on the estimated house-price relation. This could be due to a certain amount of negative overreaction in house prices, driven by very negative expectations in the wake of the financial crisis. As this overreaction fades away, a basis will

be created for some recovery in house prices, which may counter the effect of the expected interest-rate rise.

Overall, the analyses based on the housing-burden index and the house-price relation do not indicate that house prices in Denmark as a whole are currently overvalued. Nevertheless, real house prices may drop in some parts of the country over the coming years, e.g. in Greater Copenhagen. House-price developments also hinge closely on interest-rate movements. Our analysis thus shows that some decline in real house prices is to be expected if interest rates rise more rapidly and sharply than assumed in our main scenario.

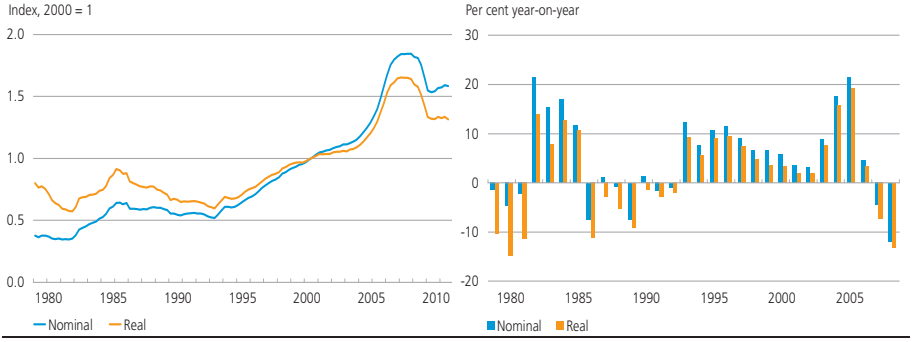
2. THE DANISH HOUSING MARKET IN RECENT YEARS

The economic upswing in 2004-06 fuelled a boom in the housing market. When the average price of a single-family house peaked in 2007, it was 63 per cent higher than the 2003 level, equivalent to an average annual growth rate of 13 per cent, cf. Chart 2.1. Adjusted for general inflation, the increase was 54 per cent or 11 per cent per year.

Such developments are not unprecedented in recent Danish economic history; from 1982 to 1986, house prices surged by a total of 84 per cent (16 per cent per year). However, inflation was higher during this period, so that the real increase was 50 per cent (11 per cent per year).

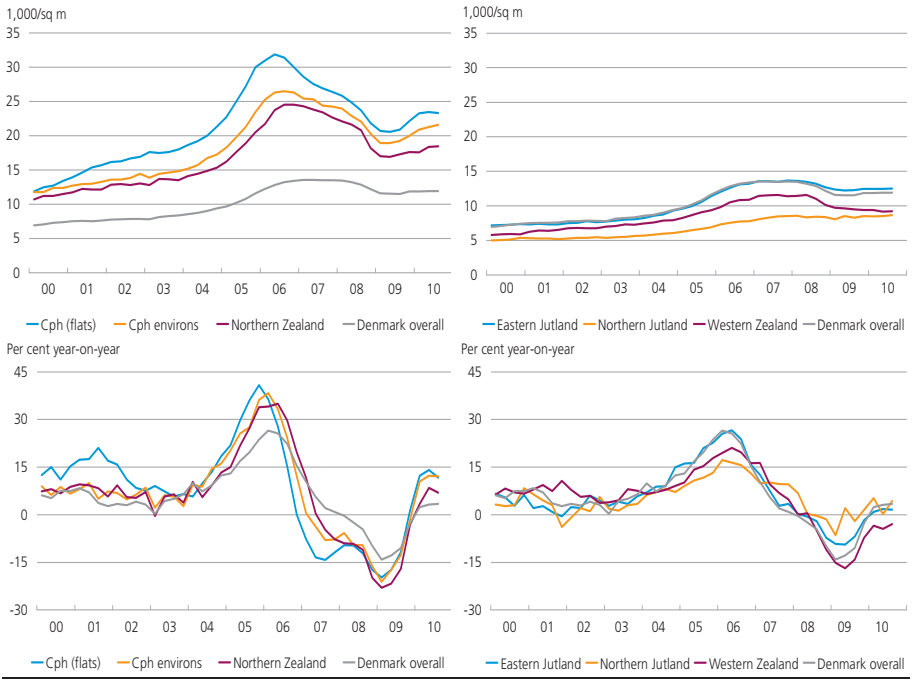
The sharp escalation in prices in the mid-2000s masks significant differences across Denmark. The upswing in the housing market started in Copenhagen, especially in the market for owner-occupied flats, and quickly spread to the environs of Copenhagen and Northern Zealand, cf. Chart 2.2 (left). The high-income municipalities north of Copenhagen thus saw quite a surge in house prices.

HOUSE PRICES, SINGLE-FAMILY HOUSES — Chart 2.1



Note: Seasonally adjusted price index (left-hand Chart). The real house price was obtained by deflating with the national accounts deflator for private consumption.
Source: Statistics Denmark and MONA databank.

REGIONAL DEVELOPMENT IN HOUSE PRICES Chart 2.2



Note: Price per square metre for single-family houses, unless otherwise indicated.
Source: Association of Danish Mortgage Banks (own seasonal adjustment).

Prices peaked towards the end of 2007, by which time turnover in the housing market had dropped to a very low level. A relatively sharp price adjustment followed; from the 4th quarter of 2007 until prices bottomed out in the 2nd quarter of 2009, the average price per square metre for houses dropped by a total of 17 per cent (20 per cent in real terms). House prices stabilised in the 2nd quarter of 2009 and, since then, they have largely tracked the consumer price index.

The largest price increases were recorded in and around Copenhagen and the subsequent fall in prices has also been most pronounced in this part of the country. Hence, the downward price adjustment of recent years has also served to reduce the significant geographical variations in the price per square metre that were observed during the boom, cf. Box 2.1.

The general economic upswing in 2004-06 was reflected in a considerable increase in household disposable income, laying the foundation for higher house prices, cf. Chart 2.4 (left). At the same time, interest rates were generally low during this period, cf. Chart 2.4 (right).

Moreover, financial market liberalisation brought increased flexibility in the composition of home buyer financing, including the option to reduce the first-year payments. Adjustable-rate loans were introduced in

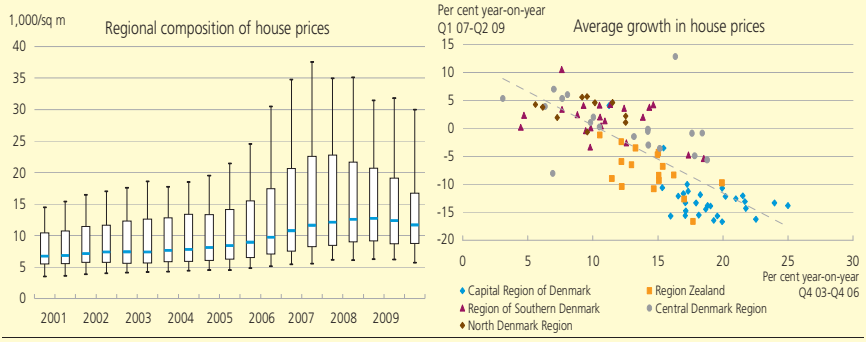
REGIONAL DIFFERENCES IN HOUSE-PRICE DEVELOPMENTS Box 2.1

The acceleration in house prices in 2004-06 was particularly pronounced in and around Copenhagen. Housing in Greater Copenhagen is also characterised by having the highest prices per square metre, causing the spread in house prices across Denmark to increase significantly during this period – the gap between cheap and expensive neighbourhoods widened.

This divergence in house prices is illustrated by a sequence of box plots in Chart 2.3 (left). Each box plot sums up the distribution of prices per square metre across municipalities in Denmark during the six-month period in question. The box plot comprises a white box spanning the lower and upper quartiles. The blue line indicates the median, while the thin "arms" span the lowest and highest observations during the given six-month period.

It is seen that while the price increases in 2004-06 affected expensive as well as cheap municipalities, the increases started in expensive municipalities in the course of 2004, while, in cheap municipalities, prices did not start rising until 2005. During the 2005-06 price boom, increases – also in relative terms – were higher in expensive municipalities, while the subsequent correction masks that prices in expensive municipalities fell, while they stagnated in cheap municipalities. The price gaps across Denmark have thus been reduced in step with the downward correction.

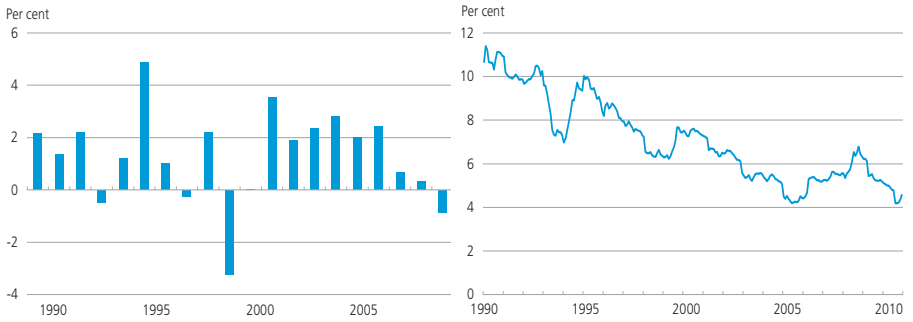
HOUSE-PRICE DEVELOPMENTS, BROKEN DOWN BY MUNICIPALITIES Chart 2.3



Note: The box plot in the left-hand Chart is based on semi-annual average prices per square metre for individual municipalities, depicting the lowest observation, lower quartile, median, upper quartile and highest observation for each six-month period. The right-hand Chart depicts average annual growth rates for the periods shown on the axes for each municipality in Denmark.
Source: Association of Danish Mortgage Banks and own calculations.

Chart 2.3 (right) shows price developments broken down by municipalities during the upswing from the 4th quarter of 2003 to the 4th quarter of 2006 compared with developments from the peak in the 1st quarter of 2007 to the trough in the 2nd quarter of 2009. Again, it is seen that the municipalities with high price increases during the upswing were also the ones to experience steep drops during the subsequent price adjustment. The Chart also documents that the greatest increases and subsequent falls were in Greater Copenhagen, while developments west of the Great Belt were generally much more moderate.

HOUSEHOLD DISPOSABLE INCOME AND 30-YEAR BOND YIELD — Chart 2.4



Note: Household disposable income has been deflated by the implicit deflator for private consumption.
Source: Statistics Denmark and Danmarks Nationalbank.

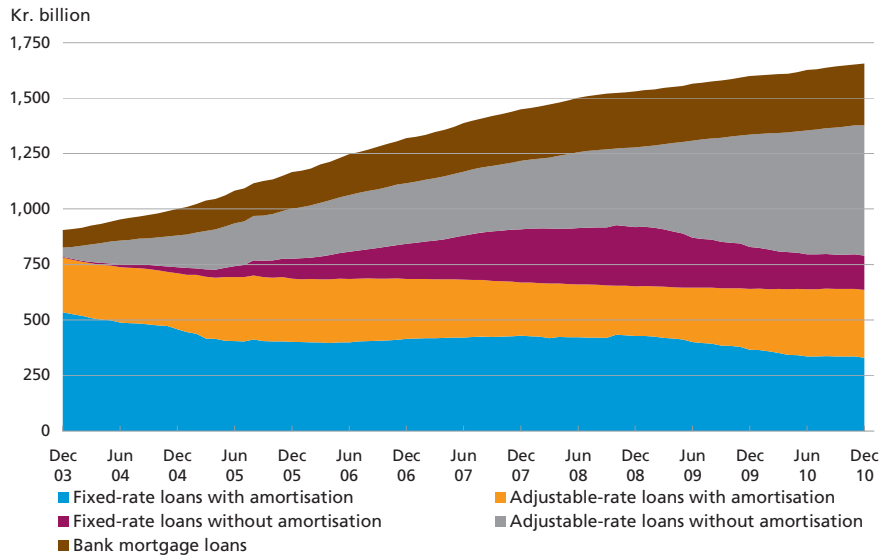
1996 and rapidly gained ground in the years just after the millennium change. October 2003 saw the launch of deferred-amortisation loans, which have also become popular in recent years, cf. Chart 2.5.

Below, we seek to illustrate the impact of the various factors on house-price developments.

Residential construction and economic developments

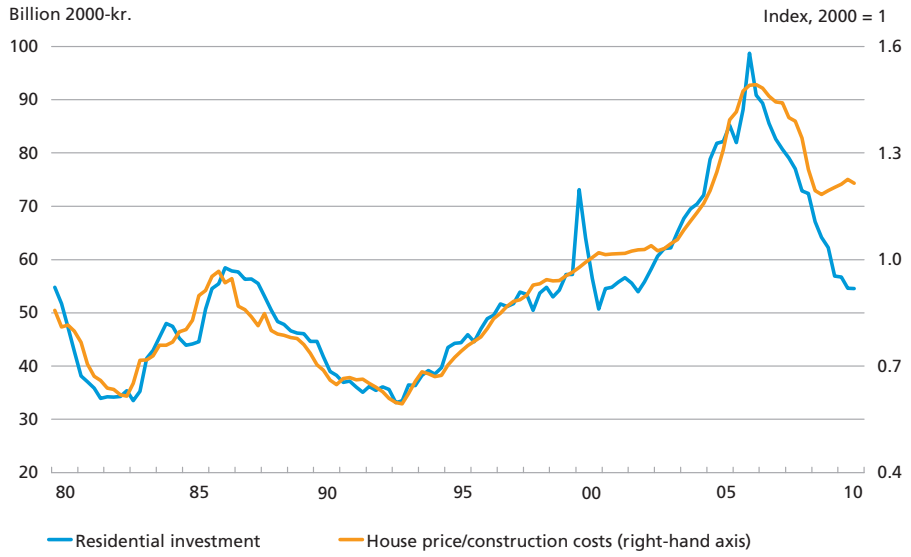
Rising house prices triggered a boom in residential construction. Historically, there has been close correlation between residential investment and the ratio of traded house prices to the price of new construction

COMPOSITION OF HOME BUYER FINANCING — Chart 2.5



Source: Danmarks Nationalbank.

HOUSE PRICES, CONSTRUCTION COSTS AND RESIDENTIAL INVESTMENT Chart 2.6



Note: Annualised seasonally adjusted quarterly figures for residential investment. The national accounts deflator for construction investment is used as construction costs. The extraordinary and temporary increase in the 1st quarter of 2000 is the result of the December 1999 hurricane.
Source: Statistics Denmark and Danmarks Nationalbank.

(*Tobin's Q*), cf. Box 2.2. During the upswing, the response did not fail to show itself when the price of the existing housing stock increased relative to new construction, cf. Chart 2.6. In 2006, residential investment was thus 61 per cent higher than in 2002.

DEVELOPMENTS IN RESIDENTIAL INVESTMENT Box 2.2

Chart 2.6 shows close correlation between residential investment, on the one hand, and the ratio of owner-occupied house prices to the price of new construction, on the other. As discussed in section 5, this correlation reflects that new construction becomes attractive when the price of existing housing tends to be higher than the price of new construction, and vice versa.

This correlation forms the basis for the determination of residential investment in MONA as well as a number of other macroeconometric models, such as ADAM. For our model-based analyses in the following sections, we have updated the MONA residential-investment relation in light of developments in recent years.

The selected formulation of the relation is estimated for the period from the 1st quarter of 1980 up to the 4th quarter of 2007. We thus choose to disregard the 1970s, during which decade the housing market was characterised by significant regulation and extensive subsidised construction. The estimated equation has the following form:

$$I^h/K^h_{-1} = 0.86 \cdot \left(I^h/K^h_{-1}\right)_{-1} + 0.003 \cdot \log\left(P^h_{-1}/P^i_{-1}\right) + 0.014\,\mathrm{Dlog}\left(P^h/P^i\right) + dummy + 0.002,$$

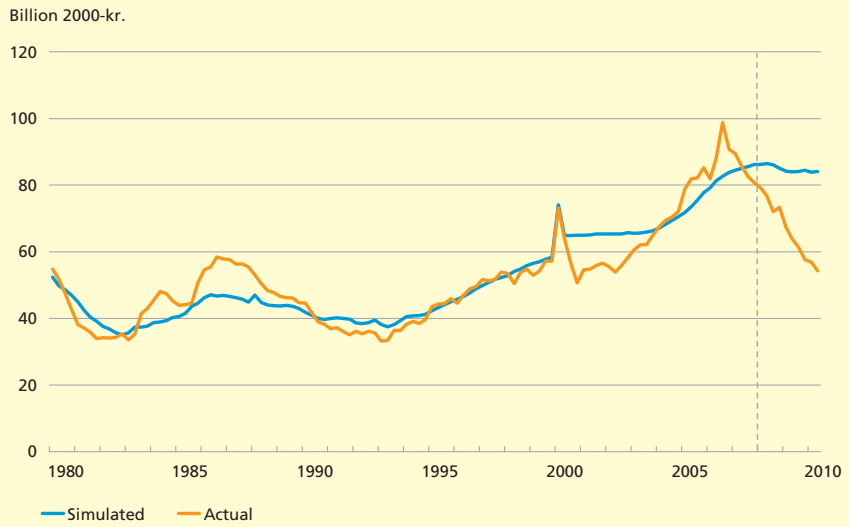
CONTINUED Box 2.2

where I^h is net residential investment, K^h is housing stock, P^h is house price and P^i is investment cost. The estimated relation contains a dummy to capture the outliers in the 1st half of 2000, when residential investment was extraordinarily high due to the December 1999 hurricane. The relation entails that, in the long term, house prices are determined by the investment cost in accordance with the theory of Tobin's Q, cf. section 5. The relation also entails a considerable degree of persistence – the response to changes in the relative price of owner-occupied housing is reflected only gradually in the level of investment.

Chart 2.7 shows actual residential investment, along with the investment predicted by the relation. It is seen that, in general, the relation explains the level of investment relatively well, while it has difficulty capturing the boom from 2004 and especially the steep fall.

The estimated residential-investment relation is described in detail in Appendix A.

ACTUAL AND PREDICTED RESIDENTIAL INVESTMENT Chart 2.7

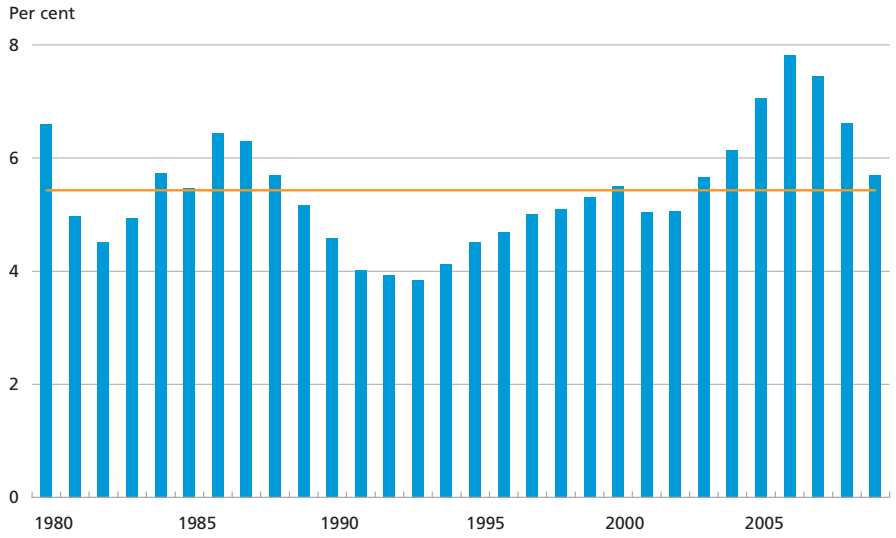


Note: Annualised chained values. Simulated values are based on dynamic simulation of residential investment as from the 1st quarter of 1980.
Source: Statistics Denmark and own calculations.

Since the housing market ran out of steam in 2007, residential construction has fallen back to the 2002 level. Remarkably, residential investment continued to fall throughout 2009 and 2010, while house prices stabilised; accordingly, the historical covariation between residential construction and relative house prices has been broken in recent years.[1]

[1] Danish Economic Councils (2010, p. 123) put forward the hypothesis that the unusually low residential investment level during the past few years may be explained by continued overvaluation of the prices of building plots.

RATIO OF RESIDENTIAL INVESTMENT TO TOTAL GVA — Chart 2.8

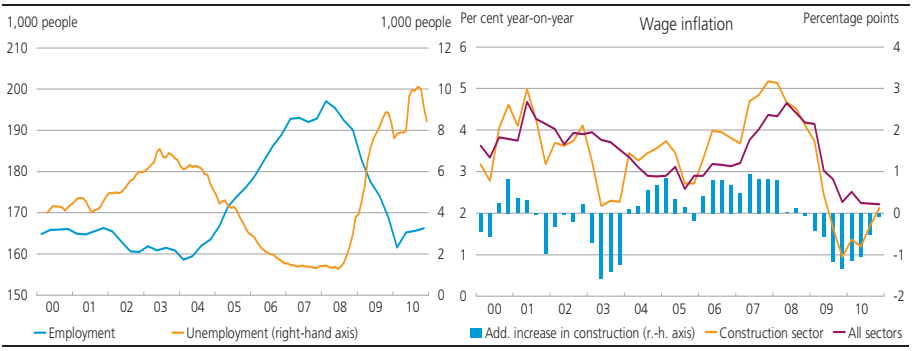


Note: Current prices. The average for the period 1980-2009 is 5.4 per cent, indicated by the horizontal orange line.
Source: Statistics Denmark.

The housing boom of 2005-07 led to an increase in residential construction as a ratio of total economic activity (measured as gross value added, GVA), cf. Chart 2.8. During the subsequent marked slowdown in construction, the ratio of residential investment to GVA declined again, but in 2009 it was still slightly higher than the average of the last 30 years.

The boom in residential construction was accompanied by an upsurge in employment in the construction sector, cf. Chart 2.9 (left). From 2004

EMPLOYMENT, UNEMPLOYMENT AND WAGE INFLATION IN THE CONSTRUCTION SECTOR — Chart 2.9



Note: Employment (seasonally adjusted) in the construction sector according to the national accounts. Unemployed workers from five selected unemployment insurance funds.
Source: Statistics Denmark (own seasonal adjustment of unemployment figures).

to 2007, employment rose by just over 30,000, which was reflected in very low unemployment in construction-related sectors; moreover, labour from other sectors migrated to construction – in line with developments during previous upswings with extensive construction activity.

The shortage of labour in construction during the upswing was reflected in substantial wage pressure; in 2004-07, annual wage inflation was 0.5 percentage point higher than in the Danish economy as a whole, cf. Chart 2.9 (right). After the slowdown, wage inflation in the construction sector quickly fell to quite a modest level. It is a well-known phenomenon that the construction sector is more cyclical in terms of both the level of activity and wage developments than the economy in general.

3. FACTORS BEHIND HOUSE-PRICE DEVELOPMENTS

Short-term house-price developments are predominantly determined by demand, the reason being that supply in the form of new construction is slow to respond to demand. Hence our analysis of house-price developments over recent years is based on an estimated relation of housing demand, the development in the overall housing stock being taken as a given.

What determines housing demand?

In general, demand for owner-occupied housing is assumed to be determined by household income and the user cost of investing in housing. The user cost consists of real interest rates (after tax) and housing-related taxes. The user cost should also include expected real capital gains on housing, but as these are notoriously difficult to estimate, they are often left out in practice. We attempt to capture the effect of expected capital gains through a process in which households form expectations of future price developments based on developments in recent years. In principle, depreciation should also be included, but in the following we have chosen to disregard depreciation.[1]

The econometric relations used until now to describe price developments in the Danish housing market all had difficulty explaining the steep price increases of the mid-2000s. This led to a sharper focus on the possible effect of first-year payments as an alternative or supplement to the significance of the user cost.

[1] In MONA, depreciation on the housing stock has, in practice, also been disregarded so far. This seems to be empirically reasonable in view of the very stable development of depreciation in the national accounts.

In a situation where consumers are fully rational and not subject to binding credit restrictions, demand should be determined solely by the economic user cost. Accordingly, the possibility of opting for deferred-amortisation periods should not impact housing demand, and thus house prices, as repayments on loans constitute savings for the home-owner rather than actual costs.

To the extent that households also consider their cash flow position, or are subject to binding credit restrictions – or simply find it difficult to comprehend the economic calculation on which the user cost is based (including the role of inflation as repayment on the real debt) – factors such as repayment profile and the possibility of opting for adjustable-rate loans will, however, have an impact on housing demand, cf. Box 3.1. We allow for this possibility in the estimation by including the lowest possible first-year payments in addition to the user cost. While the user cost is based on a 30-year fixed-rate bond loan, the immediate savings by choosing 1-year adjustable-rate loans[1] and the possibility of opting for deferred amortisation from the 4th quarter of 2003 are fully reflected in the first-year payments.

Explanation of the increase in house prices during the 2000s

Based on these considerations, we estimate a demand relation for owner-occupied housing where real demand is proportional to household disposable income and otherwise dependent on the user cost (expected house-price increases being handled separately) and the first-year payments. According to the estimation, the relative impacts on housing demand of first-year payments and user cost are 60 per cent and 40 per cent, respectively.

We now rewrite the demand relation to determine the real house price as a function of a number of key economic variables that are included in the demand factors described. The relation is written in error-correction form, meaning, roughly speaking, that the price only gradually adjusts to changes in the underlying demand as a result of changes in interest rates, income, repayment rates, etc. The estimated relation is described in Box 3.2.

Based on this price relation, developments in real house prices may now be broken down into contributions from individual variables. To this should be added other model effects which cannot be distributed unequivocally on the underlying specific economic variables, and residuals in the form of price changes that cannot be explained by the model.

[1] Adjustable-rate loans were formally (re)introduced in 1996, but this loan type did not come into widespread use until after the millennium change. Consequently, we have decided that short-term interest rates will be reflected in the first-year payments from the 1st quarter of 2000.

DEFERRED-AMORTISATION LOANS AND THEIR IMPACT ON HOUSING DEMAND Box 3.1

Deferred-amortisation loans were introduced in the autumn of 2003. They quickly became popular and now account for more than half of total lending to homeowners. These loans do not affect the user cost of owner-occupied housing – only the repayment profile – and thus it could be argued that the option to defer amortisation should not impact house prices. Still, these loans may have had an impact through the following channels:

- *Liquidity-constrained consumers*. Consumers who are subject to credit rationing cannot achieve the desired consumption smoothing over their lifetimes. It is rarely possible to borrow against future income, entailing that consumption – including housing consumption – may be lower than desired. With deferred-amortisation loans, home buyers are no longer forced to accumulate home equity, i.e. they can borrow a larger amount without having to pay more, thus increasing their housing consumption. A number of consumers must be assumed to be liquidity constrained. However, the lending policies of the mortgage banks will put a damper on the impact of deferred amortisation. In principle, they should grant deferred-amortisation loans only to consumers who can afford a fixed-rate loan with amortisation.
- *Short-sighted and irrational behaviour.* Many home buyers focus on the first-year payments when buying a home. Deferred amortisation, in combination with adjustable-rate loans, currently the most widely used loan type, has reduced these payments significantly. The low payments may have tempted many people to over-extend themselves, thus contributing to driving up housing demand. Unless the loan is refinanced, the payment increases when the deferred-amortisation period expires. Others may hope to find a solution at some point in the future, e.g. in the form of higher income, increasing house prices or political intervention. Again, the lending policies of the mortgage banks will be key for the impact.
- *Flexible repayment profile*. Some home buyers will probably choose a more demanding repayment profile than they would otherwise have done, knowing that they may opt for a deferred-amortisation period, should they suffer a period of lower income. Deferred amortisation may thus be seen as an option. However, e.g. supplementary loans have always been an option.
- *Reduced supply*. Deferred-amortisation loans may reduce the housing supply by enabling more people to stay in their homes in situations in which they would otherwise have sold. Examples could be divorce, unemployment or death. Pensioners will also be able to stay in their homes longer. The reduced supply pushes up prices. The housing supply fell immediately after the introduction of deferred-amortisation loans and up to early 2006. Since then, it has increased significantly, making it difficult to attach much quantitative weight to this explanation. Furthermore, previously homeowners were also able to obtain supplementary loans or dissaving loans if they needed extra liquidity.
- *Settlement of more expensive debt*. Homeowners with deferred-amortisation loans may settle other, more expensive debt more quickly, obtaining savings that may be used to take out a larger mortgage loan.

RELATION FOR OWNER-OCCUPIED HOUSING DEMAND Box 3.2

We let underlying (long-run) demand for owner-occupied housing be determined by real household disposable income and a free combination of user cost and the lowest possible first-year payments, where the real house price is separated out. In other words, we assume that

$$K^D = F\left(Y, u, y, p^h\right),$$

where K^D is the households' desired housing stock, Y is their real disposable income, u is an expression of elements of the user cost (see below), y is the lowest possible first-year payments and p^h is the real house price.

Theoretically, user cost is defined as

$$usercost = \left(\underbrace{\left[(1-t)r^{30} - \pi\right] + s + d}_{u} - \pi^h \right) p^h,$$

where the square brackets are real interest rates after tax on 30-year bonds, s is housing-related taxes (currently land tax and property value tax), d is depreciation and maintenance and π^h is the expected (real) capital gain in the form of higher house prices (over and above ordinary price increases). Inflationary expectations π and expected capital gains, π^h, are each approximated by adaptive algorithms of the AR(1) form. In the estimation, user cost is divided into the actual real house price p^h, the rate of user cost u (excluding expected capital gains) and expected capital gains π^h.

The first-year payments are defined as

$$payment = \underbrace{\left((1-t)r^{\min} + s + repay\right)}_{y} p^h,$$

where interest rates r^{min} as from the 1st quarter of 2000 change from the 30-year bond yield to a short-term bond yield (weighted for mortgage bonds with a maturity of 1 and 2 years) and *repay* is the repayment rate for a fully leveraged house with full utilisation of adjustable-rate loans as from the 1st quarter of 2000 and deferred amortisation as from the 4th quarter of 2003. As was the case with the user cost, the first-year payments are divided into the real house price and a rate for the first-year payments, y, in the estimation.

The relation is transformed into log-linear form and estimated over the period from the 1st quarter of 1972 to the 2nd quarter of 2010 as an error-correction model for the house price, and a few significant short-term elements are added. The underlying estimated price relation (the long-run relation) is then

$$\log p^h = -15.5 \cdot \left(0.4 \cdot u + 0.6 \cdot y\right) + 2.0 \cdot \pi^h + 1.5 \cdot \left(\log Y - \log K^h\right).$$

The price relation implies that, in the absence of a supply response, a general drop in interest rates of 1 percentage point will lead to a 15 per cent increase in the real house price, equivalent to a 9 per cent rise in the desired housing stock. If only short-term interest rates fall by 1 percentage point, the price response will be a 9 per cent increase, equivalent to a 5 per cent rise in the housing stock demand. If real household disposable income grows by 1 per cent, the real house price will go up by 1.5 per cent for an unchanged housing stock.

The estimation and the explanatory variables are reviewed in detail in Appendix B.

Specifically, we perform a breakdown based on a simulation from the 4th quarter of 1999, the last quarter before short-term bond yields are reflected in the first-year payments. The breakdown covers developments up to the 1st quarter of 2007, at the peak of house prices, and up to the 2nd quarter of 2010, the latest observation of house prices, respectively. The results of these simulations are shown in Table 3.1.

In real terms, house prices rose by 71 per cent from the millennium change until their peak in the 1st quarter of 2007. Just over half (37 percentage points) of this price increase may be distributed directly on the explanatory variables. The key factor is interest-rate developments (after tax), accounting for a total of just over 26 percentage points. The contribution from interest rates may be distributed more or less equally on the effect of lower interest rates in the form of the 30-year bond yield and cost savings from financing based on adjustable-rate loans and hence short-term interest rates rather than 30-year interest rates.

Growth in household income contributes an additional 13 percentage points, just over half of which is neutralised by an increase in the housing stock through new construction. To this should be added small positive contributions from expected rises in real house prices (3.5 percentage points) and from the changes in required repayments. In other words, the latter factor explains only a modest part of the price increase

CONTRIBUTIONS TO EXPLAINING THE INCREASE IN REAL HOUSE PRICES 2000-09

Table 3.1

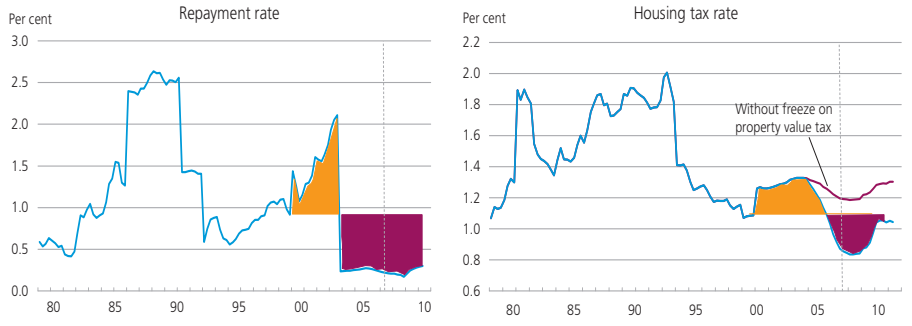
Percentage points	Q4 1999 – Q1 2007	Q4 1999 – Q2 2010
Interest-rate level (30-year), after tax	13.4	12.7
Adjustable versus fixed rate (after tax)	13.1	13.4
Housing taxes	-0.5	1.1
Repayment rate	2.0	4.9
Expected inflation	-0.6	0.6
Expected house prices (real)	3.5	-5.8
Real household disposable income	13.0	20.1
Housing stock	-6.9	-13.6
Total identified contributions	37.0	33.3
Other model effects[1]	11.3	7.3
Total explanatory contribution	48.2	40.6
Not explained	22.8	-2.6
Total real house price increase	71.0	38.0

Note: Individual explanatory contributions have been calculated by dynamic simulation of demand relations as from the 4th quarter of 1999, all other variables being kept constant at their initial levels. Sums may not add up due to rounding.

Source: Statistics Denmark, Association of Danish Mortgage Banks, Realkredit Danmark and own calculations.

[1] Other model effects are non-linear composition effects and adjustment to the initial disequilibrium in the estimated demand relation.

REPAYMENT RATE AND HOUSING TAX RATE Chart 3.1



Note: Calculated repayment rate and housing tax rate, cf. Appendix B. The coloured areas illustrate the difference between actual developments and flat developments since the 4th quarter of 1999, on which the calculations in Table 3.1 are based. The yellow areas designate contributions to lower house prices since the end of 1999, while the red areas designate contributions to higher prices. The dotted lines mark the peak of real house prices in the 1st quarter of 2007. The right-hand Chart also illustrates counterfactual developments in the overall, imputed rate of housing tax, had property value taxes not been frozen in 2002.

Source: MONA databank and own calculations.

in the period up to 2007 – despite the introduction of deferred-amortisation loans as from the 4th quarter of 2003. The reason is that the decline in interest rates during the preceding period triggered a substantial rise in required repayments on adjustable-rate loans, as repayments on these loans go up when interest rates fall and vice versa. This is illustrated by Chart 3.1 (left) where the yellow area indicates that developments in the repayment rate from the 4th quarter of 1999 point to lower house prices, while the red area as from the introduction of deferred-amortisation loans in the 4th quarter of 2003 shows that the repayment rate here points to higher house prices relative to the point of departure at the end of 1999. The net effect on house prices (i.e. the difference between the two areas) is negligible when calculated at the 1st quarter of 2007, at the peak of real house prices. On the other hand, the separate price effect of deferred-amortisation loans was significantly greater than illustrated by Table 2.1. This effect is analysed in more detail below.

Housing taxes play virtually no part in the explanation of the overall increase in house prices from the 4th quarter of 1999 to the 1st quarter of 2007. The reason is that overall housing taxes as a ratio of the market value of the housing stock increase during the first few years, reflecting factors such as the restructuring of taxes introduced by the Whitsun Package of austerity measures, which entered into force 1999, cf. the yellow area of Chart 3.1 (right).

This counters the gradual erosion of the property value tax from 2002 due to the freeze on property value tax implemented as part of the general tax freeze. The separate price effect of the freeze on property

value tax is significantly greater than illustrated by Table 2.1. This effect is analysed in more detail below.

Of the 48 percentage points of the price increase explained by the model as a whole, just under one fourth (11 percentage points) is attributable to more complex model effects. In other words, this leaves 23 percentage points – or just under one third – of the overall price increase during the period that cannot be explained by the model.[1]

If we extend the simulation to cover the period up to the 2nd quarter of 2010, the overall increase in real house prices decreases to 38 per cent. As in the previous case, the total contribution from interest rates is 26 percentage points. On the face of it, the contribution from income has increased, but adjusted for growth in the housing stock, the contribution remains 6-7 percentage points. Now the possibility of opting for deferred amortisation has been allowed to be reflected more fully in prices (5 percentage points), while the expected price increases detract from the calculation (-6 percentage points) in light of the steep fall in 2007-08.

However, the most important difference is that the model now explains the entire development in house prices. The significant portion of the price increase in 2004-06 which the model did not capture has now been eliminated. It is tempting to see this portion of developments in prices as a result of an actual price bubble, entailing that home buyers act on expectations of a future price level that is decoupled from underlying economic fundamentals. In other words, expectations of future capital gains seem to have played a greater role in price formation during this period than in the rest of historical estimation period, cf. the separate discussion below.

New loan types and freeze on housing taxes

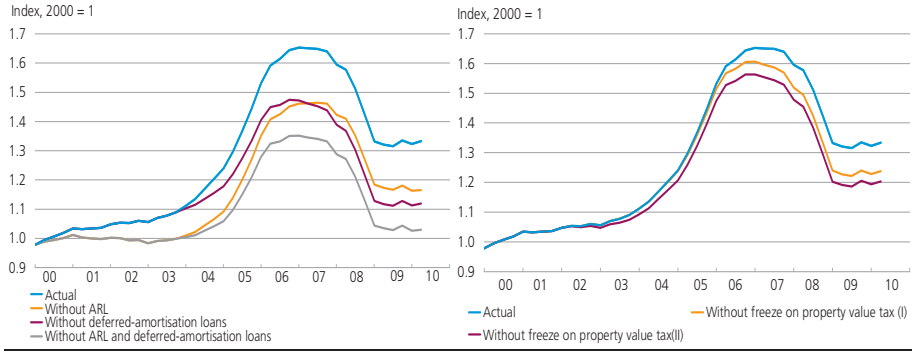
As already mentioned, the period observed (the end of 1999 up to the 2nd quarter of 2010) saw several significant instances of liberalisation of the credit market. Home buyers were given more financing opportunities to choose from in the form of adjustable-rate loans and deferred-amortisation periods – both of which have contributed to reducing the required first-year payments following a home purchase.

At the same time, a tax freeze was introduced after the change of government in 2001. In general, all rates of direct and indirect taxes were frozen, yet a special structure was introduced for property value

[1] We emphasise that this is *not* because the model in general has difficulty explaining large and steep price increases; thus the model easily captures the housing boom and the accompanying price increases in 1983-86, while it actually tends to overestimate the price increases during the upswing in 1993-2000.

REAL HOUSE PRICES WITH AND WITHOUT NEW LOAN TYPES AND FREEZE ON PROPERTY VALUE TAX

Chart 3.2



Note: Counterfactual scenarios based on the estimated demand relation. Adjustable-rate loans (ARL) are not assumed to be reflected until the 1st quarter of 2000. In the absence of the freeze on property value tax, the imputed rate of property value tax of the MONA databank is assumed to be kept constant as a ratio of the housing stock calculated at market value. The freeze on property value tax has been modelled in two alternative ways; (I) as the current realised effective property value tax and (II) as a permanent reduction in property value tax by 63 per cent in the 1st quarter of 2002, cf. Box 3.3.

Source: MONA databank and own calculations.

tax under which nominal tax payments were frozen regardless of developments in house prices and in the consumer price index. This has resulted in erosion of the effective property value tax rate in step with the increase in house prices.[1]

The price effect of these measures may be analysed separately based on the estimated housing-demand relation. In this case, we simulate the counterfactual scenario, entailing that we compare actual developments with scenarios under which we eliminate the possibility of opting for adjustable-rate loans and/or deferred amortisation as well as the effect of the freeze on property value tax, cf. Chart 3.2. The simulations take separate account of how expectations of future house-price increases change and how changes in housing taxes are reflected in household disposable income. The effects are summarised in Table 3.2 for the same sub-periods as applied in the breakdown above.

It is seen that the estimated relation attaches significant effect to both of the new loan types when it comes to house-price developments; at the peak of house prices in 2007, price increases since 2000 would have been 16-20 percentage points lower, had it not been for the new loan types. In the relation, the new loan types primarily act through a shift in the level of underlying demand, to which prices gradually adjust. Thus the price effect of deferred-amortisation loans, in particular, was not fully reflected in prices at the peak of the housing market in 2007; this appears from the even greater effect in the 2nd quarter of 2010, cf. Table 3.2.

[1] The real erosion of housing taxes is partly offset by land tax to the extent that property value tax savings result in an increase in land values.

EFFECTS ON REAL HOUSE PRICES FROM NEW LOAN TYPES AND THE FREEZE ON PROPERTY VALUE TAX

Table 3.2

Reduction of real price increase since Q4 1999, percentage points	Without changed price expectations		With changed price expectations	
	Q1 2007	Q2 2010	Q1 2007	Q2 2010
Without adjustable-rate loans	15.6	15.8	19.9	17.3
Without deferred-amortisation loans	14.7	16.9	18.7	22.2
Total without new loan types	24.9	26.3	31.2	31.4
Without freeze on property value tax (I)	4.3	7.0	4.9	9.9
Total without freeze on property value tax (I) and new loan types	28.5	32.0	35.1	39.2
Without freeze on property value tax (II)	7.5	9.9	9.3	13.4
Total without freeze on property value tax (II) and new loan types	30.5	33.5	38.0	40.9
With proportional correction of unexplained part				
Total without new loan types	32.7	25.2	46.2	28.2
Without freeze on property value tax (II)	10.2	9.5	14.3	12.3
Total without freeze on property value tax (II) and new loan types	40.0	32.1	55.7	36.5

Note: Counterfactual reductions in price increases since the 4th quarter of 1999 have been calculated using the estimated demand relation for owner-occupied housing. The calculations have been performed both with and without inclusion of the resultant changes in the approximated expectations of future real house prices. Adjustable-rate loans are not assumed to be reflected until the 1st quarter of 2000. In the absence of the freeze on property value tax, the imputed rate of property value tax of the MONA databank is assumed to be kept constant as a ratio of the housing stock calculated at market value. The freeze on property value tax from 2002 has been modelled in two alternative ways: (I) as current realised effective property value tax and (II) as a permanent reduction of property value tax by 63 per cent in the 1st quarter of 2002, cf. Box 3.3. In the bottom three rows, unexplained residuals in 2004-09 are dampened by a factor equivalent to the dampening of the explained part of the cumulated real price growth during the period from the 1st quarter of 2004 to the 1st quarter of 2007 that is caused by the counterfactual assumption.

Source: MONA databank and own calculations.

According to the estimated relation, the freeze on property value tax has little effect on house prices, cf. Chart 3.1 and Table 3.2. One implication of the modelling strategy chosen (named I) is that home buyers are not forward-looking – they base their choices on prevailing conditions at any time. Thus they assume that the tax rates prevailing at the time of purchase will apply throughout their financing horizon.

This is a problematic assumption during a period of tax freeze which, over time, erodes the real property value taxation in so far as the freeze is seen as a permanent measure. Under plausible assumptions, a lasting freeze on property value tax would be equivalent to a permanent reduction by just under two thirds as from 2002, cf. Box 3.3. Consequently, we have performed an alternative calculation (named II) under which the effect of the freeze on housing taxes is translated into a permanent proportional reduction of the property value tax included in the housing tax rate of the user cost. This is in contrast to method I, as we now allow the home buyer to factor the full future implications of a lasting freeze

THE FREEZE ON PROPERTY VALUE TAX AND THE EFFECTIVE RATE OF PROPERTY VALUE TAX — Box 3.3

Here we present a simple method for calculating the long-term effect of the freeze on property value tax on effective property value taxation. The method presupposes that the tax freeze is permanent.

Let V_0 denote the total property value at time zero (the present) and let s_0^e specify the effective rate of property value tax at time zero, defined as the current revenue from property value tax in terms of the total current property value. As the nominal principle of the tax freeze freezes the nominal tax payment,[1] the present value of the future tax revenue during the tax freeze (NV^s) may be calculated as

$$NV^s = \int_0^{\infty} s_0^e V_0 e^{-\rho u} du = \frac{s_0^e}{\rho} V_0,$$

where ρ is the nominal discount rate, *e* is the exponential function and *u* denotes the time, treated as a continuous variable.

Now assume that property value tax is instead calculated using a constant effective rate $\bar{s}$ of the current property value at any time, but that this rate is adjusted downwards in relation to the current tax rate s_0^e, so that future revenue with the same present value as the revenue during the current tax freeze is achieved. If the nominal property values on average increase by the rate π^n per period, the hypothetical tax rate $\bar{\tau}$ should thus satisfy the condition

$$\int_0^{\infty} \bar{s} V_0 e^{-(\rho - \pi^n)} du = NV^s \Rightarrow$$

$$\frac{\bar{s} V_0}{\rho - \pi^n} = \frac{s_0^e V_0}{\rho} \Leftrightarrow \frac{\bar{s}}{s_0^e} = \frac{\rho - \pi^n}{\rho}, \quad (1)$$

where we have assumed that $\rho > \pi^n$. It follows from (1) that

$$s_0^e - \bar{s} = \left(\frac{\pi^n}{\rho} \right) \cdot s_0^e. \quad (2)$$

The difference between the two tax rates of (2) specifies the permanent reduction of the effective rate of property value tax which is equivalent to the gradual tax reduction resulting from the nominal principle of the tax freeze.

With realistic parameter values, the tax freeze entails a sharper reduction of the effective property value taxation than in a situation where the principle of assessing tax on the current property value had been retained. If the average annual rate of house-price increase π^n is, say, 2.5 per cent, equivalent to a rate of inflation of 2 per cent and a real price increase of 0.5 per cent, and if the nominal discount rate is 4 per cent, it follows from (2) that retention of the nominal principle of the tax freeze is equivalent to a reduction of the effective property value tax rate by just under 63 per cent.

[1] In practice, the total nominal revenue of property value tax increases slightly from one year to the next, *inter alia* because the tax reduction for housing acquired before 1 July 1998 lapses in case of ownership change. For purposes of simplicity, we disregard this effect, since it will gradually disappear as housing is traded.

into the user cost. However, we still include the current actual property value tax in the expression of the first-year payments as the impact of

these payments on housing demand is based on the assumption that some home buyers are not forward-looking. The calculated effects of methods I and II, respectively, may be viewed as extremes; the actual effect of the freeze on property value tax should probably be found in the spread between the two.

It is important to stress the difference between the calculations in Tables 3.1 and 3.2. In the first Table, we capture, so to speak, how developments in individual market conditions, such as interest rates or income, impacted house prices under the given regulatory framework; Table 3.2 illustrates the same developments from a different angle, i.e. how changes to the regulatory framework in the form of new loan types and the freeze on property value tax from 2002 impacted price developments for the given changes in market conditions. Despite the methodological differences, the two types of calculation may be compared. As price expectations are unchanged in the breakdown exercise of Table 3.1, a comparison with the counterfactual scenarios of Table 3.2 where the change in price expectations is not factored in and where future cost-savings from the freeze on property value tax are not discounted (method I) provides the most accurate view. Thus the effect of applying a variable rather than a fixed rate of interest is roughly the same in the two calculation methods (13 against 16 percentage points). And while the isolated effect of the freeze on property value tax is 4.9 percentage points, cf. Table 3.2, this effect is offset by the preceding tax increase resulting from the Whitsun Package; when developments in housing taxes from the 4th quarter of 1999 up to the 1st quarter of 2007 are considered as one, they have no significant effect on prices (-0.5 percentage point), cf. Table 3.1 and Chart 3.1 above.[1]

If, instead, we consider the overall picture presented by the calculations in the two Tables in terms of price developments from the millennium change until the peak in the 1st quarter of 2007, the situation is as follows: the estimated relation entails that approximately 20 percentage points of the overall price increase of 71 per cent up to the 1st quarter of 2007 may be attributed to income developments (adjusted for the increase in the housing stock) and the low 30-year yields, while the remainder is due to the combined effects of low yields on adjustable-rate loans, the possibility of opting for deferred-amortisation loans and inflated household expectations of future increases in house prices in the mid-2000s. We will proceed to investigate the latter factor in more detail.

[1] The calculation of the price effect of the freeze on property value tax under method I is equivalent to comparing the actual housing tax rate (blue line) in Chart 3.1 (right) with the housing tax rate (red line) that would have applied, had property value tax not been frozen.

Expected house-prices increases in the 2000s – a price bubble?

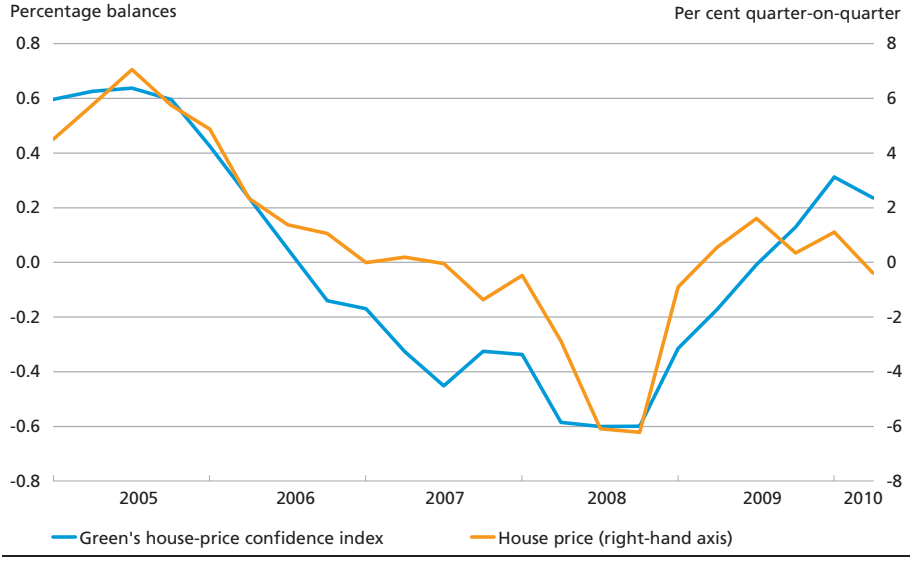
The steep increases in house prices in 2004-06 sharpened the focus on household expectations of price developments. A number of surveys were launched over the next few years, and based on a selection of these, we analyse the role of expectations in price developments.

The Ministry of Economic and Business Affairs (2005) found that in 2005 when house prices were escalating most rapidly, household expectations of future price increases were very high. Six in 10 respondents expected price increases over the next year and just under half expected the price rises to be sustained over a 5-year horizon. Expectations of continued price rises were highest in Greater Copenhagen where three in 10 respondents expected annual price increases of at least 5 per cent over the coming five years. The same trend is shown by Green's house-price confidence index with strong expectations of continued growth in the housing market in 2005 and into 2006.

Green's house-price confidence index dropped from mid-2006 until the turn of the year 2008/09 as house prices flattened and subsequently weakened during 2006-09, cf. Chart 3.3. The Ministry of Economic and Business Affairs (2007 and 2010) follows up on the 2005 survey, confirming that household-price expectations are adjusted significantly downwards as actual house prices start to decline.

GREEN'S HOUSE-PRICE CONFIDENCE INDEX AND GROWTH IN HOUSE PRICES

Chart 3.3



Note: Green's house-price confidence index is a monthly index, with linear interpolation for missing observations.
Source: Green's Analyseinstitut on behalf of Børsen (Danish daily) and Statistics Denmark and own calculations.

In other words, recent surveys show that household expectations are strongly influenced by current trends. In 2005, when the rate of house-price increases was at its highest, many households believed that the trend would continue in the coming years – especially in the areas having experienced the steepest price rises. According to a survey conducted by the Knowledge Centre for Housing Economics in 2010, price developments during the last six months are the most important factor in Danish households' expectations of house prices, while the state of the Danish economy is the second-most important factor. This confirms that expectations of the future are solidly anchored in the current situation. This formation of expectations is consistent with the adaptive modelling of expectations applied in the estimated house-price relation, cf. Appendix B.

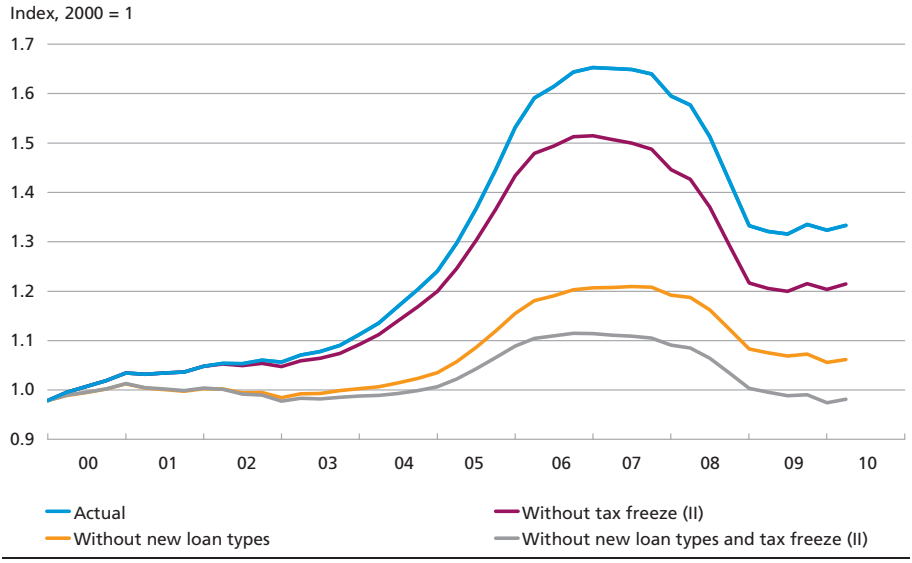
When households extensively base their expectations on current trends, this has a self-reinforcing effect on price developments – both when prices go up and down. The rather high expectations in 2005, indicated by the surveys, probably had a stronger effect – especially in Greater Copenhagen – than captured by the modelled formation of expectations. In other words, we find it likely that the unexplained price increases in 2004-06 are attributable, in large measure, to (unrealistically) high expectations of future house prices. Hence, a housing bubble did exist, especially in and around Copenhagen, cf. also Pedersen and Sørensen (2009). It should be noted, however, that these are high-density areas. This limits the possibility of new construction, particularly houses, thereby contributing to steeper price increases in this region than in the rest of Denmark.

If the steep price increases of 2004-06 were triggered, in part, by self-reinforcing expectation effects, it follows that in the calculations above we tend to underestimate the impact of measures that would have curbed price increases during this period. The immediate reduction in the rate of price increases would also have reduced the bubble element in the form of the extraordinarily high expectations that could not be explained by the estimated relation.

Therefore we have recalculated the counterfactual scenarios without new loan types and the freeze on property value tax, reducing the unexplained portion of price developments in 2004-09 by a factor corresponding to the reduction in the explained price increases in 2004-06 resulting from the measures analysed.[1] When e.g. new loan types reduce

[1] We reduce the unexplained component until 2009, as the sharp price adjustment in 2008-09, including a significant component that is left unexplained by the estimated relation, should be seen in the context of the preceding surge in prices. Accordingly, a smaller rise in the unexplained component should be accompanied by a correspondingly smaller decrease in the subsequent downward price adjustment.

REAL HOUSE PRICE WITH AND WITHOUT NEW LOAN TYPES AND FREEZE, WITH PROPORTIONAL ADJUSTMENT OF UNEXPLAINED PART Chart 3.4



Note: Counterfactual scenario based on estimated demand relation. Adjustable-rate loans are not assumed to be reflected until the 1st quarter of 2000. In the absence of the freeze on property value tax, the imputed rate of property value tax of the MONA databank is assumed to be kept constant as a ratio of the housing stock calculated at market value. The freeze on property value tax is modelled in accordance with method (II) as a permanent reduction in property value tax by 63 per cent in the 1st quarter of 2002, cf. Box 3.3. The red line depicts the total effect of new loan types (blue line) and the freeze on property value tax (yellow line).

Source: MONA databank and own calculations.

the explained price increases in 2004-06 by 56 per cent, we also reduce unexplained developments by 56 per cent. Chart 3.4 shows the results of this simulation for three selected counterfactual scenarios. These results are also included in Table 3.2 (lower section). It is seen that the price effect of the new loan types and the freeze on property value tax increases substantially when we attempt to include their effect via the bubble element. We emphasise that these calculations involve a particularly high degree of uncertainty.

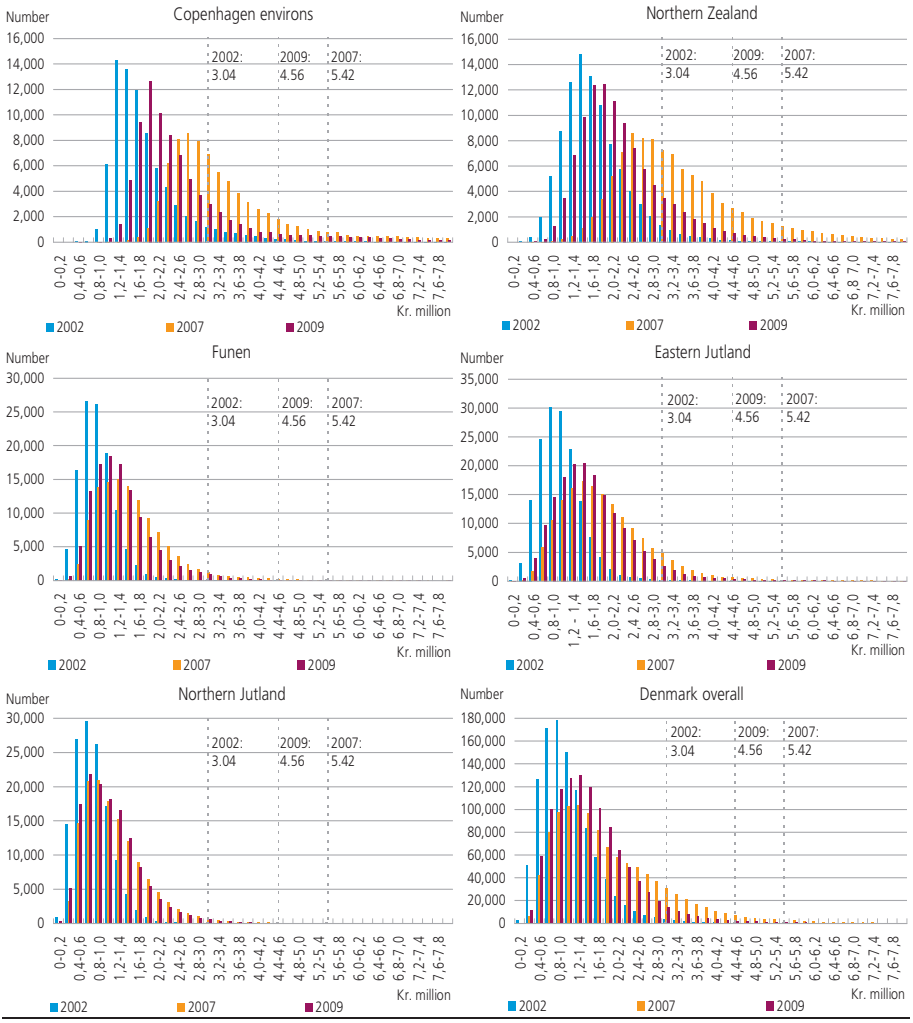
Regional impacts of the freeze on property value tax

The effect of the freeze on property value tax on house prices, calculated on the basis of the estimated house-price relation, is an average consideration for Denmark as a whole. In the areas in and north of Copenhagen, where prices per square metre are high, the increases were especially steep (cf. also Chart 2.2). Accordingly, the impact of the freeze on user cost and first-year payments was significantly greater in these areas than in the rest of the country.

Chart 3.5 shows the distribution of public property valuation figures on single-family houses for selected regions in 2002, when the freeze

SINGLE-FAMILY HOUSES, BROKEN DOWN BY VALUATION PRICE IN SELECTED PARTS OF DENMARK AND FOR DENMARK OVERALL

Chart 3.5



Note: The data referred to as 2002, 2007 and 2009 is census data from 2003, 2008 and 2010 for the housing specified, calculated at the valuation price in 2002, 2007 and 2009, respectively. Houses valued at more than kr. 8 million have been excluded. The dotted lines indicate the actual progressivity threshold for property value tax in 2002 of kr. 3.04 million and the calculated progression limits for 2007 and 2009 of kr. 5.42 million and kr. 4.56 million, respectively, based on developments in average public property valuations.

Source: Statistics Denmark and Danmarks Nationalbank.

was introduced; in 2007 at the peak of house prices; and in 2009, the time of the latest property valuation. The steep price increases around Copenhagen relative to the rest of Denmark are evident in that the distributions in the top two graphs in Chart 3.5 shift substantially more to the right from 2002 to 2007 (and similarly to the left from 2007 to 2009) than the distributions in the other graphs.

Chart 3.5 also reveals that the progressive element of property value tax – i.e. the fact that the value of housing exceeding kr. 3,040,000

CALCULATED EFFECTIVE PROPERTY VALUE TAX RATES, BROKEN DOWN BY AREA

Table 3.3

Per cent	2002	2007		
		With tax freeze	Without tax freeze	Difference[1]
Copenhagen city	1.03	0.52	1.08	0.56
Copenhagen environs	1.08	0.54	1.16	0.62
Northern Zealand	1.05	0.53	1.09	0.56
Bornholm	1.00	0.57	1.00	0.43
Eastern Zealand	1.01	0.54	1.02	0.48
Western and Southern Zealand	1.00	0.56	1.00	0.44
Funen	1.00	0.57	1.01	0.43
Southern Jutland	1.00	0.66	1.00	0.35
Eastern Jutland	1.01	0.55	1.02	0.47
Western Jutland	1.00	0.67	1.00	0.33
Northern Jutland	1.00	0.65	1.00	0.35

Note: Property value tax has been calculated based on extracts of data from Statistics Denmark where all single-family houses are divided into ranges of kr. 100,000 on the basis of their public property valuation. Reductions in property value tax for pensioners and houses traded before 1 July 1998 are disregarded. The counterfactual property value tax has been calculated with a progressivity threshold projected based on the rules applicable until 2002, cf. footnote 1 on this page.

Source: Statistics Denmark and own calculations.

[1] Difference in percentage points between the calculated property value tax rate with and without the tax freeze. Sums may not add up due to rounding.

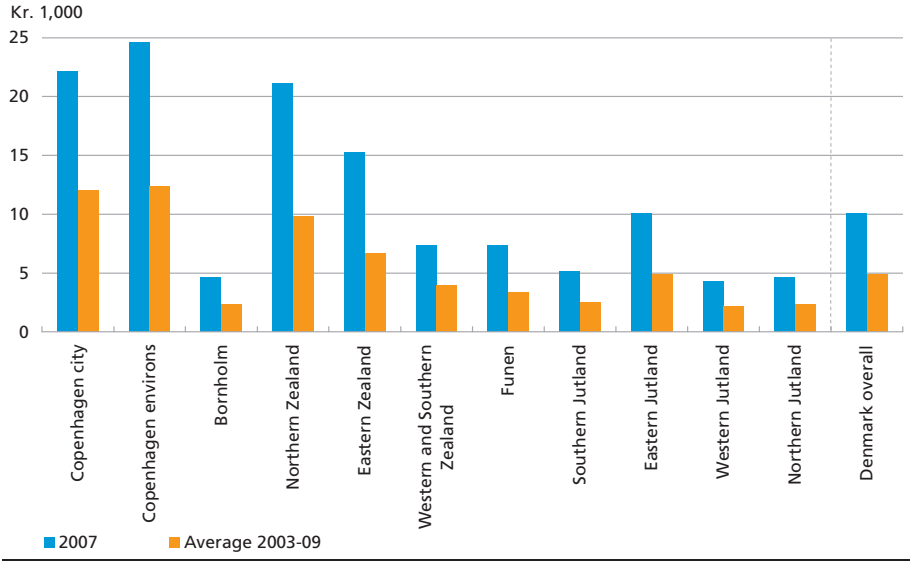
(frozen 2002 level) is triple-taxed – is predominately a Copenhagen phenomenon. This means that the freeze on property value tax has been particularly favourable for expensive houses in and around Copenhagen, which have avoided the high rate of tax on the marginal increase in value despite steep price rises. However, in this respect, it is important to take into account how the progressivity threshold would have developed under the rules applying before the tax freeze.[1] We have calculated these progressivity thresholds, which are shown in Chart 3.5 for the three years. The calculations reveal that although the spread between property values has increased, the separate effect of the freeze through the progressive element of property value tax is of secondary importance in the big picture – despite giving substantial tax cuts to the most affluent homeowners.

Overall, the freeze on property value tax undisputedly led to large tax savings in expensive residential areas around Copenhagen. Thus, the freeze has contributed to higher price increases in these areas than in the rest of Denmark. This is confirmed by Table 3.3, where we have calculated the effective property value tax rates in the different parts of Denmark using simplified assumptions. As shown, during the housing

[1] The progressivity threshold was adjusted annually by weighting together the price increases for owner-occupied housing subject to property valuation, the weighting being 75 per cent for single-family homes, 15 per cent for summer cottages and 10 per cent for owner-occupied flats. We have continued this calculation to 2009 using the valuation statistics of the Danish Tax and Customs Administration (Skat).

REDUCTION IN PROPERTY VALUE TAX PER HOUSEHOLD DUE TO THE NOMINAL PRINCIPLE OF THE TAX FREEZE

Chart 3.6



Note: All amounts at 2010 level. Property value tax has been calculated based on extracts of data from Statistics Denmark where all single-family houses are divided into ranges of kr. 100,000 on the basis of their public property valuation. Reductions in property value tax for pensioners and houses traded before 1 July 1998 are disregarded. The counterfactual property value tax has been calculated with a progressivity threshold projected based on the rules applicable until 2002, cf. footnote 1 on page 27.

Source: Statistics Denmark and own calculations.

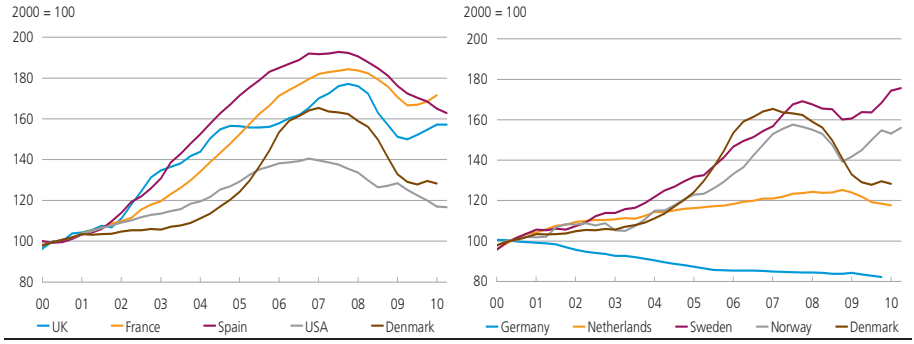
bubble, the greatest reductions in the effective property value tax rates occurred in expensive residential areas in Greater Copenhagen where house prices showed the highest increases – in absolute as well as relative terms. The tax savings per household are illustrated in Chart 3.6. While the average household in the environs of Copenhagen saved kr. 25,000 (2010 level) at the peak of house prices in 2007, savings were less than kr. 5,000 in Northern and Western Jutland.

4. INTERNATIONAL HOUSING MARKETS

Denmark was not the only country to experience rapidly escalating house prices in the early years after the millennium change. The UK, France, Spain, the USA, Norway and Sweden also recorded solid real price increases in the period up to 2007. Subsequently, house prices generally dropped sharply in the period until 2009 and since then they have remained largely static, cf. Chart 4.1.[1] Danish house prices started rising at a relatively late stage, but momentum was strong around 2005-

[1] In Ireland, house price changes have been particularly dramatic over the last decade. Irish house price developments are described in the article by Jakob Ekholdt Christensen on the economic crisis in Ireland, Iceland and Latvia in Part 1 of this Monetary Review.

REAL HOUSE PRICES IN SELECTED OECD COUNTRIES Chart 4.1

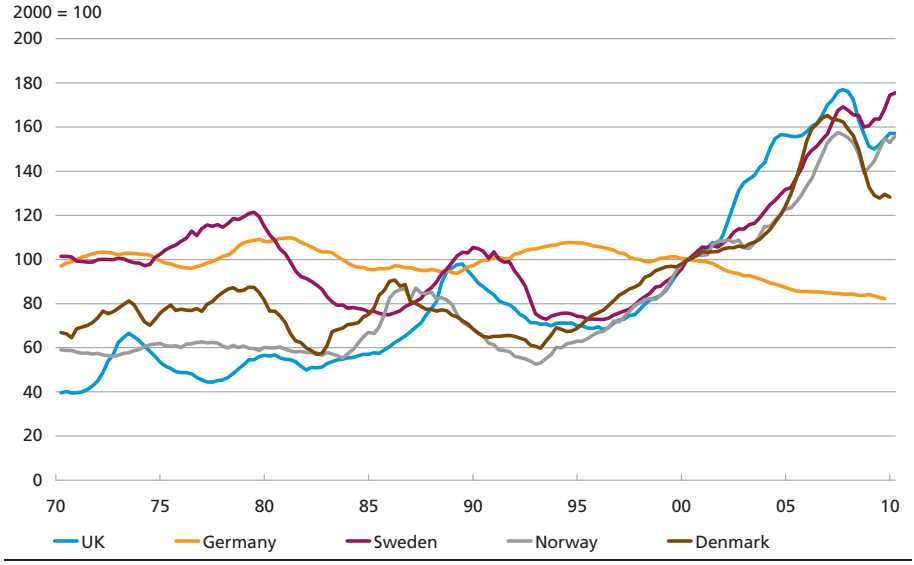


Note: Real house prices: nominal house prices deflated by the national accounts deflator for private consumption. See Appendix C for more details on individual house price series.
Source: OECD House Price Database, cf. Appendix C.

06; in most other countries, the pace of increase was more gradual. Norway and Sweden stand out, as real house prices had already returned to the peak levels of 2007 (or higher) by 2010. In the Netherlands, house prices climbed slowly in the period up to 2008 and the subsequent decline has been modest. Germany stands in stark contrast to most other OECD countries with slightly falling house prices throughout the period.

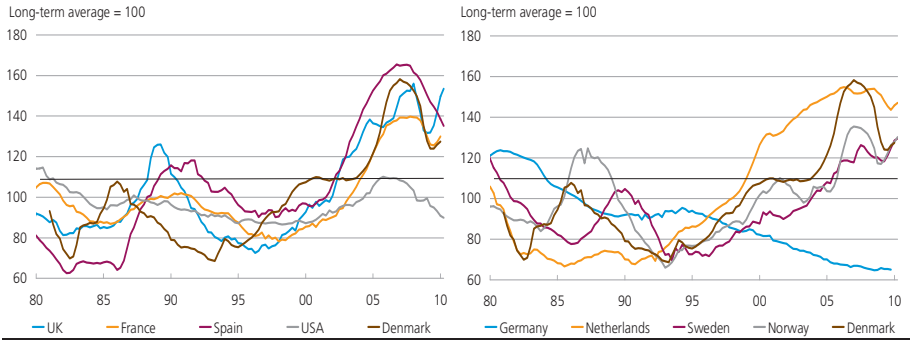
House-price developments have been relatively synchronous across the OECD countries – also relative to previous decades. This is illustrated by Chart 4.2, which shows more uniform developments in house prices in

REAL HOUSE PRICES OF DENMARK'S LARGEST TRADING PARTNERS 1970-2010 Chart 4.2



Note: Real house prices: nominal house prices deflated by the national accounts deflator for private consumption.
Source: OECD House Price Database.

HOUSE-PRICE-TO-INCOME RATIO Chart 4.3



Note: Nominal house prices as a ratio of disposable income per capita. Average for the period 1970-2010 (France, Norway and Denmark from 1978, 1975 and 1981, respectively).
Source: OECD House Price Database and own calculations.

Denmark and our key trading partners during the period 1995-2010 compared with 1970-95. This suggests that house prices are not driven by national conditions alone, but increasingly by ever more synchronised international economic and financing conditions.

House prices relative to income and rents

The ratio of house prices to household disposable income and the ratio of house prices to rents are often used as measures of whether house prices are relatively high or low.[1] Measured in terms of both income and rents, house prices increased far above the long-term average from about 2000 to 2007 in most OECD countries, Germany being the exception, cf. Charts 4.3 and 4.4.

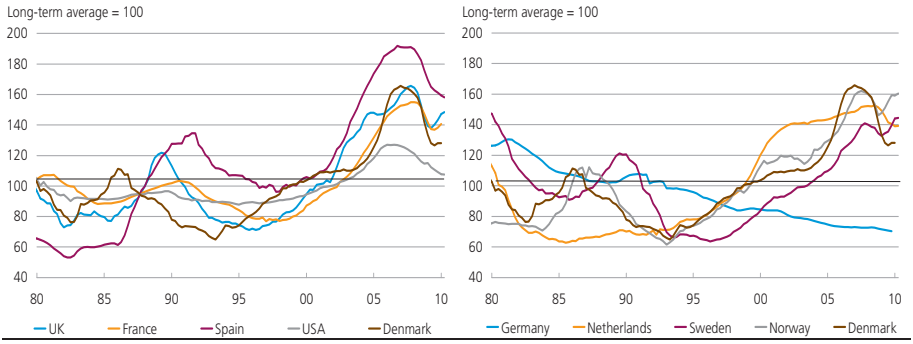
Among the countries observed, the highest increases – and thus the largest deviations from the long-term average – were recorded in Spain, the UK and Denmark. Despite the downturn in 2007, the measures still indicate a certain positive gap in all countries with the exception of the USA, where prices have fallen to or below the long-term average, and Germany, where, according to both measures, house prices are lower than the long-tem average.

House prices and macroeconomic developments

National house prices have closely tracked cyclical movements, which have been relatively synchronous across countries. For example, house prices generally peaked a couple of quarters before GDP around 2007, cf. Table 4.1. Countries in which house prices had appreciated substantially experienced correspondingly strong GDP growth during the period of rising prices and sharp declines in GDP during the period of falling

[1] Cf. section 5 for a discussion of the house-price-to-rent ratio.

HOUSE-PRICE-TO-RENT RATIO Chart 4.4



Note: House-price-to-rent ratio: nominal house prices as a ratio of nominal rents given by the rent component of the consumer price index. Average for the period 1970-2010 (Spain, Norway and Sweden from 1971, 1979 and 1980, respectively). Rent data from the rent component of the consumer price index, but characteristics and locations of housing may vary somewhat between the owner-occupied and rental housing markets. Differences between developments in rents and house prices may be based *inter alia* on regulation of the rental market.

Source: OECD House Price Database and own calculations.

prices. Denmark, like Sweden and Norway, recorded particularly strong GDP growth and sharp increases in house prices during the period 2003-07, cf. Chart 4.5.

Historically, house prices have tracked cyclical movements, both with a cycle of around 10 years, the expansion phase lasting about six years, cf. André (2010). However, the latest upturn in house prices went on for more than 10 years and house prices have, to some extent, become de-coupled from cyclical movements.

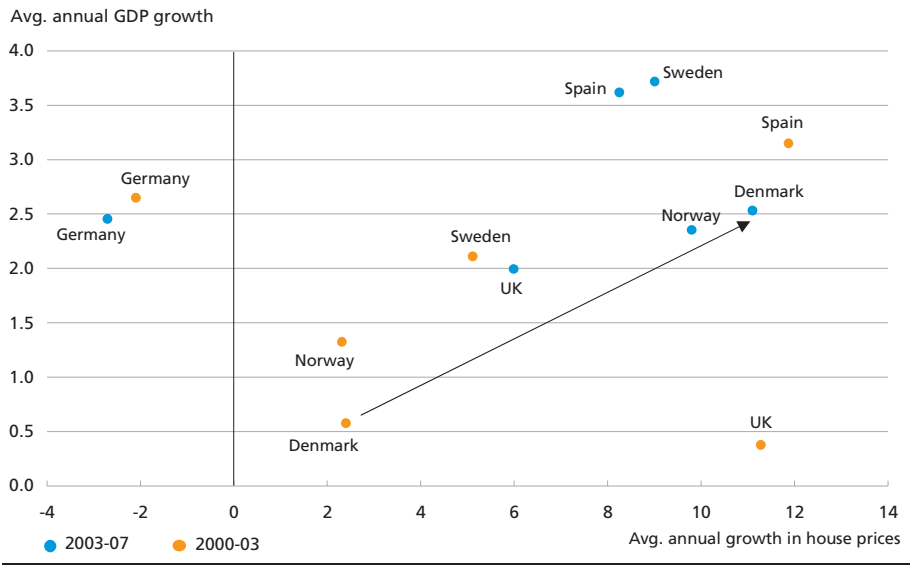
The economic downturn in 2001 was not followed by a decline in house prices, as was the case in 2007-08. In 2001, low monetary-policy interest rates and mortgage-market innovations in many countries

HOUSE PRICES, GDP AND TIMING Table 4.1

	Latest house price peak	Latest GDP peak	Increase in house prices, 2000 house price peak (per cent)	Increase in GDP, 2000 GDP peak (per cent)	Fall in house prices, peak-bottom (per cent)	Fall in GDP, peak-bottom (per cent)
Denmark	Q1 2007	Q4 2007	69	13	23	7
Sweden	Q4 2007	Q4 2007	77	27	5	8
Norway	Q3 2007	Q2 2008	61	15	12	2
Netherlands	Q4 2008	Q1 2008	30	19	6	5
Ireland	Q1 2007	Q4 2007	72	55	36	14
Germany	Q3 1994	Q1 2008	-	13	24	7
France	Q4 2007	Q1 2008	88	16	9	3
Spain	Q3 2007	Q1 2008	93	30	16	5
UK	Q4 2007	Q1 2008	84	22	15	7
USA	Q4 2006	Q4 2007	43	21	17	4

Source: OECD House Price Database.

GROWTH IN GDP AND REAL HOUSE PRICES IN SELECTED COUNTRIES Chart 4.5



Source: Reuters EcoWin and OECD House Price Database.

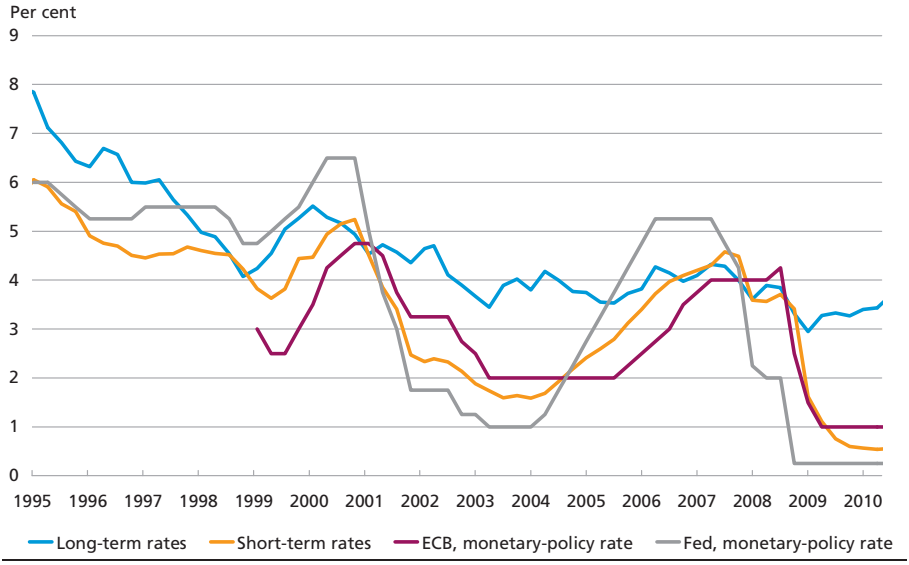
fuelled borrowing and housing demand. As a result, increases in household debt were accompanied by higher house prices.

Interest-rate developments have had a key impact on user cost and thus on the course of house prices and debt. Relevant rates of interest on loans differ across countries, but a simple weighted country average of short-term and long-term interest rates, respectively, underpins the impression of declining interest rates from 2000 to 2004 followed by higher interest rates until the peak of the financial crisis in 2007-08, cf. Chart 4.6. This pattern is clearest for short-term interest rates, which are more closely linked to monetary-policy interest rates.

Lower interest rates have fuelled housing demand and the supply of mortgage loans. As lenders focus on the borrowers' interest expense-to-income ratios, lower interest rates point to credit expansion. Moreover, lower long-term risk-free interest rates may have provided an incentive for investors to increase their portfolio of mortgage loans as part of a global "search for yield", cf. White (2006). A steep yield curve and less volatility in short-term interest rates mean that adjustable-rate loans have become more attractive at the expense of long-term fixed-rate loans.

Over the last two decades, there has been an increasing tendency towards synchronisation of interest-rate movements across countries. Notably, the introduction of the euro caused long-term interest rates in the euro area to converge. This has, to some extent, contributed to con-

SHORT- AND LONG-TERM INTEREST RATES IN SELECTED OECD COUNTRIES Chart 4.6



Note: Weighted average based on PPP-adjusted GDP weights from 2005 for 17 OECD countries. Nominal interest rates. Monetary-policy interest rates are the ECB's interest rate in its main refinancing operations and the Federal Reserve's Fed Funds Target Rate (end of quarter).
Source: OECD and own calculations.

vergence of house prices, cf. André (2010). In 2009-10, yield spreads in a number of countries widened somewhat due to concerns over the size of the government debt. This has had a knock-on effect on mortgage yields and has contributed to less homogeneous house-price developments after the reversal in 2007.

In Denmark and Spain, in particular, lending growth surged by about 25 per cent year-on-year in 2005-06, but subsequently growth has halted and been close to zero since the autumn of 2009, cf. Chart 4.7. Other OECD countries also recorded significant lending growth of about 10 per cent year-on-year during the period 2004-06 and a subsequent fall to very low or negative growth rates. Sweden and Norway are the exceptions, recording only a marginal reduction in lending growth. Germany has had no growth at all.

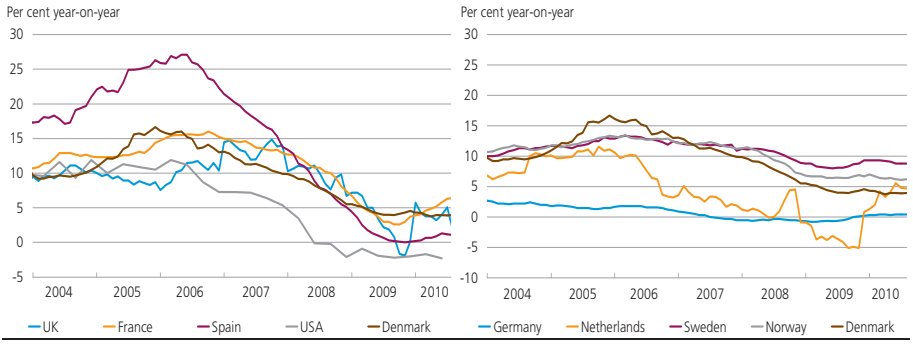
Institutional conditions

Institutional conditions, especially in mortgage markets, play a key role in housing demand and house prices.

Over the last decade, mortgage-market innovations have contributed to improving credit facilities for households and enabled more people to buy their own home despite rising house prices. According to the IMF (2008), mortgage markets in Denmark and the USA are among the most

GROWTH IN LENDING FOR HOUSEHOLDS' HOME PURCHASES IN SELECTED OECD COUNTRIES

Chart 4.7



Note: For Sweden, Norway, the UK and the USA, the figures include financial institutions' total lending to households. Quarterly data for the USA.
Source: ECB and Reuters EcoWin.

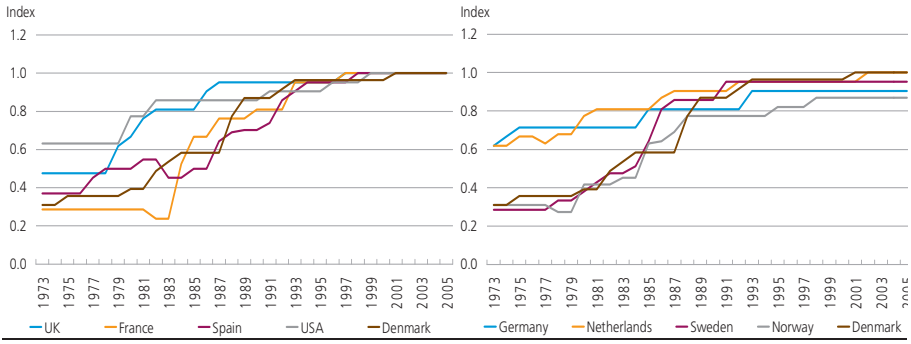
liberal with their possibilities of mortgage equity withdrawal and mortgage refinancing free of charge; a high mortgaging ratio; long-maturity mortgage loans; and a large proportion of mortgage bonds and financial products secured on mortgage bonds. Based on these criteria, the housing markets in Spain, France and Germany are among the least liberal markets. As Spain, in particular, has recorded sharp rises in house prices, the degree of mortgage-market liberalisation is not the only driver of house prices.

Abiad et al. (2008) have attempted to estimate a measure of financial regulation over time. To that end, an index of financial reforms has been designed based on the timing of changes to financial regulation, such as the lifting of credit restrictions, interest-rate control, extraordinarily high reserve requirements, market-access restrictions, government ownership in the banking sector and banking regulation. The index has been set at between 0 and 1 and is a rough measure of policy changes that enabled increased mortgage-market competition during the period 1973-2005.

All countries have deregulated their financial sectors during recent decades, but the timing and point of departure vary greatly, cf. Chart 4.8 and Box 4.1. Most of the observed countries had fully liberalised their financial sectors (index 1) already in the early 2000s, the exceptions being Germany, Sweden and Norway. The Danish index reached the upper limit when deferred-amortisation loans were introduced in 2003.

Home financing also differs across countries in terms of the popularity of different loan types. Fixed-rate loans are the dominant loan types in the USA and the Netherlands, which have the most liberal mortgage markets, and in Germany and France. In Sweden, Norway, the UK and Spain, like in Denmark, adjustable-rate loans account for an equally

INDEX OF FINANCIAL REFORMS IN SELECTED OECD COUNTRIES Chart 4.8



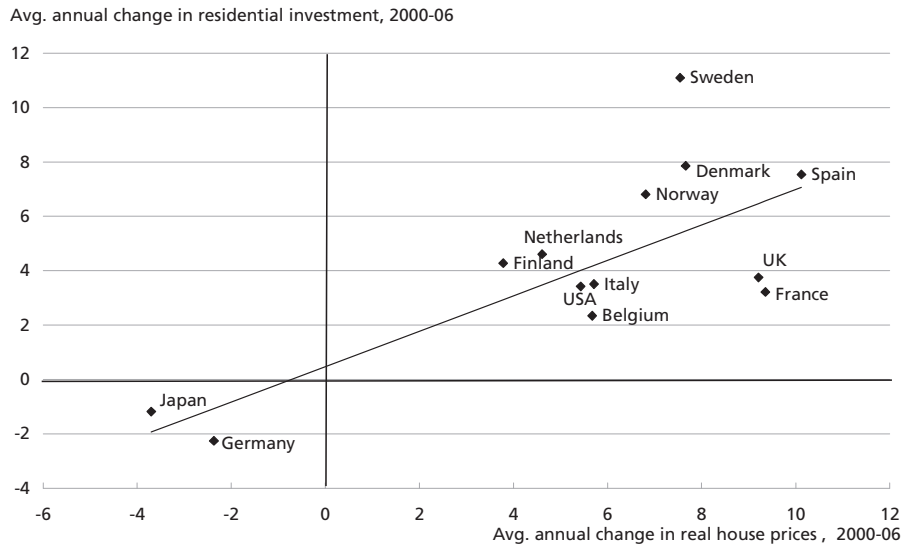
Note: The higher the index, the more liberal the financial system. The index has been normalised to the range between 0 and 1.
Source: Abiad et al. (2008).

large or larger share than fixed-rate loans. This indicates that the volume of adjustable-rate loans in the housing market is not unequivocally linked to the degree of liberalisation of the mortgage market.

Housing supply

The supply of housing is affected by many factors in the form of local conditions such as vacant land for construction, infrastructure, building regulations, construction costs and expectations of future house prices. The latest upswing in house prices saw strong correlation between changes in residential investment and changes in real house prices, cf. Chart 4.9.

CHANGE IN RESIDENTIAL INVESTMENT AND REAL HOUSE PRICES Chart 4.9



Source: OECD (2010) and OECD House Price Database.

FINANCIAL LIBERALISATION IN SWEDEN, THE UK AND SPAIN Box 4.1

According to the OECD (2006), the Danish mortgage market has become more "complete" than most other European home financing systems following extensive innovation since the mid-1990s. An international survey shows that the average price of a mortgage loan is among the lowest in Europe and the product range is broader. Moreover, few other countries enable homebuyers to redeem mortgage loans prematurely and to take over existing mortgage loans. However, experience from Sweden, the UK and Spain indicates that financial deregulation and innovation in the mortgage markets have also impacted housing demand and house prices in these countries – despite a smaller volume of loans.

As far as Sweden is concerned, Nyberg (2006) notes that sweeping changes in the mortgage market have contributed to a sharp increase in house prices. The crisis in the early 1990s delayed financial market deregulation, but subsequently the mortgage market, among others, underwent major changes. Competition was strengthened and margins were squeezed, causing mortgage yields to drop. Moreover, mortgage banks became more flexible in terms of mortgaging ratios and offered a wider selection of loan products. Nyberg particularly emphasises less stringent repayment requirements with extended maturities and the fact that fewer borrowers opted to amortise their loans – probably in expectation of higher house prices. Unlike in Denmark, deferred amortisation has been an option for Swedish mortgage borrowers all along, but it became increasingly popular during the latest upswing in house prices. Moreover, adjustable-rate loans[1] accounted for a still higher portion of loans.

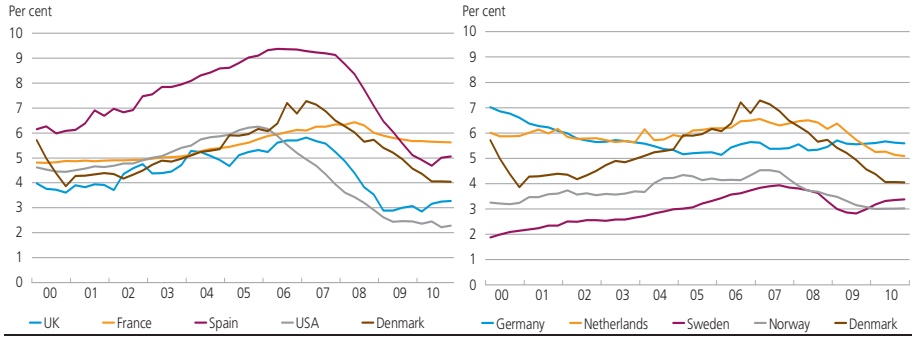
In the UK, according to Kuenzel and Bjørnbak (2008), credit market liberalisation contributed substantially to boosting housing demand. Financial deregulation, underpinned by innovation and new mortgage instruments, enabled lenders to diversify their credit risk. This helped to increase the credit supply and intensify competition in the mortgage market. In the years before the reversal in house prices in 2007, there was also an increase in subprime-style mortgage loans with mortgaging ratios exceeding 100 per cent. According to the authors, credit terms were eased particularly from the mid-1990s when house prices also gained momentum.

In Spain, credit market liberalisation contributed to increasing competition between financial institutions from the mid-1990s. Competition has taken place both through prices and through the issuance of mortgage products with greater flexibility in terms of maturity and mortgage yields. Since then, credit institutions have started launching mortgage products which can be directed to uses other than home purchases, cf. Manzano (2005). Lending for new construction saw a particular increase. Stronger demand for loans has been met, in part, through foreign finance and mortgage refinancing.

Overall, the mortgage markets in Sweden, the UK and Spain, as well as Denmark, have undergone substantial changes since the mid-1990s. In all cases, these changes have increased housing demand as well as house prices – especially through the introduction of adjustable-rate loans. Denmark stands out with a particularly high degree of innovation in this field, however.

[1] Reference is made to Frisell and Yazdi (2010) for a recent analysis of the Swedish housing market.

RESIDENTIAL INVESTMENT-TO-GDP RATIO Chart 4.10



Note: Residential investment and GDP calculated at current prices.
Source: OECD (2010).

However, residential investment has responded very differently to house-price increases. In the UK and France, investment has risen relatively slowly despite high increases in house prices; Denmark, Norway and Sweden, on the other hand, have seen relatively large increases. This indicates that the housing supply is more elastic in the Nordic countries, cf. André (2010). As shown by Chart 4.10, the volume of residential construction remains moderate in Norway and Sweden, however, while it is somewhat higher in Spain and, to some extent, France expressed as a ratio of total GDP. In Germany, which has recorded a decline in house prices, residential investment has also dropped, albeit from a high level. This should be seen in light of German reunification in 1991.

Rural-urban differences

In urban areas, the housing supply is determined also by factors such as the number of inhabitants, population growth and density, as well as transport costs and the degree of regulation of new construction. Across countries, it applies that large towns and cities have experienced the highest house-price increases, while rises have been more subdued in rural areas and small towns.

According to Hiebert and Roma (2010), house-price cycles in urban areas in the four largest euro area member states (Germany, France, Italy and Spain) and the USA have been relatively uniform since 1990. But developments in national housing indices conceal considerable heterogeneity in house prices in towns and cities within individual countries. In the four euro area member states, average house prices in the most expensive towns and cities were 2-4 times higher than in the towns and cities with the lowest house prices. The spread was significantly wider in the USA, where these prices were about 10 times higher.

5. ARE DANISH HOUSE PRICES OVERVALUED?

Having dropped sharply throughout 2008 and the first part of 2009, Danish house prices seem to have stabilised for now, although the correction in 2008-09 eliminated only part of the escalation in real house prices occurring from 2003 to 2007. Whether further downward adjustment in real house prices is required over the coming years or whether the necessary correction of the housing bubble of the previous decade must be assumed to be complete will have a significant bearing on the Danish economy over the coming years.

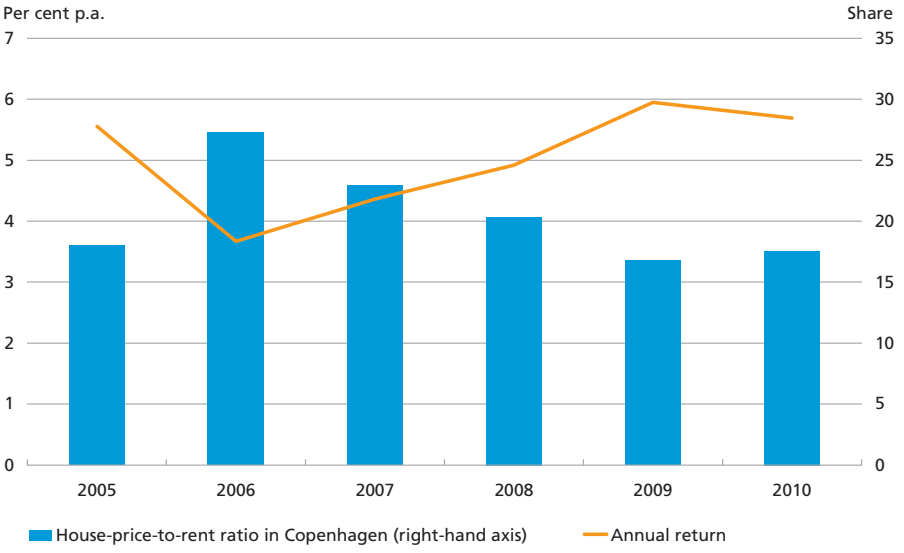
In this section, we present a number of methods to assess whether and to which extent real house prices are overvalued relative to a level that is compatible with long-term equilibrium in the housing market. The results are not unambiguous. Some of the methods reviewed would indicate that the housing market is still overvalued, while other methods indicate that real house prices have already more or less reached a long-term sustainable level. What is certain, however, is that it is important to distinguish between developments in Greater Copenhagen and the rest of Denmark. The analysis also indicates that prices of and access to building plots play a key role in price formation in the housing market.

Is the current house-price-to-rent ratio sustainable?

The ratio of the house price per square metre to rent per square metre of similar rental housing is sometimes used as an indicator of whether the housing market is overvalued. Rent represents the housing cost homeowners would have had, should they have rented similar housing. The reciprocal value of the house-price-to-rent ratio can thus be seen as the annual return accruing to homeowners from owning their home (excluding possible capital gains or losses on the home). Obviously, the price-to-rent ratio also determines the return received by homeowners if they decide to let their home. If the price-to-rent ratio e.g. is 15, implying that the price per square metre when purchasing the home is 15 times the annual rent per square metre, the annual return is 6.7 per cent (100*(1/15)). This return may be compared with the return on alternative investments to assess whether house prices are in disequilibrium.

In practice, the price-to-rent ratio for comparable houses may be reasonably calculated only for large towns and cities with a certain number of rental single-family houses. Søndagsavisen (Danish weekly), in association with Boligportal.dk, has performed such calculation for large Danish towns and cities, cf. Søndagsavisen (2010). In the 2nd quarter of 2010, the house-price-to-rent ratio of similar housing in

HOUSE-PRICE-TO-RENT RATIO IN COPENHAGEN Chart 5.1



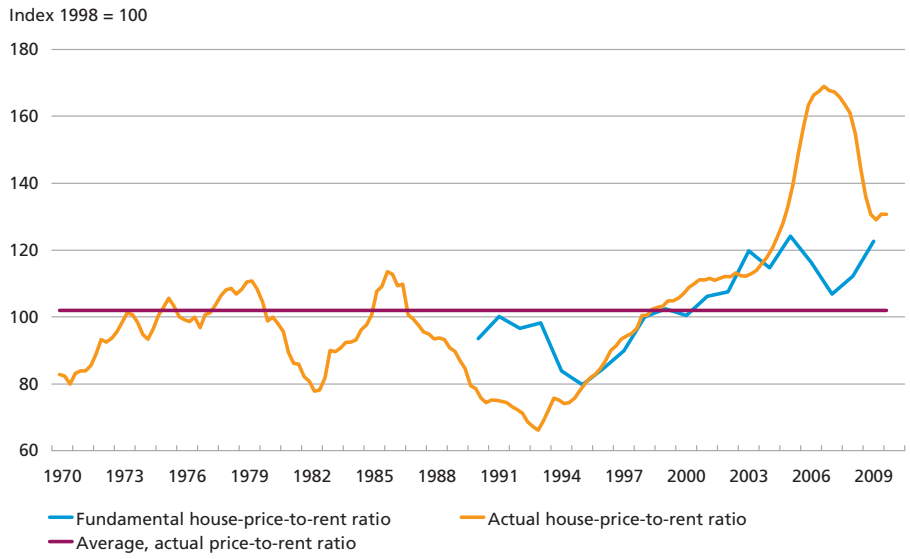
Note: Annual return is calculated as the reciprocal value of the house-price-to-rent ratio.
Source: Søndagsavisen (2010).

Greater Copenhagen was just under 18, equivalent to an annual rental return of 5.6 per cent, cf. Chart 5.1. In addition to the actual return on invested capital, the rental return is to cover depreciation and risk premium. Against this backdrop, the calculated return of 5.6 per cent seems to be on the low side in a long-term perspective. A low current return indicates that owner-occupied house prices are too high – unless there are expectations of future capital gains on the home that may offset the low direct return.

A related method for investigating whether house prices are overvalued is to calculate the house-price-to-rent ratio – not in Danish kroner (as done above) but as an index. This is referred to as the "actual house-price-to-rent ratio" in Chart 5.2. This measure is used e.g. by the OECD. According to this method, a comparison of the current level of the house-price-to-rent ratio and the average of the ratio over an extended period shows whether the housing market is overvalued. Chart 5.2 shows that, in 2009, the actual house-price-to-rent ratio was more than 25 per cent higher than the average for the period 1970-2009. This could suggest that the Danish housing market is substantially overvalued.

The OECD recently assessed the level of Danish house prices by comparing an index of a "fundamental" house-price-to-rent ratio with the index described above of the actual house-price-to-rent ratio, cf. André (2010). The fundamental ratio calculates a rate of return based on the user cost of owner-occupied housing. The calculation is based on the

HOUSE-PRICE-TO-RENT RATIO, NATIONWIDE AVERAGE Chart 5.2



Source: André (2010).

Poterba model for determining house prices where the rent in equilibrium is equal to the user cost of investing in owner-occupied housing, cf. Poterba (1984).

For the 2nd quarter of 2009, the calculation in André (2010) results in a user cost of 5.64 (the sum of a rate of interest after tax of 3 per cent, property value tax of 0.6 per cent, depreciation of 0.04 per cent and expected capital gains of 2 per cent). The reciprocal value of 5.64 gives a fundamental house-price-to-rent ratio of 18. Chart 5.2 shows the series as an index (blue graph). A comparison of this index with the actual house-price-to-rent ratio provides an indication of how much house prices deviate from a level of equilibrium under the given assumptions. With this calculation, Danish house prices were almost 10 per cent overvalued in 2009. According to this measure, house prices were significantly more overvalued during the period 2005-07, cf. Chart 5.2.

The approaches described for assessing the housing market are not without problems. In its calculation of the actual house-price-to-rent ratio, the OECD uses the housing item of the consumer price index as a rental index. However, the consumer price index measures the rent for all types of rental flats, including subsidised housing – not just rental single-family houses. Consequently, the housing units in the numerator and the denominator do not match. Moreover, the theoretical assumption of equivalence between user cost and rent requires that the markets are free, efficient and unregulated.

In Denmark, the usefulness of the method applied by Søndagsavisen is hampered by the relative smallness of the rental market for single-family houses, which is hardly likely to have any impact on owner-occupied house prices – not even in large towns and cities. The return to be used for comparison is not clear either. Interest rates affect house prices, but, in practice, they do not impact rents to the same extent. Thus a high price-to-rent ratio is more a reflection of low interest rates than of overvalued house prices. In order to apply this ratio, assumptions have to be made of a normal rate of return against which rents are to be measured.

A general problem of all the methods described is that, in large segments of the Danish housing market, rents are regulated to some extent; thus the comparison is not between two free markets and, furthermore, significant friction exists in mobility between the two markets. Below we will focus on other methods of assessing the sustainability of house prices.

House-price-to-constructioncost ratio calculated as an index measure

In the short term, house prices fluctuate with housing demand, but in the long term, prices of existing housing must be assumed to adjust to the cost of new construction, cf. Box 5.1. In other words, an assessment of whether house prices are overvalued or undervalued in a long-term perspective may be based on the ratio of prices of existing housing to the cost of new construction. This price ratio, described in the literature as "Tobin's Q for the housing market",[1] can often be calculated only as an index measure. This makes it possible to monitor *developments* in the price ratio relative to a given base year or a given trend level for the index.

However, Tobin's Q calculated as an index measure makes it possible to assess whether house prices are overvalued or undervalued only if there is reason to assume that the base year or trend level selected represents a situation in which the housing market was in long-term equilibrium (i.e. a situation where prices of existing housing were equivalent to prices of similar new housing).

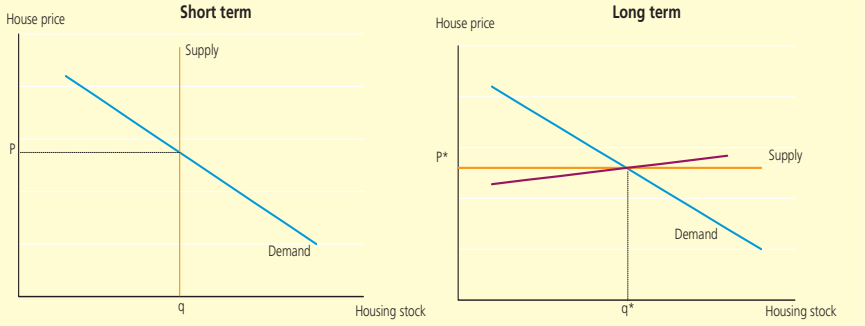
Tobin's Q as an index measure is calculated by deflating a house-price index by an index of construction costs measured in terms of the national

[1] The name is based on Tobin (1969), who developed the theory that business investment is stimulated, the higher the market value of existing business assets (e.g. measured in terms of share prices) is relative to the cost of acquiring new capital goods. Correspondingly, it must be assumed that it will be attractive to acquire new housing rather than similar existing housing when the latter is more expensive than the former.

PRICE ADJUSTMENT IN THE HOUSING MARKET Box 5.1

In the housing market, as in other markets, the price is determined by supply and demand. However, the housing market differs from other markets in that supply cannot be changed overnight, i.e. the supply curve is vertical in the short term, cf. Chart 5.3 (left). So the price of owner-occupied housing is determined initially by housing demand and may fluctuate relatively widely with cyclical trends as there is no short-term supply response to dampen the movements.

PRICE ADJUSTMENT IN THE HOUSING MARKET, SHORT AND LONG TERM Chart 5.3



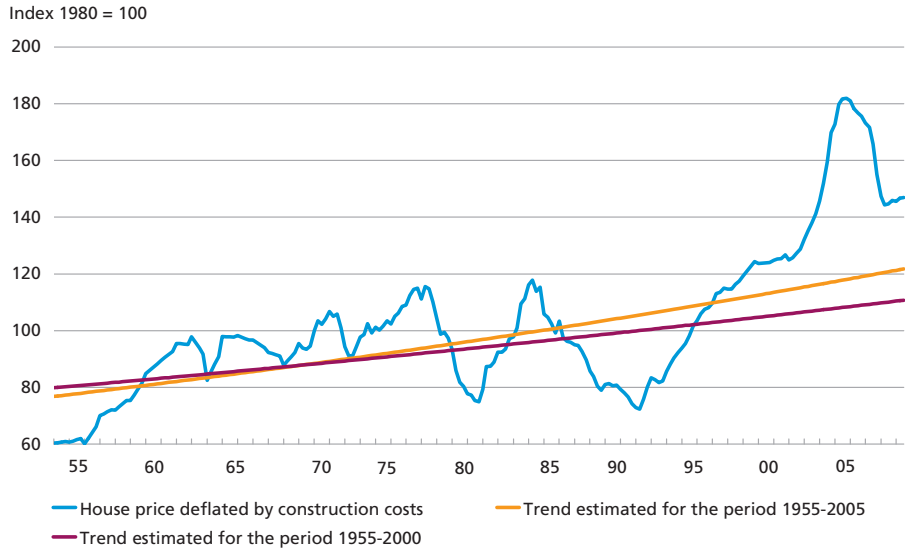
Demand for housing increases with income, i.e. the demand curve is continuously shifted to the right, with a tendency towards higher prices so that residential construction is boosted. Construction activity will continue for as long as the price of existing housing exceeds the price of new construction, i.e. for as long as it pays to acquire new housing rather than purchasing existing housing stock. The increased supply of housing gradually drives the price down towards the cost of new construction, which thus determines house prices in the long term.

The horizontal long-term supply curve in Chart 5.3 (right) reflects the real cost *P** of constructing new housing. If the long-term supply curve is actually horizontal, the real house price will be constant in the long term. In that case, the increase in the nominal house price will be equivalent to general inflation. If, on the other hand, the long-term real marginal cost of increasing the housing stock is rising, the long-term housing supply curve will have a positive slope, as indicated by the red curve in Chart 5.3 (right). In that situation, the increase in housing demand prompted by economic growth will be reflected in higher real house prices – even in the long term. As explained in the main text, shortage of building plots could mean that the long-term real marginal cost of expanding the housing stock rises.

accounts deflator for new construction, cf. chart 5.4. Assessing developments in the Tobin's Q index based on very long historical time series is not unproblematic, as the time series go back to times when the regulatory framework in terms of financial market regulation, the economic policy pursued, land zone legislation, etc. were very different from current conditions.

HOUSE-PRICE-TO-CONSTRUCTION COST RATIO, CALCULATED AS AN INDEX MEASURE

Chart 5.4



Note: The estimated trend curve is a logarithmic trend. Growth at a constant rate results in a linear trend. The house-price-to-construction cost ratio has been calculated as kp/pih in the ADAM notation.

Source: Statistics Denmark and own calculations.

However, as previously mentioned, the main problem with the interpretation of the index in Chart 5.4 is that it is unclear where to establish the fundamental level, i.e. which year to choose as the equilibrium year. This makes it difficult to assess how far the current value is from equilibrium. If a logarithmic trend line is included, current prices are significantly above the trend level. Based on an almost identical analysis, the Danish Economic Councils (2010) assess that house prices at the national level are currently 10-20 per cent too high.

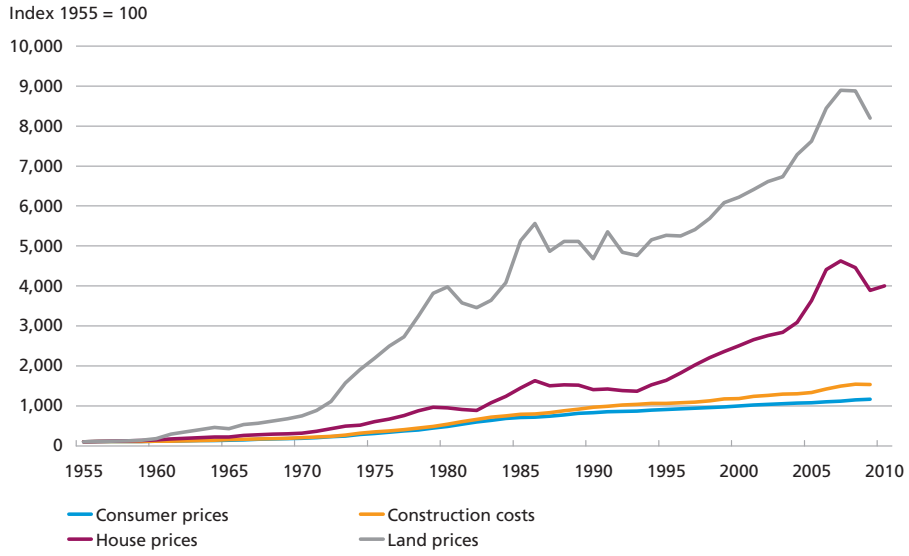
According to the traditional housing market model, described in Box 5.1, house prices will track construction costs in the long term. Based on this theory, the trend lines of Chart 5.4 should thus be completely horizontal. But in fact, the trend lines increase over the observed periods, i.e. house prices tend to increase more rapidly than the cost of new residential construction. Presumably the reason is that house prices include not just the cost of buildings but also land values, which have historically risen more than construction costs, cf. Chart 5.5.[1]

The long-term trend towards relatively steep increases in prices of building plots may reflect that – since the overall supply is constant – the supply of land for housing purposes is not easy to increase. Other things

[1] Thus the construction cost indices in Charts 5.4 and 5.5 include only the cost of new construction, not the cost of building plots.

DEVELOPMENT IN LAND PRICES, CONSTRUCTION COSTS, HOUSE PRICES AND CONSUMER PRICES

Chart 5.5



Note: All indices state developments in nominal prices and costs.
Source: Statistics Denmark.

being equal, increases in the prices of building plots will provide an incentive to convert land from other purposes to housing. However, general economic growth also tends to increase the shortage of land for alternative uses. As a result, prices of land e.g. for agricultural and other business purposes are bid up, thereby reducing the incentive to develop land for housing purposes. As land is a non-reproducible resource, there is thus an underlying tendency for land prices to increase more rapidly than prices of reproducible construction materials, etc.

On average, both land prices and construction costs have increased more rapidly than the consumer price index since 1955. So it is hardly surprising that house prices have also risen faster than consumer prices, cf. Chart 5.5. Obviously, it is of key importance in the assessment of the outlook for nominal house prices whether the historical long-term trend towards increasing real prices of owner-occupied housing is likely to continue. If real house prices are currently overvalued, a period of significant nominal price falls is not necessarily required, provided that the underlying trend is for house prices to increase significantly more than the consumer price index. If this historical trend does not continue, and the housing market is currently overvalued, the adjustment to a new long-term equilibrium may, on the other hand, require a long period of declining nominal house prices. This will erode homeowners' home equity, rendering many technically insolvent.

As mentioned earlier, the inelastic supply of land gives reason to assume that real increases in prices of building plots will also occur in future due to land shortage. It is more uncertain whether the historical trend towards systematic increases in real construction costs will also continue. The trend reflects that, so far, productivity growth in the construction sector has been relatively weak; as a result, there may be potential for catching up on the productivity backlog in future.[1]

It is sometimes argued that there would not be room in household budgets to finance the observed increase in the scope and quality of housing consumption if significant permanent increases in real house prices actually did occur, cf. e.g. Laursen et al. (2010). This argument is, however, based on the assumption that the ratio of housing consumption to total consumption is more or less constant. As Chart 5.6 shows, there has, actually, been a tendency for the ratio of housing consumption to total Danish private consumption to increase during the period after World War II. Thus expenditure for housing consumption has risen more rapidly than that for other consumption and, accordingly, there has been "room" both for a relative increase in the price of housing consumption and a rise in the scope and quality of the housing stock.

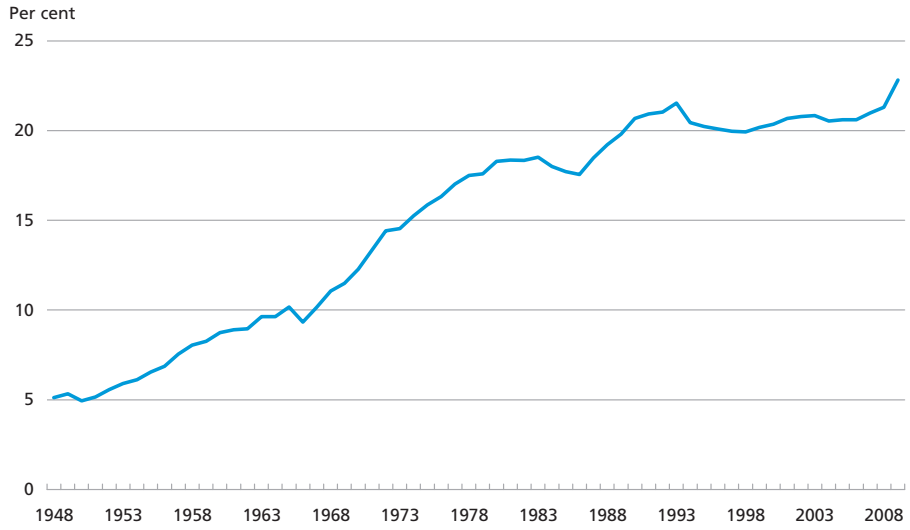
The analysis in Box 5.2 also illustrates a clearly increasing trend in the ratio of owner-occupied housing consumption to household disposable income. As explained in the Box, this budget ratio depends on income and price elasticities in the demand for owner-occupied housing. These elasticities do not necessarily imply that the ratio of owner-occupied housing consumption to total consumption should be constant over time.

It is clear, however, that the housing consumption budget ratio cannot increase indefinitely; a saturation point must be reached sometime before the budget ratio reaches 100 per cent. If, in future, construction costs rise only at the general rate of inflation, while real land prices on average increase in line with real GDP growth (entailing that the ratio of ground rent to GDP is constant), at GDP trend growth of about 1.5 per cent, the average annual real growth in the price of new housing will be approximately 0.3 per cent. This calculation is based on the premise that, according to Statistics Denmark, the cost of the building plot accounts

1 In 2008, the Danish Competition Authority focused critically on productivity developments in the Danish construction sector and demonstrated very subdued growth for a number of years, apparently due to lack of competition. Sharpening competition in the sector could probably boost productivity growth over the coming years. In an assessment of developments in the construction sector, it should be taken into account, however, that the official index of construction costs by Statistics Denmark is not adjusted for any quality improvements of new houses. Thus the construction cost index of Chart 5.4 probably overvalues the real cost increase. Similarly, it is possible that recorded house prices of existing housing overvalue the real increase in prices to the extent that higher prices reflect ongoing improvements to the existing housing stock.

DEVELOPMENT IN THE RATIO OF HOUSING CONSUMPTION TO TOTAL PRIVATE CONSUMPTION

Chart 5.6



Source: Statistics Denmark.

for an average of 20 per cent of the total cost of acquiring new housing. At this annual rate of real growth, it will require just over four years without nominal house price increases to return to a long-term sustainable level for real house prices, if the price of existing housing is, in general, 10 per cent higher than the cost of acquiring similar new housing and the average annual rate of inflation is 2 per cent. Underlying real growth in house prices of 0.3 per cent a year is a relatively conservative estimate in view of the average increase in real house prices of about 1.5 per cent a year during the period from 1955 to 2005.

House-price-to-construction cost ratio calculated as a level measure

Unless there are strong indications that the housing market was in long-term equilibrium in the base year chosen for calculating the index, as mentioned earlier, the Tobin's Q index measure cannot be used as a measure of how far house prices are from equilibrium. According to the classic Tobin's Q approach, the housing market is in long-term equilibrium if the prices of existing housing are equivalent to the costs of constructing similar new housing. Consequently, we now seek to directly measure the prices of existing housing relative to the costs of acquiring new housing. The measure can only be approximated, *inter alia* because data on building plot prices is very sparse.

DEVELOPMENT IN HOUSE PRICES AND THE BUDGET SHARE OF HOUSING CONSUMPTION Box 5.2

Is a situation of sustained real price increases for owner-occupied housing compatible with ongoing improvement of housing standards? To investigate this question, we assume, once again, that demand for owner-occupied housing is given by the function $K(bp,Y)$, where *bp* is the real user cost of owner-occupied housing consumption and *Y* is real household disposable income. The total cost of owner-occupied housing consumption is then $bp \cdot K(bp,Y)$ and its share of disposable income (the budget share) is thus:

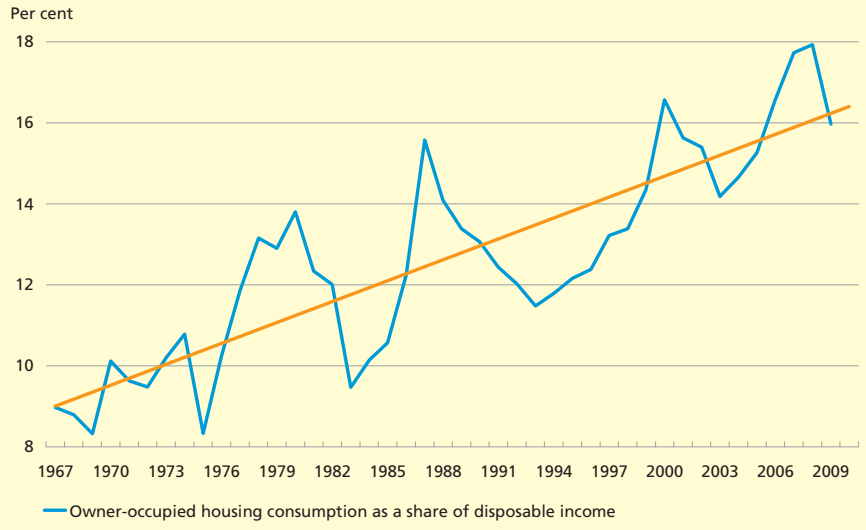
$$B = \frac{bp \cdot K(bp,Y)}{Y}. \qquad (1)$$

By differentiating the expression in (1), after a transformation, we find that the relative change of the budget share of owner-occupied housing consumption over time is given by the expression

$$\frac{\Delta B}{B} = (1-\varepsilon_b)\cdot\frac{\Delta bp}{bp} + (\varepsilon_Y - 1)\cdot\frac{\Delta Y}{Y}, \qquad \varepsilon_b \equiv -\frac{\partial K}{\partial bp}\frac{bp}{K}, \qquad \varepsilon_Y \equiv -\frac{\partial K}{\partial Y}\frac{Y}{K}, \qquad (2)$$

where ε_b is the numerical elasticity of owner-occupied housing demand in terms of user cost, ε_Y is the income elasticity of housing demand and the operator Δ is the change in the subsequent variable.

DEVELOPMENT IN OWNER-OCCUPIED HOUSING CONSUMPTION AS A SHARE OF HOUSEHOLD DISPOSABLE INCOME Chart 5.7



Source: Statistics Denmark and own calculation.

Chart 5.7 shows that the budget share of owner-occupied housing consumption has had an underlying tendency to increase during the last 45 years (short-term fluctuations in the budget share reflect that housing consumption develops more evenly

CONTINUED Box 5.2

than income during cyclical fluctuations). In equation (2), ΔY will usually be positive due to ordinary economic growth. If real house prices have an underlying tendency to increase, Δbp will also, on average, be positive. According to (2), the increasing budget share of owner-occupied housing consumption may thus reflect that the income elasticity of owner-occupied housing demand is higher than 1 and/or that the numerical user-cost elasticity is lower than 1. In fact, empirical studies of owner-occupied housing demand have often found numerical price elasticities somewhat below 1, cf. e.g. the overview in Englund (2003).

It also follows from equation (1) that

$$\frac{\Delta K}{K} = \frac{\Delta Y}{Y} + \frac{\Delta B}{B} - \frac{\Delta bp}{bp}. \qquad (3)$$

The fraction on the left-hand side of (3) is a measure of the relative quantitative and qualitative improvement in standards of owner-occupied housing. According to the data on which Chart 5.7 is based, the budget share of owner-occupied housing consumption has increased by an average of 1.34 per cent a year during the period 1966-2009, i.e. $\Delta B / B = 0.0134$. In the long term, developments in the real user cost will be driven primarily by real house prices, which have increased by an average of 1.55 per cent a year during the period specified. Against this backdrop, we can specify $\Delta bp / bp \approx 0.0155$ in equation (3). The equation then implies that there has been scope for an annual improvement in housing standards of approximately 0.2 percentage point less than the annual increase in income. With an average annual rise in real income of about 2 per cent, there has thus been ample scope for an increase in real housing consumption – despite the relatively high increases in real house prices.

The data basis for the analysis is described in more detail in Box 5.3. We have performed two types of calculation. In item 4 of Table 5.1, we remove the land value from the price per square metre of the total property before comparing with construction costs. Accordingly, Tobin's Q is calculated as the price of an existing building relative to the price of a newly constructed building of the same size.

In item 5 of Table 5.1, the price of an existing housing unit including the building plot is compared with the sum of the price of a newly constructed building and the price of an undeveloped plot. This approach provides more stable figures for Tobin's Q than the calculation under item 4.

The calculations show that, historically, Tobin's Q has been significantly below 1, and still remains below 1, although the estimate of construction costs in Table 5.1 is conservative, cf. Box 5.3.[1] Thus the price of existing housing is generally lower than the price of new housing of the same size. The reason may be that new housing is of a higher quality and, in some

[1] An analysis conducted by the Association of Danish Mortgage Banks has also demonstrated that, since 2007, prices of new housing have been 25-30 per cent higher than prices of other housing. This is in line with the results of item 5 in Table 5.1.

CALCULATION OF TOBIN'S Q AS A LEVEL MEASURE — Table 5.1

Kr. per square metre of living space	1989	1995	2008	2010
1. Price of existing housing according to ADMB				
Capital Region	5,400	6,500	20,900	18,900
Rest of Denmark	4,000	4,300	10,800	10,000
2. Price of new construction, incl. garage				
Statistics Denmark, national accounts	6,300	6,200	9,500	10,000
3. Land prices[1] per square metre of house				
Capital Region	4,007	3,550	19,590	14,600
Rest of Denmark	860	1,015	5,380	5,090
4. Tobin's Q for buildings: (1-3)/2				
Capital Region	0.26	0.39	0.13	0.43
Rest of Denmark	0.46	0.41	0.56	0.50
5. Tobin's Q for the entire property: 1/(2+3)				
Capital Region	0.51	0.55	0.72	0.74
Rest of Denmark	0.52	0.48	0.69	0.66

Note: When Tobin's Q is less than 1, the price of existing housing is lower than the price of new construction. Figures for 2010 are based on the first three quarters.

Source: Statistics Denmark, Association of Danish Mortgage Banks (ADMB) and own calculations.

[1] Land prices according to Statistics Denmark's 10-year statistical overview and StatBank Denmark, "Grunde under 2.000 kvm" (Plots below 2,000 square metres – in Danish only). The calculation is based on a plot of 1,000 square metres and a house of 130 square metres. Land price per square metre of house is thus calculated as (Land price per square metre*1,000)/130. In 2010, land prices were thus approximately kr. 1.9 million in Greater Copenhagen and kr. 620,000 outside Greater Copenhagen.

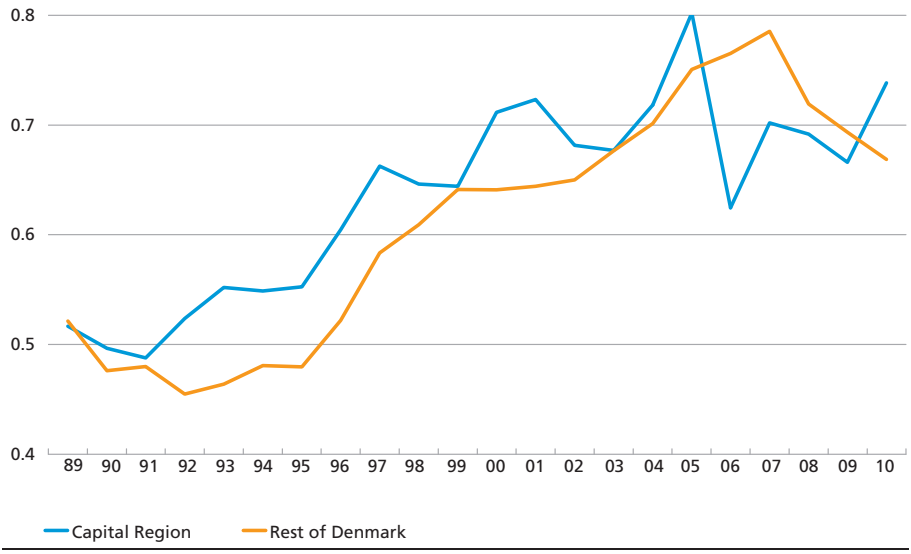
cases, new construction makes it easier to accommodate home buyers' individual needs and preferences. However, it is not clear how much the price of existing housing should be below the price of new housing in order for the housing market to be in long-term equilibrium.

Chart 5.8 shows Tobin's Q calculated using the method in item 5 of the Table. The Chart indicates that, during the 1990s, Tobin's Q shifted to a higher underlying level close to 0.7. Interestingly, the Chart also shows that Tobin's Q is currently at roughly the same level as in the early 2000s – before the housing bubble. If the increase in Tobin's Q in the 1990s represented an adjustment to a new long-term equilibrium in the wake of the protracted downturn in the housing market from 1987 to 1993, there is reason to believe that current prices of existing housing are not significantly overvalued relative to the prices of new housing. The estimated relations for house prices and residential investment presented in section 3 indicate that the housing market was actually close to long-term equilibrium around the year 2000. This underpins the hypothesis that Tobin's Q was at a long-term sustainable level around this time. We emphasise, however, that this conclusion is uncertain.

The uncertainty of our calculations may be attributed in part to the use of data for land prices that comprises only recorded selling prices of

RATIO OF HOUSE PRICE TO CONSTRUCTION COSTS, CALCULATED AS A LEVEL MEASURE

Chart 5.8



Note: Tobin's Q has been calculated using the method stated in item 5 in Table 5.1.
Source: Statistics Denmark, Association of Danish Mortgage Banks and own calculations.

undeveloped plots. In many key areas, relatively few undeveloped plots are traded. Consequently, selling prices in these areas may be subject to random fluctuations that make it difficult to assess the price of constructing new housing on an undeveloped plot. The shortage of undeveloped plots is particularly prevalent in and around large towns and cities where recorded selling prices may thus fluctuate greatly depending on the specific location of the plots traded. This probably explains the relatively wide fluctuations in the calculated value of Tobin's Q in Greater Copenhagen shown by Chart 5.8.

Using Tobin's Q as an indicator of whether or not the housing market is overvalued also raises a problem of a more fundamental nature. As previously mentioned, land price is part of the numerator as well as the denominator of Tobin's Q, but two different land prices are involved. The price in the numerator is the price of a developed plot, which may be located close to the centre of a town. The price in the denominator, on the other hand, is the price of an undeveloped plot, often located on the outskirts of the town. If a large urban area is involved, in practice, the same type of housing is not compared, as most people would find that it is very different to live close to the centre of town and on the periphery of town.

Even if existing and new housing were of the exact same quality, the equilibrium for Tobin's Q for the housing market would hence not be 1,

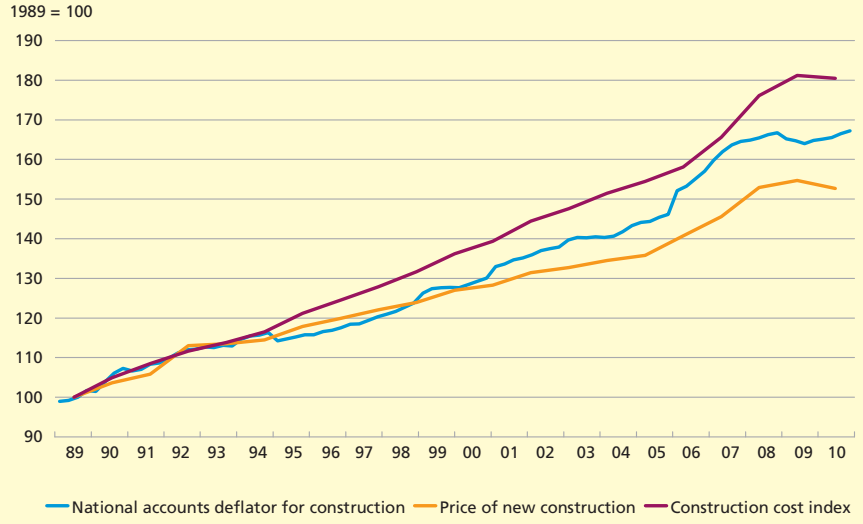
DESCRIPTION OF DATA BEHIND TABLE 5.1 Box 5.3

Price of existing housing: Data for prices per square metre is provided by the Association of Danish Mortgage Banks.

Price of new construction: These figures are provided by Statistics Denmark. They are part of the national accounts. The assumption in Table 5.1 of a price of new construction in 2010 of kr. 10,000 per square metre excluding VAT is comparable with the extensive survey of construction costs conducted by the National Agency for Trade and Industry in 2000. According to this survey, the price of new construction was approximately kr. 8,500 in 1999. According to the national accounts, the price has since then increased by 25 per cent, indicating good consistency between the estimate of the Agency and the estimate used in Table 1. According to Danish Building Information Centre 2010, single-family houses can be constructed at a cost of about kr. 11,000 per square metre excluding VAT and a number of other costs.

Statistics Denmark's figure for the price of new construction has developed more slowly than both the construction cost index and the national accounts deflator for construction, cf. Chart 5.9. One reason is that the price of new construction is adjusted for construction productivity increases of an estimated 1 per cent p.a. The national accounts deflator is not delimited in the same manner as the figures for new construction, as it is based on a broader delimitation than merely construction of single-family houses.

DEVELOPMENT IN CONSTRUCTION COSTS Chart 5.9



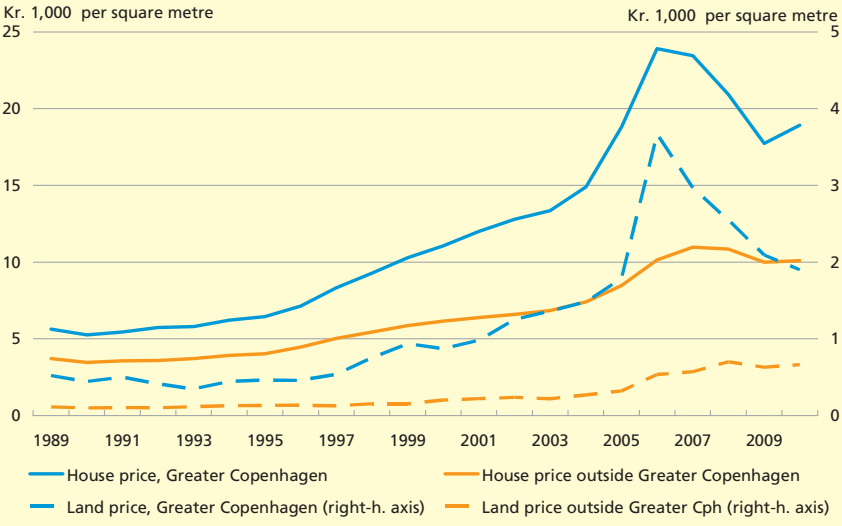
Note: "Price of new construction" is the figures behind the calculation of Tobin's Q in Table 5.1.
Source: Statistics Denmark.

Price of building plots: These figures are particularly uncertain. They are Statistics Denmark's data for the price per square metre for plots below 2,000 square metres, cf. Chart 5.10. The category comprises both undeveloped plots for housing purposes, plots for recreational use and plots for commercial construction. In other words: a highly heterogeneous group of plots. Moreover, some of the observations are based on a relatively small number of transactions, rendering prices very volatile.

CONTINUED Box 5.3

Short-term fluctuations in house prices must be attributed mainly to fluctuations in land prices, as developments in construction costs are more subdued. However, construction costs do have a strong cyclical element. All in all, the costs of new construction are conservatively estimated in the calculation in Table 5.1. Higher construction costs than assumed will strengthen the hypothesis that current house prices are not significantly overvalued.

HOUSE PRICES AND LAND PRICES Chart 5.10



Note: The land price outside Greater Copenhagen is a simple average of land prices, excluding the Capital Region. Nominal values.
Source: Association of Danish Mortgage Banks and Statistics Denmark.

as the location value differs for the plots on which existing and new housing is constructed. The problem with comparability is probably most pronounced in built-up urban areas, rendering it particularly difficult to identify an equilibrium level for our measure of Tobin's Q in an area such as Greater Copenhagen. If economic developments lead e.g. to a relative improvement of employment and education possibilities in and around large towns and cities, or if transport costs go up and congestion worsens, demand for centrally located housing in built-up urban areas will grow. Given the limited possibilities of constructing new housing in these areas, these developments will increase the equilibrium price level for existing housing relative to new housing in more peripheral areas. Conversely, if home buyer preferences change towards more rural and scenic surroundings, this will contribute to lowering our Tobin's Q measure for areas such as Greater Copenhagen, since such change will result in a relative increase in demand for more remotely located plots.

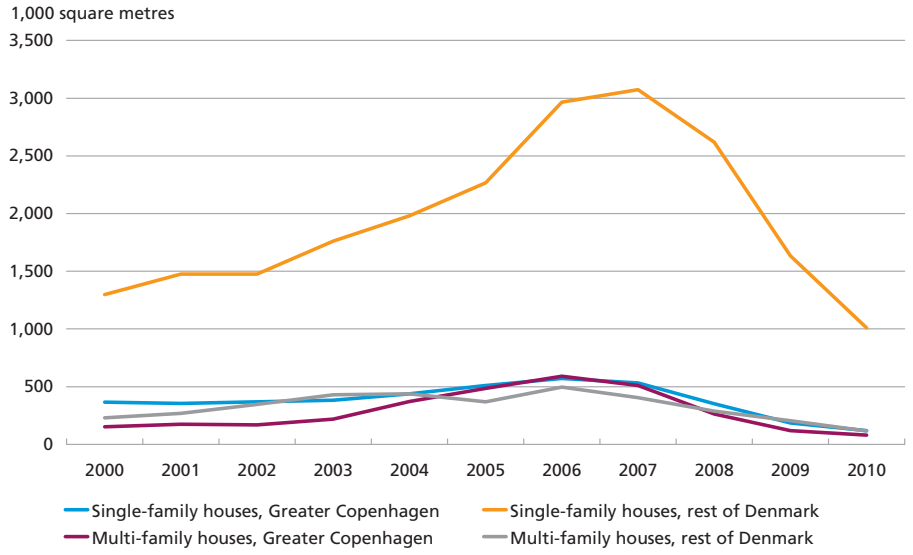
Accordingly, in an area such as Greater Copenhagen, the costs of acquiring new (often more peripherally located) housing are not a firm long-term anchor for the prices of existing housing. Even in a long-term perspective, the size of Tobin's Q in Greater Copenhagen will, to a great extent, be determined by demand for centrally located housing. In the provinces, on the other hand, the supply of building plots will often be more ample, partly due to better possibilities of rezoning agricultural land for residential purposes. Thus the difference in the location value of existing housing relative to new housing will typically be smaller, and the possibilities of countering increases in the price of existing housing by constructing new housing will be greater.[1]

The chain of reasoning above is based on the assumption that it is more difficult to acquire vacant building plots in built-up urban areas – and thus more difficult to meet a rise in housing demand through new residential construction. This assumption is supported by the observations in Chart 5.11, showing developments in new construction over the preceding decade. At the height of the boom in 2007, the number of newly constructed square metres of single-family houses in the provinces was 2.5 times higher than in 2000. In Greater Copenhagen, the increase in the supply of new single-family houses was only 50 per cent. On the other hand, the construction of multi-family homes, mostly owner-occupied flats, almost quadrupled in Greater Copenhagen from 2000 to 2007. So it is actually possible to substantially increase the housing supply even in Greater Copenhagen if house prices rise sufficiently, but the increase in supply will mainly be in the form of flats, requiring less land than single-family houses. Since the peak in 2007, new construction activity has been plunging all over the country. An important reason is undoubtedly that land prices reached a very high level during the boom.

The shortage of land is particularly acute in Greater Copenhagen and, historically, prices of owner-occupied housing have risen more rapidly in this area than in the rest of Denmark, cf. Chart 5.12, and real capital gains have been made over an extended period. As mentioned earlier, there may be several reasons for this. Since many people want to live in Copenhagen, preferably close to the centre, upward pressure is exerted on real prices in Copenhagen relative to the rest of Denmark. Moreover, house prices are more volatile to fluctuations in demand in Greater

[1] Brøchner Madsen (2007) investigates a hypothesis that the price of undeveloped plots on the periphery of town is related to alternative use of agricultural land. In this case, the price of undeveloped plots is thus anchored in the price of agricultural land and the knock-on effect of price rises for existing properties on undeveloped plots is smaller. As already mentioned, the theory of the price of agricultural land as an anchor for building plot prices seems most relevant in areas outside Greater Copenhagen.

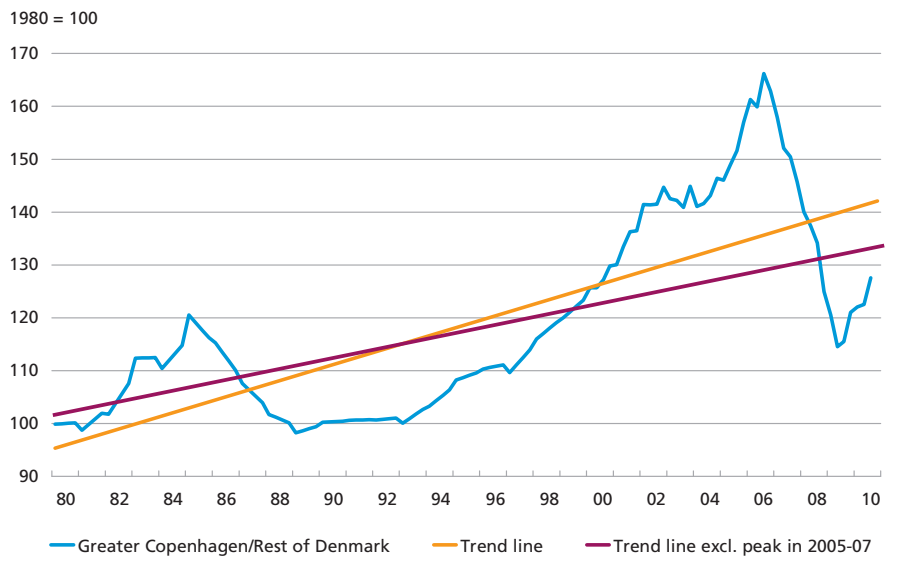
NUMBER OF NEWLY CONSTRUCTED SQUARE METRES — Chart 5.11



Note: The 2010 figures are estimated based on the 1st half of the year.
Source: Statistics Denmark.

Copenhagen than in the rest of the country. This is a reflection of the shortage of vacant plots – and thus the reduced potential for new construction to keep price increases at bay.

RATIO OF HOUSE PRICES IN GREATER COPENHAGEN TO THE REST OF DENMARK — Chart 5.12



Note: House prices in Eastern Jutland have been used as an indicator of prices outside Greater Copenhagen. The flatter of the trend lines has been calculated by disregarding the peak in 2005-07.
Source: Association of Danish Mortgage Banks, Statistics Denmark and own calculation.

Factors contributing to curbing price increases in Greater Copenhagen include the ability and willingness to meet payment obligations by people migrating to the city from the rest of Denmark. In general, prices cannot be too far out of line with prices in the rest of the country. As a substantial degree of substitution must be assumed to exist between houses and owner-occupied flats, the supply of owner-occupied flats may also put a damper on house-price appreciation in Greater Copenhagen. Single-family houses and terraced houses in Greater Copenhagen account for 20-25 per cent of the total number in Denmark – somewhat more if values are considered. Owner-occupied flats in Greater Copenhagen, on the other hand, account for more than 60 per cent of the total number in Denmark.

As shown by Chart 5.12, house-price developments during the latest boom bifurcated, with significantly higher price increases in Greater Copenhagen than in the rest of Denmark. Developments in Greater Copenhagen were unsustainable, and prices subsequently dropped. Despite recent increases, prices in Greater Copenhagen relative to the rest of Denmark are still below the long-term trend.

The question is whether, over the long term, prices in Greater Copenhagen can continue to rise at a faster pace than in the rest of Denmark. This would seem unrealistic and the limit may be close to being reached. To assess this in more detail, we will investigate the ratio of housing costs to disposable income at the current house prices in different parts of Denmark.

Is the current ratio of housing costs to income sustainable?

A frequently used measure for assessing the level of house prices is the housing burden – i.e. costs of ongoing financing of owner-occupied housing relative to the household income. A special and somewhat simplified measure of the housing burden is the ratio of the house price of owner-occupied housing to household income, as described in section 4.

We have chosen to consider developments in actual financing costs for a fully leveraged purchase of an average house with a garden, including property value tax and land tax, cf. Box 5.4.[1] These housing costs are compared with average household disposable income. We include all households, whether homeowners or tenants, as (many) tenants are potential home buyers. Thus the housing burden can be used to assess

[1] We disregard other housing-related costs, such as water and heating, insurance and maintenance. The Ministry of Finance (2010) uses a closely related measure of the housing burden, but does not extend the statement of the housing burden as far back as we do in this article.

CALCULATION OF THE HOUSING BURDEN Box 5.4

The housing burden *B* may be calculated as follows:

$$B = \frac{E\left(V^e\right) + G\left(g, V^g\right) + \sum_i w_i R\left(r^i, t, repay, P^h\right)}{Y}.$$

The numerator is the housing cost, where property value tax *E* is based on the public property valuation V^e, land tax is a function of land tax rate *g* and the assessed taxable land value V^g, while the total financing payment is a weighted sum of the relevant loan products with financing payment *R*, depending on interest rates *r*, the rate of capital income tax *t*, the repayment profile *repay* and the nominal house price P^h. We assume that the home purchase is fully leveraged, so a solution with e.g. a fixed-rate 30-year mortgage bond loan with amortisation will indicate a weight *w* of 0.8 for a financing payment *R* based on a 30-year annuity loan at the 30-year mortgage rate of interest; and a weight *w* of 0.2 at a financing payment *R* based on the banks' lending rate to households for housing purposes.

The denominator *Y* is the household disposable income. The calculations are based on an average house of 140 square metres on a plot of 1,860 square metres. The data basis and the calculations are described in detail in Appendix D.

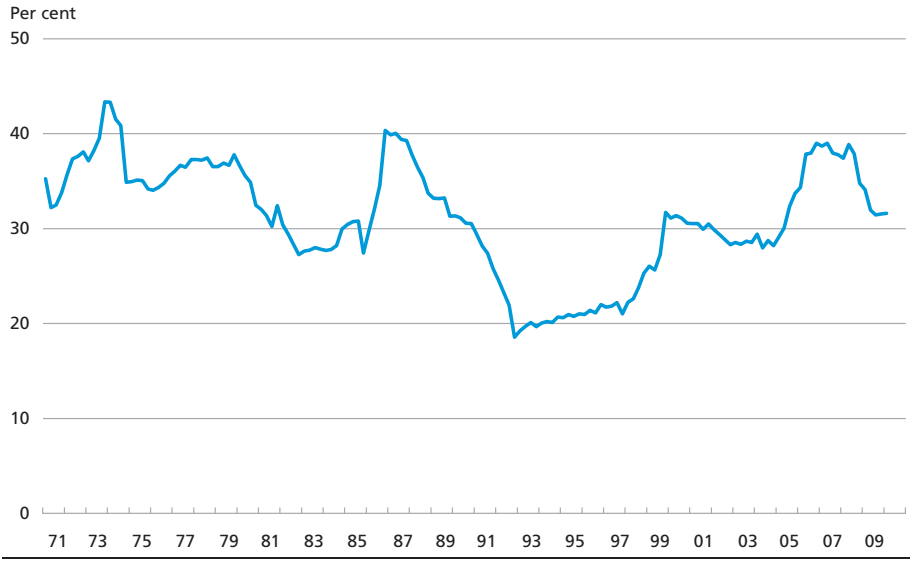
whether the price of owner-occupied housing results in financing costs that are affordable to the average household.

Theoretically, our measure of the housing burden may be criticised for including mortgage repayments, which should not be seen as costs, but rather as savings.[1] However, the empirical analysis in section 3 showed that housing demand among households responds, to a great extent, as if mortgage repayments are costs in line with interest payments and housing taxes. The reason may be that many home buyers are liquidity constrained and/or simply short-sighted. Our measure of the housing burden assesses the ability and willingness of this apparently large group of home buyers to pay the current house prices. Below we assess current house prices based on the house-price relation estimated in section 3, in which mortgage repayments are seen only in part as costs.

Obviously, financing costs vary depending on the home buyer's choice of loan type. As discussed in sections 2 and 3, the (re)introduction of adjustable-rate loans in 1996 and the possibility of opting for deferred amortisation as from the autumn of 2003 resulted in the launch of new loan products, which have become popular. However, fixed-rate loans with amortisation have been the prevailing type of financing in a longer-term perspective. By focusing on this type of loan, we get a consistent picture of housing burden developments over time. Chart 5.13

[1] Conceptually, the housing burden thus differs materially from the national accounts measure of housing consumption, which e.g. does not include loan repayments and housing taxes.

HOUSING BURDEN SINCE 1971 Chart 5.13



Note: The housing burden in the form of stylised financing costs, including property taxes, on the purchase of a single-family house as a ratio of the average household disposable income, cf. Appendix D. Financing costs are based on a fixed-rate mortgage loan with amortisation plus a bank-financed loan for the portion that cannot be financed by a mortgage loan.

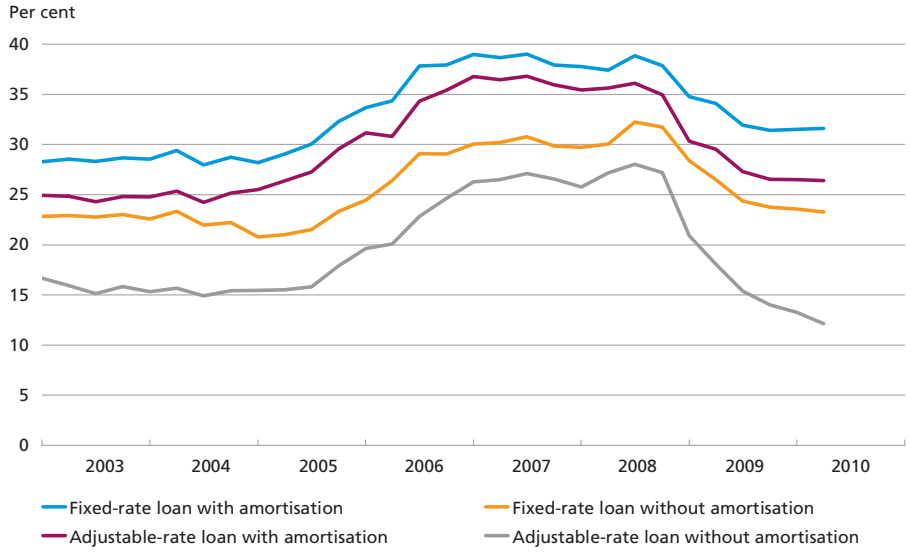
Source: Statistics Denmark, Association of Danish Mortgage Banks, the Danish Customs and Tax Administration (Skat) and Danmarks Nationalbank.

shows how the average housing burden for Denmark as a whole has changed since 1971.

The Chart shows that the housing burden is currently very close to the average of the last almost 40 years, i.e. 31 per cent. Accordingly, the housing burden has dropped by just over 8 percentage points since the latest peak in 2007 when prices of owner-occupied housing were at their highest. It is also worth noting that the housing burden has previously exceeded the levels seen during the latest boom – i.e. during the boom in the mid-1980s and during the period after the first oil crisis when inflation and interest rates were high. Based on this consideration, the current price of owner-occupied housing thus does not seem to have outpaced income and interest developments for Denmark as a whole.

Chart 5.14 shows how the housing burden has varied in recent years, depending on the type of financing selected. This illustrates the considerable increase in the disposable amount immediately available to home buyers who choose either adjustable-rate loans or deferred amortisation. It is also seen that with the current low interest rates, the housing burden for adjustable-rate loans without amortisation is now below the level prevailing before house prices began to soar.

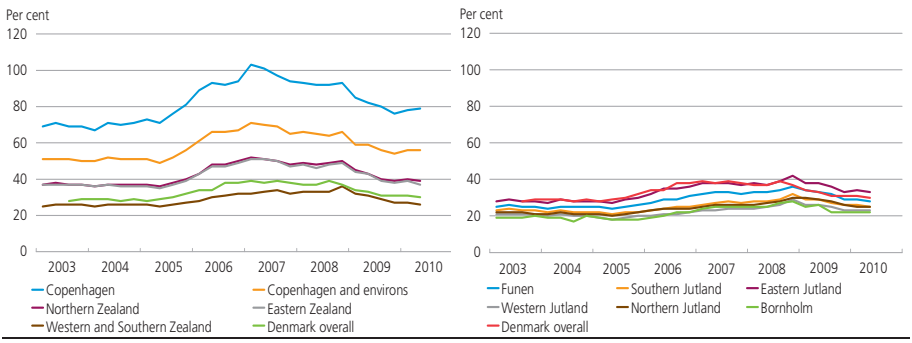
HOUSING BURDEN FOR VARIOUS TYPES OF FINANCING Chart 5.14



Note: The housing burden in the form of stylised financing costs, including property taxes, on the purchase of a single-family house as a ratio of the average household disposable income, cf. Appendix D. Financing costs are based on the loan type specified plus a bank-financed loan for the portion that cannot be financed by a mortgage loan.
Source: Statistics Denmark, Association of Danish Mortgage Banks, the Danish Customs and Tax Administration (Skat) and Danmarks Nationalbank.

We have also calculated housing burdens for the different parts of Denmark over recent years, cf. Chart 5.15. Again, we assume that mortgage financing is based on a fixed-rate loan with amortisation. The Chart illustrates a wide spread in the housing burden for the different parts of Denmark. Thus the purchase of an average-sized house absorbs a much larger proportion of the average household disposable income

HOUSING BURDEN IN DIFFERENT PARTS OF DENMARK Chart 5.15



Note: The housing burden in the form of stylised financing costs, including property taxes, on the purchase of a single-family house as a ratio of the average household disposable income, cf. Appendix D. Financing costs are based on a fixed-rate mortgage loan with amortisation plus a bank-financed loan for the portion that cannot be financed by a mortgage loan.
Source: Statistics Denmark, Association of Danish Mortgage Banks, the Danish Customs and Tax Administration (Skat) and Danmarks Nationalbank.

east of the Great Belt (Bornholm excluded) and especially in and around Copenhagen. This should be seen in the context of a significant spread in income levels in Copenhagen where the average household cannot afford to buy a normal-sized house in the City itself.

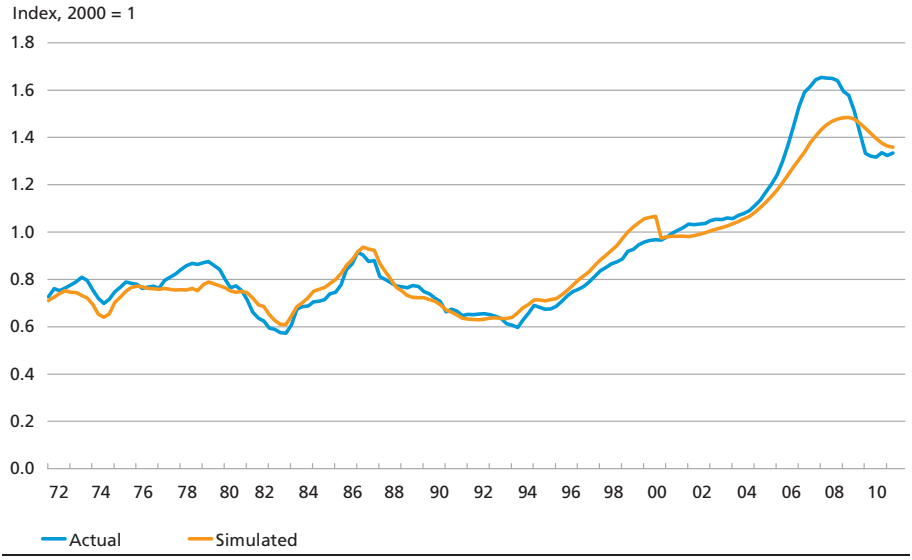
Although the housing burden in Copenhagen and environs has dropped substantially since the peak of the housing market in 2006-07, it still remains higher in these areas than in early 2003, before house prices began to accelerate rapidly. This could indicate that prices in these areas are still slightly overvalued.

In the rest of Denmark, the housing burden has more or less returned to the level from early 2003. Measured in terms of the housing-burden index, a further significant correction in house prices in the provinces thus does not seem to be required.

Prospects for house prices over the new few years

Another method for determining whether the housing market is over-valued is to compare current house prices with the price level predicted by the house-price relation estimated in section 2. Chart 5.16 compares historical developments in real house prices with a simulated scenario calculated using the house-price relation. From the early 1970s up to the period around 2005, the relation captures house-price movements fairly well, but it underestimates the large price boom in 2004-07 and the size

REAL HOUSE PRICES, ACTUAL AND SIMULATED — Chart 5.16



Note: Simulated house prices are based on a dynamic simulation of the demand relation introduced in section 3. Simulations are made as from the 1st quarter of 1972.

Source: MONA databank and own calculations.

of the subsequent price fall. As discussed in section 3, this is probably because increases in house prices in the mid-2000s were driven, to an extraordinary degree, by self-reinforcing expectations of further increases in the future – expectation effects that are difficult for a house-price relation estimated over a longer historical horizon to capture.

However, during 2010, actual house prices and the price level predicted by our house-price relation just about coincided again, cf. Chart 5.16. This could be interpreted as a return to normal economic conditions in the housing market after some exceptional years with a housing bubble succeeded by a financial crisis. Assessed on the basis of our house-price relation, there are thus no indications that house prices are currently overvalued, given the current levels of income, interest rates and other credit terms, etc. In that context, it is worth noting that our house-price relation takes account of the extensive residential construction of the preceding decade, which has put a damper on house prices.

An important question is, however, whether new sharp declines in house prices are likely over the coming years, when interest rates must be expected to rise from their current very low level to a more normal level. To investigate this question, we have incorporated our estimated relations for determining residential investment and house prices (cf. Appendices A and B) into MONA, Danmarks Nationalbank's macroeconometric model, and have calculated a medium-term projection of house-price trends, allowing for expected macroeconomic developments over the coming years. The advantage of incorporating house price and residential investment relations in the MONA model is that this allows us to take account of the interaction between the housing market and the rest of economy, including the fact that changes in house prices affect the overall economic activity, and hence income formation, which, in turn, impacts housing demand and house prices.

Our medium-term projection of the Danish economy up to and including 2015 is based on the assessment of cyclical developments presented in Part 1 of this Monetary Review. Table 5.2 summarises the key calculation assumptions and the main elements of the expected macroeconomic developments.

The projection is based on the assumption that, by 2015, the Danish economy will approach a situation with normal capacity utilisation as the rates of private consumption and investment increase from their current low levels. In that case, there will be basis for growth in output and income and some decline in unemployment, although interest rates are also expected to rise to a more normal level. An important precondition for this scenario is that the economy does not suffer further

KEY ASSUMPTIONS OF THE PROJECTION OF THE DANISH ECONOMY UP TO 2015

Table 5.2

	2011	2012	Avg., 2013-15
Export market growth, per cent year-on-year	7.5	6.5	4.4
Short-term mortgage yield[1], per cent p.a.	1.7	2.7	3.5
Long-term mortgage yield, per cent p.a.	5.5	6.0	6.0
Real GDP growth, per cent year-on-year	1.9	1.9	1.7
Net unemployment, 1,000 people	113	106	99
Real household disp. income, per cent year-on-year	0.3	0.9	1.3

Note: Projection based on MONA extended by new relations for house price and residential investment.
Source: Danmarks Nationalbank.
[1] The short-term mortgage yield is assumed to reach a level of 4 per cent by the end of the period.

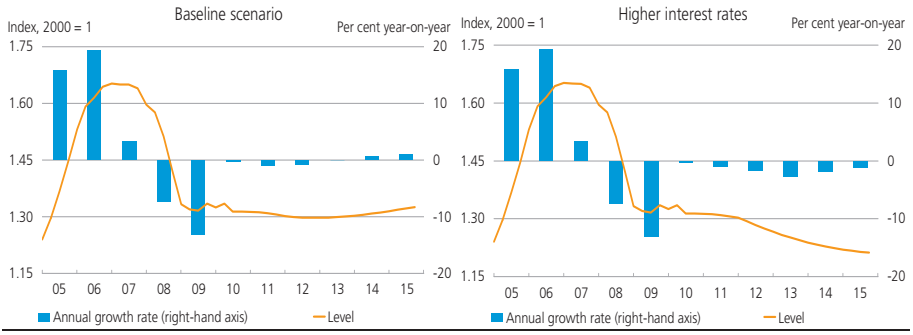
severe shocks – e.g. in the form of a strong international slowdown and/or financial market events triggering a sudden hike in interest rates.

In the scenario summarised in Table 5.2, according to the model, real house prices will develop as illustrated by Chart 5.17 (left).[1] The Chart shows that the expected modest growth in income provides a basis for maintaining real house prices more or less unchanged despite a gradual normalisation of interest rates. Another reason why a rise in interest rates does not trigger a decline in house prices is that, according to the estimated house-price relation, house prices are currently at a lower level than would be expected in light of the current very low interest rates, cf. the observations for 2010 in Chart 5.16. The explanation could be that the very pessimistic expectations in the wake of the financial crisis have caused some degree of negative overreaction in house prices. As this overreaction is corrected, house prices will, to a certain extent, recover, which may offset the impact of the expected interest-rate increase.

Chart 5.17 (right) shows simulated developments in housing under an alternative scenario in which international and Danish interest rates as from 2012 rise at a steeper pace than in the baseline scenario above. In this scenario, both the short-term and long-term bond yields in 2015 are 1 percentage point higher than in the baseline scenario. Higher international and Danish interest rates may occur if international economic growth exceeds the assumptions of the baseline scenario, so that foreign central banks are compelled to raise interest rates more aggressively to keep inflation in check. In that case, the negative impact of interest-rate rises on house prices will be countered by the stimulus provided to Danish exports by stronger international growth, entailing

[1] As the economy frequently suffers new, unexpected shocks, actual developments will undoubtedly be more erratic than illustrated by the Chart. Accordingly, more emphasis should be placed on the underlying trend shown than on the developments described for individual years.

MEDIUM-TERM PROJECTION OF REAL HOUSE PRICES Chart 5.17



Note: Projection of real house prices based on MONA extended by new relations for house price and residential investment.
Source: Danmarks Nationalbank.

that growth in the Danish economy, and thus housing demand, is underpinned. More rapid increases in international and Danish interest rates may also occur, however, in the event of financial market turmoil, e.g. as a result of deepening of the European sovereign debt crisis. In that case, interest-rate rises must be expected to go hand in hand with a foreign downturn.

In other words, it is not clear how export market growth will perform in a situation of stronger-than-expected interest-rates rises. To serve as a neutral indicator, we have assumed the same market growth as in the baseline scenario of the model simulation on which the alternative scenario in Chart 5.17 (right) is based. The interest-rate rise will dampen growth in the Danish economy, which will reduce housing demand and thus house prices. In addition, there is a direct negative impact on house prices since the extra interest-rate rise will increase the households' housing costs. The result is illustrated in Chart 5.17 (right): real house prices drop by 6-7 per cent in the period up to 2015.

The scenarios indicate that quite substantial interest-rate hikes will be required to trigger a steep fall in Danish house prices over the coming years. But our alternative scenario also demonstrates that some decline in real house prices can by no means be ruled out. Moreover, as previously mentioned, both scenarios presume that a new severe international recession does not occur.

Summary: Is the housing market overvalued?

In this section, we have used five different methods in an attempt to assess whether Danish house prices are currently unrealistically high viewed in a long-term perspective.

The first method was based on the house-price-to rent-ratio – i.e. the ratio between current prices of owner-occupied housing and the rents for similar housing. A comparison of current and average historical price-to-rent ratios provides an indication of whether current house prices ensure that homeowners receive a normal return on their housing investment. The current price-to-rent ratio could suggest that owner-occupied house prices are above the long-term sustainable level. In a Danish context, however, the weakness of this method is that the rental market for single-family houses is very thin and that rents for rental housing hardly provide a true and fair view of the price at which owner-occupied housing could be rented, given that the market for rental housing is not free. Hence, the data basis for calculating the price-to-rent ratio is very small and, consequently, this method cannot be accorded much weight.

We then assessed house prices using two variants of the Tobin's Q method. This method is based on the assumption that, in the long term, prices of existing housing are determined by the costs of acquiring similar new housing. The first and most widely-used variant (Tobin's Q as an index measure) compares *developments* in house prices with *developments* in construction costs. However, unless the housing market happened to be in long-term equilibrium in the base year (or at the trend level) selected for the calculation, this does not provide a basis for determining whether house prices are above or below their long-term equilibrium.

In the second variant of the method (Tobin's Q as a level measure), the *level* of existing house prices is compared with the *level* of costs of acquiring new housing of the same size. In this case, the crux is that existing and new housing may be difficult to compare due to differences in quality and location. In built-up urban areas, in particular, new housing will often have to be constructed on more remotely located plots with a lower location value than the centrally located plots on which much existing housing has been constructed. The problem of comparability renders it difficult to identify a "normal" long-term level for prices of existing housing relative to prices of new housing (Tobin's Q). The reason is that changes in employment and transport opportunities and in location preferences could cause the demand for centrally located housing relative to more peripherally located housing to shift over time. According to our analysis, Tobin's Q is currently at roughly the same level as in the early 2000s – before the housing boom.[1] This could indicate that prices have reverted to a long-term sustainable level after the

[1] We here refer to our calculation of Tobin's Q as a level measure rather than as an index measure.

"bubble years" in the mid-2000s. However, our analysis also shows that Tobin's Q remains somewhat above the average level of the 1990s. The reason could be that prices of existing housing were very low in the early 1990s following the long period of slow growth starting in 1987. All in all, a calculation of Tobin's Q thus gives us only a very uncertain indication of whether or not house prices are overvalued.

A fourth method for assessing house prices is by calculating the housing burden. The housing burden is calculated as the sum of housing taxes and financing costs of a fully leveraged purchase of a typical single-family house as a ratio of average household income. Assuming that a fixed-rate mortgage loan with amortisation has been chosen, we were able to calculate developments in the average housing burden for Denmark as a whole from 1971 up to the present. The calculations showed that the current housing burden is almost exactly in line with the average housing burden of the last 40 years. We also investigated how the housing burden varies with the type of financing selected. We found that the housing burden for an adjustable-rate loan without amortisation is currently lower than it was in 2003 – although real house prices are higher today. Finally we examined developments in the housing burden for different parts of Denmark during the last decade, assuming that financing was in the form of a fixed-rate loan with amortisation. This analysis showed that the housing burden in Copenhagen and environs is currently slightly higher than in early 2003, while it is roughly unchanged in the rest of Denmark. Overall, our analyses of the housing burden do not indicate that house prices are currently overvalued at the prevailing low interest rates.

We reached the same conclusion using the house-price relation estimated in section 3. According to this relation, house prices are currently slightly below the level to be expected based on the historical impact of developments in income, housing taxes, interest rates and other financing conditions on house prices. We subsequently incorporated the house-price relation into MONA, Danmarks Nationalbank's macroeconometric model, to investigate how house prices can be expected to develop over the next five years, taking into account that interest rates must be expected to increase from their current very low levels. We found that the expected improvement of cyclical conditions by 2015 provides a basis for maintaining the current level of real house prices despite gradual normalisation of interest rates. However, house prices may fall if interest rates rise more suddenly and rapidly or in case of a new international slowdown.

Overall, the analyses based on the house-price-to-rent ratio and Tobin's Q could indicate that current house prices are still above their

long-term sustainable level. However, as mentioned, it is very difficult to identify a long-term equilibrium for real house prices based on these measures. This speaks in favour of placing more emphasis on analyses based on calculations of the housing burden and on the empirical house-price relation. These analyses do not indicate that the housing market is generally overvalued at the current level of interest rates and income, etc. This conclusion is in line with the econometric analysis in Skaarup and Bødker (2010).

Our analyses have also shown that wide regional differences may exist in house-price developments. In Greater Copenhagen, in particular, prices seem to be more volatile to cyclical fluctuations; one explanation could be greater shortage of vacant building plots in the capital. Thus modest increases in average house prices for Denmark as a whole may coincide with price falls in parts of the country.

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APPENDIX A: RESIDENTIAL-INVESTMENT RELATION

The residential-investment relation determines net investment as a function of the ratio of the house price to investment cost. When the price of existing housing is high relative to construction costs, it is advantageous to construct new housing, causing residential investment to expand, cf. section 2. In this context, we choose to disregard the fact that some areas may have a shortage of building plots.

In the long term, house prices are determined by investment costs in accordance with the theory of Tobin's Q, cf. section 5. Thus the long-term supply curve is horizontal:

$$\log P^h = \log P^i + \beta,$$

where β is a constant, depending *inter alia* on the coefficients in the estimated relation below.

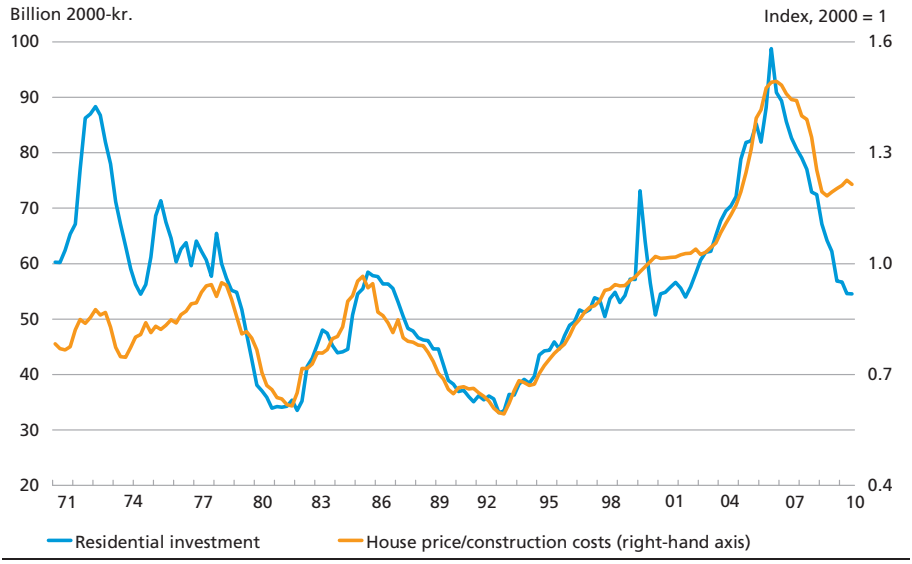
As mentioned above, disequilibrium in the Tobin's Q price ratio, i.e. the house-price-to-construction cost ratio, affects investment activity. Thus short-term dynamics are given by:

$$I^h/K^h_{-1} = \alpha_0 + \alpha_1\left(I^h/K^h_{-1}\right)_{-1} + \alpha_2 D\log\left(P^h/P^i\right) + \alpha_3 \log\left(P^h/P^i\right)_{-1},$$

where I^h is net residential investment, K^h is housing stock, P^h is house price and P^i is investment cost, reflecting construction costs.

Historically, as Chart A.1 illustrates, there has been close correlation between residential investment and Tobin's Q. However, residential investment was some-

HOUSE PRICES, CONSTRUCTION COSTS AND RESIDENTIAL INVESTMENT — Chart A.1



Note: Annualised seasonally adjusted quarterly data for residential investment. The national accounts deflator for construction investment is used as construction costs. The extraordinary and temporary increase in the 1st half of 2000 is due to the December 1999 hurricane.

Source: Statistics Denmark and Danmarks Nationalbank.

RESIDENTIAL-INVESTMENT RELATION — Table A.1

Variable	Name	Coefficient	t value
Net investment/housing stock	$fIhn/fKbh_{-1}$		
Net investment/housing stock	$fIhn_{-1}/fKbh_{-2}$	0.8573	19.8
Tobin's Q, change	$Dlog(kp/pih)$	0.0137	2.7
Tobin's Q	$log(kp/pih)_{-1}$	0.0033	2.8
Dummy[1]	*D100q1*	0.0094	5.9
Dummy	$D100q1_{-1}$	-0.0048	3.0
Constant		0.0017	2.9

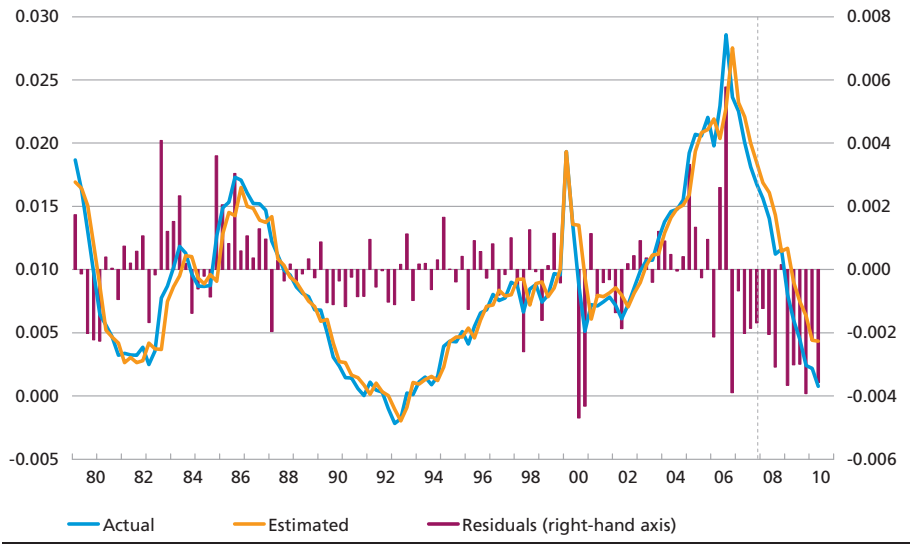
T	=1980Q1 – 2007Q4	DW	= 1.634	AR(1)	= 5.062	SE	= 0.0016
R^2	= 0.9429	JB	= 27.607	AR(4)	= 13.851		

Note: Names refer to the MONA nomenclature rather than the one applied in the text.
(1) The dummy captures the extraordinarily high level of residential investment in the 1st half of 2000 due to the December 1999 hurricane.

what higher in the 1970s than can be explained by Tobin's Q, presumably reflecting extensive subsidised housing activity in the early 1970s; at the same time, it was easier to obtain financing for new construction than for existing housing. As these factors are both a thing of the past, we choose to disregard the period before 1980. The relation estimated for the period from the 1st quarter of 1980 to the 4th quarter of 2007 includes a dummy variable to capture the outliers in the 1st half of 2000 when residential investment was extraordinarily high due to the December 1999 hurricane.

The estimation results are set out in Table A.1, while the explanatory power is shown by Chart A.2. All coefficients are significant and a recursive estimation

RATIO OF NET INVESTMENT TO HOUSING STOCK, ACTUAL AND ESTIMATED — Chart A.2

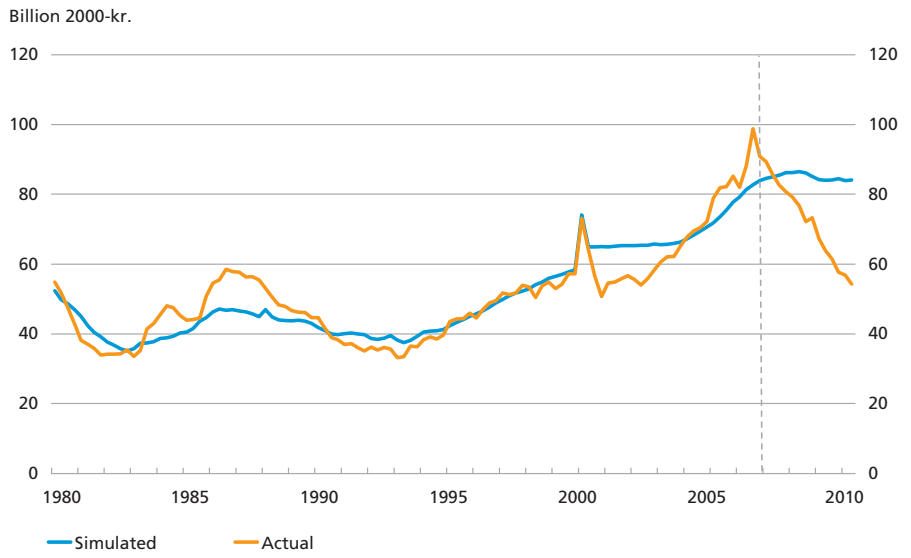


Note: The estimation covers the period from the 1st quarter of 1980 to the 4th quarter of 2007.
Source: MONA databank and own calculations.

shows relatively stable parameters. However, when the last few years are included in the estimation, the coefficient for Tobin's Q decreases. It should be noted that the coefficient for the lagged net investment is relatively high; residential investment thus displays considerable stickiness. It should also be noted that there seems to be some systematic correlation in the residuals that is not captured by the relation.

A dynamic simulation shows that, over a longer horizon, the relation captures developments in residential investment fairly well, cf. Chart A.3, but that it has particular difficulty capturing the sharp decline since 2006, during which period investment has fallen far more than indicated by Tobin's Q.

RESIDENTIAL INVESTMENT, ACTUAL AND SIMULATED — Chart A.3



Note: Simulated values are based on dynamic simulation of the residential-investment relation as from the 1st quarter of 1980.
Source: MONA databank and own calculations.

APPENDIX B: HOUSE-PRICE RELATION

The house-price relation is an inverse relation of household demand for housing. The relation is formulated in error-correction form for quarterly data where house prices gradually adjust to the price that makes the underlying demand match the overall supply of housing, which cannot be changed in the short term, cf. the discussion in section 3.

Definitions and variables

Accordingly, we refer to the long-run relation as the underlying demand for houses. The relation is assumed to depend on real household income, user cost and first-year payments, as well as the real house price;

$$K^D = F\left(Y, u, y, p^h\right), \tag{B.1}$$

where K^D is the overall housing demand, Y is the household disposable income deflated by the price of private consumption and p^h is the real house price (cf. the overview below). u and y are user cost and the lowest possible first-year payments, respectively, defined as follows:[1]

$$u = \left[(1-t)r^{30} - \pi\right] + s + d, \text{ and} \tag{B.2}$$

$$y = (1-t)r^{min} + s + repay, \tag{B.3}$$

where t is the relevant tax rate for housing-related interest costs, r^{30} is the 30-year bond yield, while r^{min} is the lowest possible bond yield and π denotes the expected inflation rate; s is total housing taxes as a ratio of the total housing stock calculated at market price, d is repairs and depreciation and *repay* are the lowest possible repayments on a fully leveraged home purchase.

We do not have observations of the expected inflation rate of households. We thus approximate this rate through an autoregressive process, assuming adaptive expectations;[2]

$$\pi = (1-\gamma)\pi_{-1} + \gamma \log\left(P / P_{-4}\right), \tag{B.4}$$

where we set $\gamma = 0.125$, and P denotes the price of private consumption.

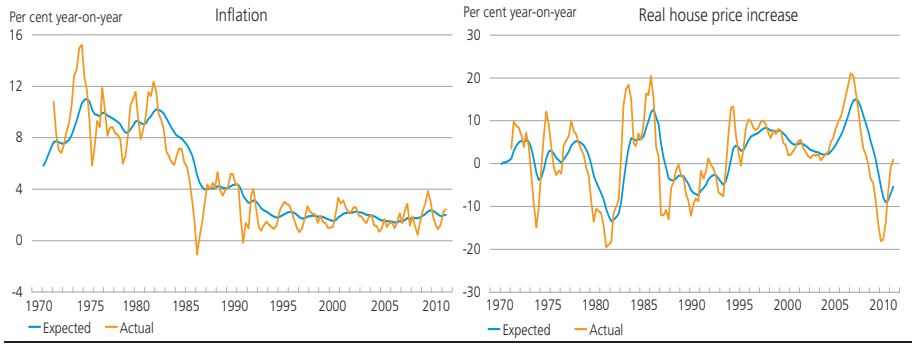
Changes in house prices result in capital gains or losses for homeowners. Strictly speaking, user cost u should therefore include expected future annual changes in real house prices, referred to as π^h. As in the case of inflation, we do not, however, have consistent observations of these expectations. Again, we

[1] Note that in line with the previous practice used in MONA, we define user cost as the factor by which the real house price must be scaled to obtain the economic costs of one unit of housing. The product of the user cost defined here and the real house price, $u \cdot p^h$, thus denotes what is referred to in other contexts as user cost.

[2] This expression is identical to Cogley's (2002) *exponential smoother* estimate. Cogley argues in favour of using this estimate of core inflation (which is, in turn, linked to inflationary expectations). This may be interpreted as a learning process based on *constant gains* updating; i.e. an updating algorithm where the agents attach greater importance to the latest developments when using historical data to form expectations of the future.

PRICE INCREASES FOR HOUSES AND PRIVATE CONSUMPTION, ACTUAL AND EXPECTED

Chart B.1



Note: House prices are deflated by the price of private consumption. Expected price increases have been approximated by autoregressive processes as specified in the text. Annual percentage price increases have been calculated as the logarithmic change over four quarters scaled up by a factor of 100.

Source: MONA databank and own calculations.

approximate these through an autoregressive process of the same type as (B.4), setting $\gamma = 0.20$. However, due to significant fluctuations in house prices and our insufficient identification of these expectations, we have decided to include them as a separate explanatory variable in the relation of underlying demand so as not to distort the estimated parameter of user cost.[1] Actual and expected price increases for private consumption as well as houses are illustrated by Chart B.1.

As already mentioned, the expression of the first-year payments has been designed to denote the lowest possible payments on a fully leveraged home purchase. This entails that both the relevant bond yield and the repayment rate are affected by changes in available credit facilities. Adjustable-rate loans were formally (re)introduced in 1996, but did not gain ground until after the millennium change. Consequently, we have constructed the lowest bond yield, r^{min}, as the long-term (30-year) bond yield up to and including the 4th quarter of 1999, while it subsequently comprises a short-term bond yield.[2]

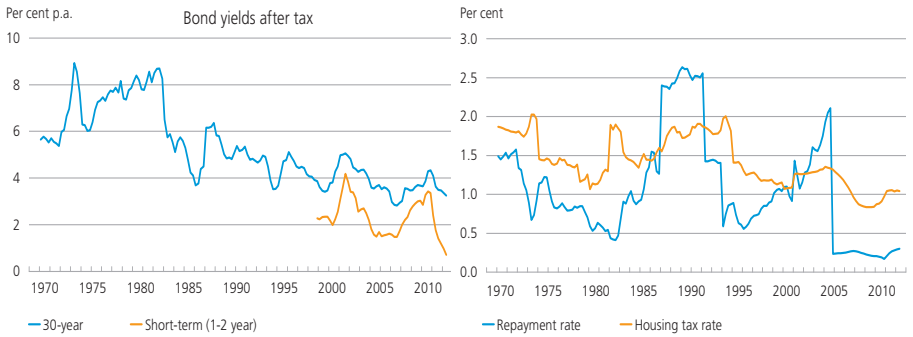
The repayment rate is based on available loan types over time. This entails that the rate is affected by the possibility of opting for adjustable-rate loans as from the 1st quarter of 2000 (it rises as low short-term interest rates result in higher repayments) and especially by the possibility of opting for deferred-amortisation periods as from the 4th quarter of 2003. The bond yields applied (after tax) and the repayment rate as well as the imputed rate of property taxes are shown by Chart B.2.

In line with the practice previously used in MONA, we disregard repairs and depreciation (i.e. $d = 0$). We thus obtain the time series for user cost u and first-year payments y shown by Chart B.3, cf. the discussion below.

1 The estimation confirms that user cost, u, and the approximation of the expected house price changes, π^b, have significantly different effects on underlying housing demand.

2 More specifically, the average yield on bonds with maturities of 1 and 2 years, calculated by the Association of Danish Mortgage Banks.

BOND YIELDS, REPAYMENT RATE AND HOUSING TAX — Chart B.2



Note: The short-term bond yield is an average of maturities of up to two years. The repayment rate has been calculated based on fully leveraged loan financing composed in accordance with current rules, including deferred amortisation as far as the bond loans (but not supplementary bank loans) are concerned, as from the 4th quarter of 2003. Housing taxes include land tax and the imputed rate of property value tax as a ratio of the housing stock, calculated at market value.

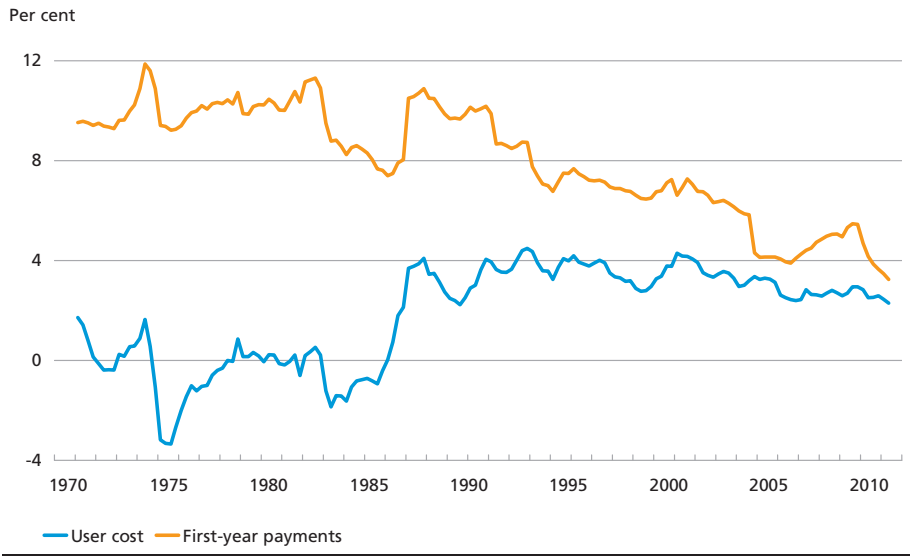
Source: Association of Danish Mortgage Banks, Realkredit Danmark and Danmarks Nationalbank, including the MONA databank.

Estimation results

We let the relation of underlying demand, (B.1), assume a linear form with appropriate use of logarithms, and subsequently invert it to a relation of the real house price:

$$\log p^h = a_1 \cdot u + a_2 \cdot y + a_3 \cdot \pi^h + a_4 \log(Y / K) + a_5, \qquad \text{(B.5)}$$

USER COST AND FIRST-YEAR PAYMENTS — Chart B.3



Note: User cost and first-year payments as defined in equations (B.2) and (B.3), respectively, with related explanations.

Source: Association of Danish Mortgage Banks, Realkredit Danmark and Danmarks Nationalbank, including the MONA databank.

REAL HOUSE PRICE — Table B.1

Variable	Name	Coefficient	t value
Real house price, change	Dlog(*kp/pcp*)		
Real house price, lagged change ..	Dlog(*kp/pcp*)$_{-1}$	0.3215	5.0
Interest and tax rates, change[1]	D(*rente30* + *ssats*)·*db98k4*	-3.7212	9.8
Real house price	log(*kp/pcp*)$_{-1}$	-0.0473	4.6
User cost	*rente30*$_{-1}$ + *ssats*$_{-1}$ –*dpcpe*$_{-1}$	-0.2878	2.9
First-year payments	*rentemin*$_{-1}$ + *ssats*$_{-1}$ + *afdrag*$_{1}$	-0.4435	3.2
Expected change in house price ...	*drkpe*$_{-1}$	0.0938	3.0
Real income/housing stock	log(*Ydph/pcp*)$_{-1}$ - log(*fKbh*$_{-1}$)	0.0729	1.7
Constant		0.1106	2.6

T	=1972Q1 – 2010Q2	DW	= 1.904	AR(1)	= 0.910	SE	= 0.0177
R^2	= 0.6413	JB	= 0.358	AR(4)	= 7.007		

Note: Names refer to the MONA nomenclature rather than the one applied in the text.
[1] Change in the sum of the imputed rate of housing tax and bond yields after tax before the 4th quarter of 1998.

where, according to the theory, a_1 and a_2 are negative, while a_3 and a_4 are expected to be positive.

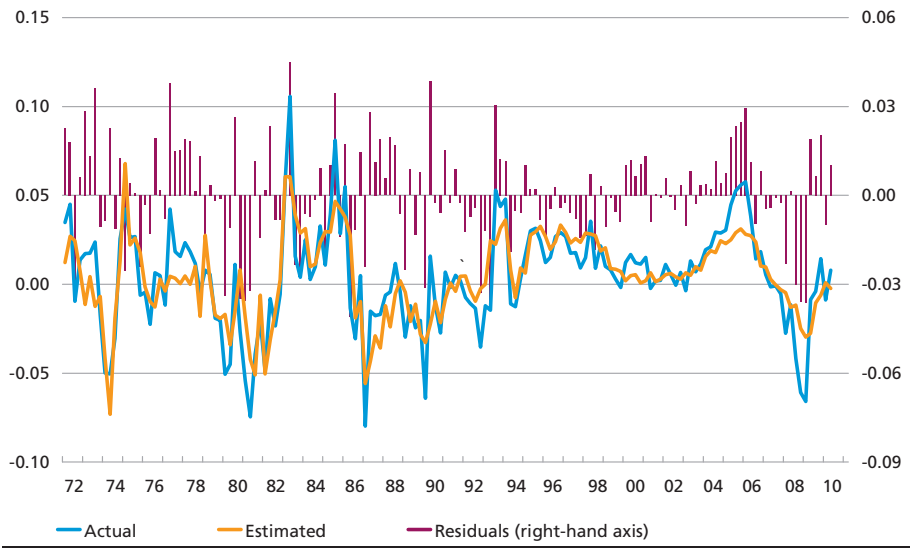
The relation is used as a long-run relation in a univariate error-correction model, estimated for the period from the 1st quarter of 1972 to the 2nd of 2010. We test a number of different variables for the short-term dynamics but – based on statistical criteria – end up including only the lagged change in the real house price and the sum of changes in the bond yield after tax and the imputed rate of property tax. The latter variable has significant short-term effects at several times during the years up to the second half of the 1990s, but subsequently the immediate pass-through effect of interest rates and taxes on house prices declines. This could reflect that homeowner financing has become more flexible. Using a dummy structure, we eliminate this short-term effect as from the 4th quarter of 1998.[1]

The estimation results are shown in Table B.1, while the predicted price increases are compared with actual increases in Chart B.4. As shown, the relation generally captures the most important fluctuations up to 2004 fairly well, while it has difficulty explaining the steep rise in prices in 2005-06 and the subsequent fall in 2008-09, cf. also the discussion in section 3. There are also clusters of residuals with the same sign earlier in the estimation period, although the statistical tests of the properties of the residuals do not indicate any problems with auto correction.

A dynamic simulation in which predicted house prices in a given period are based on the predicted prices of previous periods shows that, also over a longer horizon, the relation captures large movements in real house prices – although with the problems of the boom-bust cycle in 2004-09 mentioned in section 3; in addition, the declining interest rates in the mid-1990s also warranted a higher increase in house prices than actually occurred. cf. Chart B.5.

[1] A *t* test confirms that, as from the 4th quarter of 1998, the effect is insignificant.

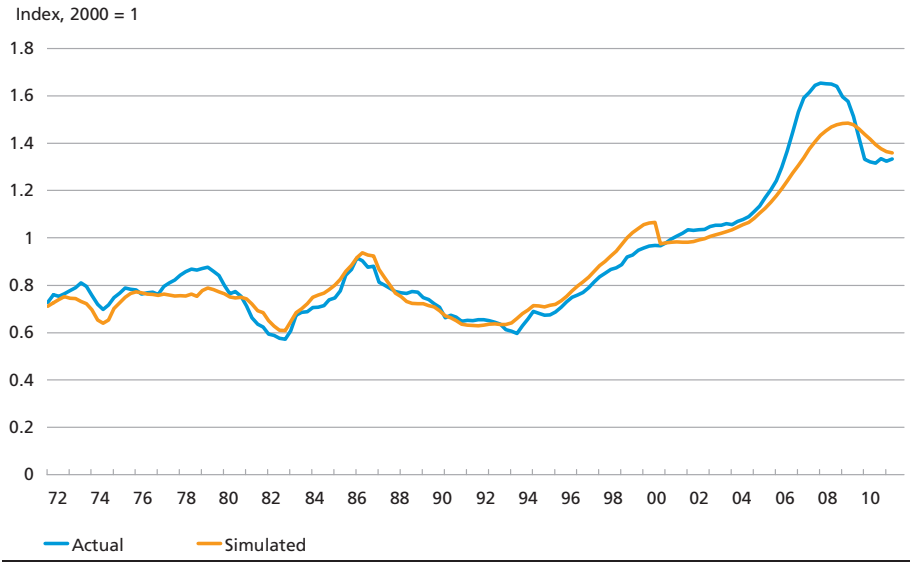
CHANGES IN REAL HOUSE PRICES, ACTUAL AND ESTIMATED Chart B.4



Note: Changes in the logarithm of the average house price divided by the implied private consumption deflator.
Source: MONA databank and own calculations.

The long-term relation is reviewed in Box 3.2 in section 3. It should be noted that we have restricted the income elasticity to unity, so that housing demand increases on a one-to-one basis with real income. In a free estimation, the

REAL HOUSE PRICES, ACTUAL AND SIMULATED Chart B.5



Note: Simulated house prices are based on a dynamic simulation of the demand relation as from the 1st quarter of 1972.
Source: MONA databank and own calculations.

income elasticity is somewhat lower (0.40) and the restriction imposed gives a *p* value of 0.03; thus data is somewhat at odds with the restriction.

The estimated relation suffers somewhat from unstable parameters. Moreover, the parameters changed in 2005-06 in response to sharp increases in prices, which the relation has difficulty explaining. However, if the relation is estimated on data for the period up to the 4th quarter of 2004, price-development predictions for the entire period match those obtained from the relation in Table 3.1.[1]

User cost, first-year payments and repayment rate

The house-price relation used in MONA so far did not factor in the first-year payments – only the economically-based user cost, cf. Danmarks Nationalbank (2003).[2] As Chart B.3 illustrates, there are significant trend-related deviations between the expressions. This may be attributed predominantly to inflationary expectations since – unlike the first-year payments – the user cost allows for inflation representing a real repayment on the debt.[3]

As inflation (and the value of mortgage tax relief) was high in the 1970s, in real terms, it was thus quite inexpensive to borrow money and thus to buy a home. However, current expenses were high, which is reflected in the high first-year payments. The consequence is well-known: during this period, home buyers tightened their belts and cut back on other consumption immediately after the home purchase and in the course of a few years, inflation reduced the real payments on the mortgage loan, thus making funds available for other consumption. The transition to a regime of low and stable inflation during the 1980s has ensured greater consistency between first-year payments and user cost.

As we combine user cost and first-year payments in the house-price relation, we allow these different perceptions of the costs of a home purchase to affect demand. A conversion of (B.5) gives the following:

$$\log p^h = b \cdot omk + a_3 \pi^h + a_4 \log(Y/K) + a_5, \qquad \text{(B.6)}$$
$$b = a_1 + a_2, \quad \lambda = a_1/(a_1 + a_2) \quad \text{and} \quad omk = \lambda \cdot u + (1-\lambda) \cdot y,$$

where λ can be seen as the weight of the user cost in the combined expression of total housing costs, *omk*, cf. also Box 3.2 in section 3. The empirically determined weighting of user cost and first-year payments in total costs can be interpreted in several ways; thus $(1-\lambda)$ may be interpreted as the proportion of home buyers who are subject to credit restrictions and are therefore limited by their immediate financial resources in the form of the first-year payments. Alternatively, each home buyer may take account of both factors in his cal-

1 There is also a general match between the parameter estimates for the samples from the 1st quarter of 1972 to the 4th quarter of 2004 and to the 2nd quarter of 2010, albeit with shifts in individual parameters.

2 Until recently, a similar modelling strategy was applied by other Danish macroeconometric models such as ADAM and SMEC.

3 The user cost thus includes real interest rates after tax (the square brackets in equation (B.2)), while the nominal rate after tax is included in the first-year payment, cf. (B.3).

culation and λ thus captures the weight of the respective factors in the calculation.

A comparison of equation (B.6) with (B.2) and (B.3) shows that inflation is included in *omk* with a weight of only λ. Downweighting of inflation in the definition of costs is not unknown in Danish macroeconometric tradition. It has been widely used in both ADAM and MONA and may be interpreted *inter alia* as a tendency among households and firms to expect that periods of high inflation will not last, cf. the discussion in Knudsen (2002). Thus, while this house-price relation explains the downweighting of inflation by combining user cost and first-year payments, respectively, that is not the only possible explanation.

Another important implication of the approach chosen is that, through the first-year payments, repayments on the loan are included in the overall cost term with a weight of $(1-\lambda)$. By isolating *repay* as a separate variable from *y*, we test this implication of including the first-year payments by re-estimating the house-price relation. This results in the following long-run relation:

$$\log p^h = c_1 \cdot u + c_2 (y - repay) + c_3 \cdot repay + c_4 \cdot \pi^h + c_5 \log(Y / K) + c_6, \qquad \text{(B.7)}$$

and the hypothesis on which our demand function is based is thus $c_3 = c_2$. This hypothesis cannot be rejected based on a statistical *t* test. On the other hand, the parameter for *repay* is weakly determined in the regression, so neither can it be ruled out that it is zero, i.e. $c_3 = 0$.

In other words, based on statistical criteria, it is not possible unambiguously to determine the effect of deferred-amortisation loans on housing demand – and thus their significance for house prices. Our preferred relation is based on expressions of costs that are in line with the stated economic considerations in terms of user cost and first-year payments, and this relation cannot be rejected based on common statistical criteria.

As interest and tax rates are included in both user cost and first-year payments, the impact of the various factors on housing demand, and thus house prices, is slightly more complex than in a model in which costs are based solely on user cost. By combining the equations (B.2) and (B.3), the definition of total costs may thus be stated as follows:[1]

$$\begin{aligned} omk &= \lambda \cdot u + (1-\lambda) \cdot y \\ &= \left[\underbrace{(1-t) r^{30} - \pi}_{\text{real interest rate}} \right] + s + (1-\lambda) \left[\underbrace{(repay + \pi)}_{\text{real repayment}} - \underbrace{(1-t)\left(r^{30} - r^{min}\right)}_{\text{yield spread}} \right]. \end{aligned}$$

The weighted definition of cost may thus be interpreted as comprising long-term real interest rates after tax and housing tax (fully included), the full repayment in real terms and the spread between long and short-term interest rates after tax weighted by the weight of the first-year payments, (1-λ).

[1] Here we have used the assumption *d* = 0, i.e. no depreciation.

APPENDIX C: DATA FOR INTERNATIONAL HOUSE PRICES

The OECD database is quarterly and goes back to the 1st quarter of 1970. Where national data is available from a later time only, the OECD has used quarterly and/or annual data from the Bank for International Settlements, BIS, cf. André (2010).

National data varies considerably in terms of frequency and underlying data, cf. below.

Country	Specification	Source
Denmark	Index of single-family houses sold	Statistics Denmark
France	Index of existing housing	INSEE
Netherlands	Existing housing	Nederlandsche Bank
Norway	Nationwide index	Statistics Norway
Spain	Price per square metre, >2-year old housing	Banco de España
UK	Weighted average of housing types	CLG
Sweden	Properties with 1-2 housing units	Statistics Sweden
Germany	Resale prices	Deutsche Bundesbank
USA	Index of single-family homes	FHFA

APPENDIX D: BASIS FOR THE HOUSING-BURDEN INDICES

Here we document the basis for the housing-burden indices shown and discussed in section 5. The point of departure is a single-family house of 140 square metres with a plot of 1,860 square metres (the average area in 2001).

By way of introduction, we repeat the expression of the housing-burden index presented in Box 5.4, where the housing burden *B* was defined as follows:

$$B = \frac{E\left(V^e\right) + G\left(g, V^g\right) + \sum_i w_i R\left(r^i, t, repay, P^h\right)}{Y},$$

where the property value tax *E* is a function of the public property valuation V^e, land tax *G* is a function of the land tax per thousand *g* and the taxable land value V^g, while the total financing payment is a weighted sum of the *i* relevant loan products with financing payments *R*, depending on the specific rate of interest r^i, the capital income tax rate *t*, the repayment profile *repay* and the nominal house price P^h. Finally, *Y* is household disposable income.

The housing-burden index for Denmark as a whole

We calculate four different indices based on national averages, i.e. fixed and adjustable-rate loans with and without amortisation. First, a number of time series are stated, which are the same for all four indices and based on a single-family house:[1]

- The price per square metre P^h is derived from the statistics of the Association of Danish Mortgage Banks.
- The public property valuation V^e is calculated by adjusting the price per square metre by the ratio of the property's purchase price to the property value as calculated by Statistics Denmark. The property value tax *E* is then calculated as 1 per cent of the property valuation up to the 1st quarter of 2002, after which time it is kept constant.
- Land tax *G* is calculated based on the land tax rate *g*, compiled by Statistics Denmark, and the land value V^g, calculated on the basis of the valuation statistics of the Danish Customs and Tax Administration (Skat).
- Total household disposable income is based on data from Statistics Denmark. Total income is compared with the number of households according to Statistic Denmark's annual data, interpolated linearly to quarterly figures.

As mentioned above, we calculate four different financing payments. In all four cases, we assume that a fully leveraged home purchase is involved, distributed by 80 per cent ($w_i = 0.8$) on a mortgage loan as stated below and 20 per cent ($w_i = 0.2$) on a 30-year annuity loan at the banks' average lending rates for housing purposes, as calculated by Danmarks Nationalbank. The four different types of bond are:

[1] All series are seasonally adjusted except for interest rates and the ratio of the property's purchase sum to the property value.

1. *Fixed-rate loan with amortisation*: The payment is based on a 30-year annuity loan at the 30-year mortgage bond yield calculated by Danmarks Nationalbank.
2. *Adjustable-rate loan with amortisation*: The payment is based on a 30-year annuity loan at the Association of Danish Mortgage Banks' weighted yield to maturity for 1- and 2-year adjustable-rate loans.
3. *Fixed-rate loan without amortisation*: The payment is the 30-year mortgage bond yield calculated by Danmarks Nationalbank.
4. *Adjustable-rate loan without amortisation*: The payment is the Association of Danish Mortgage Banks' weighted yield to maturity for 1- and 2-year adjustable-rate loans.

The housing-burden index for different parts of Denmark

A housing index, based on a fixed-rate loan with amortisation, is calculated for each part of the country. The sources of the time series used are identical to the sources used for Denmark as a whole. However, for some series, other calculations have been carried out to obtain observations for parts of Denmark.

- The ratio of the property's purchase price to the property value, used to calculate public property valuation on the basis of the price per square metre, is based on weighted averages for the former counties until 2007. From 2007 onwards, Statistics Denmark's calculation of the purchase price for each part of the country is used.
- Land tax rates have also been calculated based on weighted averages for the former counties until 2007.
- The taxable land value is based on the valuation statistics of the Danish Customs and Tax Administration (Skat) for single-family houses at municipality level, which is available for odd years only. Even years are calculated by writing back data using the Danish Customs and Tax Administration's growth rates. Until the tax freeze in 2002, the taxable land value is equal to the assessed land value, lagged two years. After the tax freeze, it is equal to the lower of the assessed land value, lagged two years, and the latest taxable value, adjusted by the rate of adjustment for each part of the country, calculated by the Ministry of Taxation.
- Household disposable income, distributed on the different parts of Denmark, is based on annual data from Statistics Denmark, interpolated linearly to quarterly figures based on the growth rate for the disposable income of Denmark as a whole. The income of the different parts of the country is divided by the number of households, calculated by Statistics Denmark on an annual basis and interpolated linearly to quarterly figures.

Can House-Price Fluctuations be Dampened?

Niels Arne Dam, Tina Saaby Hvolbøl and Peter Birch Sørensen, Economics

1. INTRODUCTION AND SUMMARY

Historically, real prices of owner-occupied housing have shown very large fluctuations. In this article we describe the costs to the whole economy generated by house-price fluctuations, followed by a discussion of various economic-policy measures to dampen the price fluctuations.

The housing supply can only be changed at a slow rate through new construction and wearing down of the existing housing stock. Hence, changes in house prices invariably have a significant impact on the creation of equilibrium between supply and demand in the market for owner-occupied housing when housing demand fluctuates as a result of e.g. changes in interest rates and incomes. Our analysis shows, however, that the house-price fluctuations necessary to ensure equilibrium in the housing market can be reduced through a more appropriate set of rules for housing taxation and financing.

In section 2, we describe the economic costs caused by large house-price fluctuations, with particular emphasis on experience from the "housing bubble" of the previous decade. Property value tax was frozen at the beginning of 2002, and deferred-amortisation mortgage loans were introduced in the autumn of 2003. As a result of these measures, house-price increases during the boom years and the subsequent price drop became much stronger than they would otherwise have been, thereby amplifying the cyclical fluctuations of the economy. A calculation using a macroeconometric model shows that lower unemployment and stronger public finances might have been expected in the coming years if the deferred-amortisation mortgage loans had not been introduced and property value tax had not been frozen. We also show that large house-price fluctuations imply microeconomic welfare costs, as homeowners – due to the combination of strong unexpected price movements and heavy costs of moving – may find themselves fixed in a different housing consumption situation than what they would have preferred in view of the house prices applicable from time to time. Finally, we point out that large house-price fluctuations may lead to significant and often arbitrary redistribution of incomes and wealth.

Section 3 discusses whether it is possible to smooth large house-price fluctuations through more appropriate planning of general monetary and fiscal policy. We point out that Danish monetary-policy interest rates must follow monetary-policy interest rates in the euro area to keep the krone stable against the euro. Accordingly, Denmark's interest-rate policy cannot be planned with a view to dampening Danish house-price fluctuations, even if it might be desired to use monetary policy for this purpose. We also find that while a systematic countercyclical fiscal policy might to some extent dampen house-price fluctuations, it would require an unrealistically high level of fiscal-policy tightening to combat bubble trends in the housing market solely via fiscal policy. The rest of the article therefore focuses on other instruments to reduce house-price volatility.

In section 4 we find, based on various methods of analysis, that the freeze on nominal property value tax may have increased average house-price fluctuations by between one fifth and one fourth. The freeze also implies that the effective property value tax (adjusted for inflation) will fall during periods of economic boom, while on the other hand it tends to increase during downturn periods, thereby amplifying the cyclical fluctuations. Against this background, we discuss the effects of lifting the freeze and restoring the link between property value tax and the current property valuation. If the property value tax rate is adjusted at the same time, thereby preventing a short-term increase in the overall taxation level, lifting the freeze will have no significant adverse impact on house prices in the short to medium term. In the longer term, restoring the link between property value tax and house prices will contribute to stabilising the housing market and the economy and to preventing further weakening of government finances.

In section 5 we point out that the introduction of deferred-amortisation loans has increased house-price instability to an even greater extent than the freeze on property value tax. This speaks in favour of future mortgage loans for owner-occupied housing being granted solely with amortisation. Like lifting the freeze on property value tax, such a reform would reduce long-term fluctuations in the housing market. By ensuring the build-up of larger home equity, phasing out deferred-amortisation mortgage loans would also reduce the vulnerability of homeowners and society at large to unexpected negative shocks to the housing market. To avoid putting too much pressure on the housing market in the short term, access to deferred-amortisation loans should be phased out slowly, e.g. by reducing, over a period of time, the credit limit for new deferred-amortisation mortgage loans by 10 percentage points annually. Our analysis shows that this will only dampen house prices to a limited extent

in the next few years. Our calculation of the long-term impact on house-price fluctuations is based on complete phasing-out of access to deferred-amortisation mortgage loans. In connection with the preparation of a specific proposal, maintaining limited access to this type of loan might be considered if it can be done without compromising the above objectives of the measure.

Section 5 also analyses whether a cyclical restriction of access to the use of adjustable-rate loans and deferred-amortisation loans may contribute to dampening house-price fluctuations. In principle, such cyclical restrictions may reduce fluctuations in the housing market, but there is a significant risk that the timing and dosing of such measures will be wrong because of insufficient information about the current situation in the housing market and uncertainty about the long-term equilibrium level for house prices. Cyclical "loan brakes" should therefore be implemented only when there is an obvious risk that the housing market would otherwise be overheated, and it might be preferable to let the decision or recommendation to implement credit restrictions be up to an independent institution with the necessary expertise.

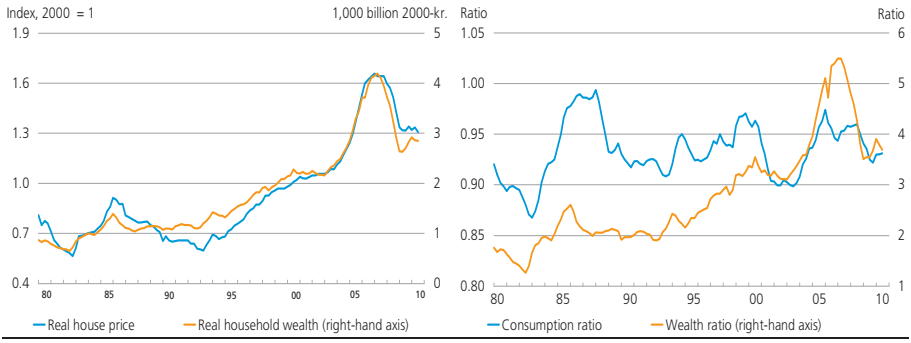
2. SOCIAL COSTS OF HOUSE-PRICE FLUCTUATIONS

Macroeconomic costs of fluctuating house prices

House-price fluctuations generate costs to society by amplifying cyclical fluctuations in economic activity. As shown in the previous article by Dam et al. (2011) in this *Monetary Review*, there is usually a close link between house-price developments and residential investment: the larger the house-price fluctuations, the more unstable the building activity. Variations in house prices have also turned out to be the most important source of fluctuations in the value of household wealth which is one of the drivers of private consumption, cf. Chart 2.1. Rising house prices may thus stimulate private consumption through increasing wealth, whereas consumers will suffer a loss of wealth as a result of falling house prices, encouraging them to rebuild wealth by increasing their savings.

The negative macroeconomic impact of large house-price fluctuations is sometimes amplified by the fact that such fluctuations may also jeopardise financial stability. Strong price increases may be accompanied by unsustainably high credit growth, and banks and mortgage institutes may incur heavy losses on their debtors in the subsequent downturn with price drops, which may force them to tighten their credit standards. This will deepen and prolong the downturn, cf. the article by Abildgren and Thomsen (2011) in part 1 of this *Monetary Review*.

HOUSE PRICES, WEALTH DEVELOPMENT AND PRIVATE CONSUMPTION Chart 2.1



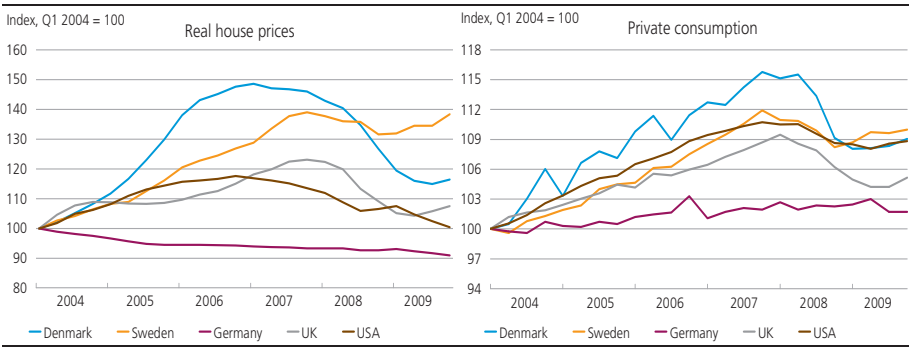
Note: Households' wealth (including estimated after-tax value of total pension savings). In the left-hand chart the house price of single-family houses and household wealth are deflated by the price of private consumption. The right-hand chart shows private consumption and household wealth as a ratio of households' disposable income, including payments to collective pension schemes. The consumption ratio is shown as a four-quarter moving average.

Source: Statistics Denmark and Danmarks Nationalbank.

Experience from the last decade also illustrates the high costs of fluctuating house prices. Chart 2.2 (left-hand side) shows a somewhat faster pace of house-price inflation in the middle of the last decade in Denmark than in its four most important trading partners (Germany, Sweden, the UK and the USA). Presumably, the explosive rise in Danish house prices and the subsequent steep decline are the most significant reasons why private consumption development in Denmark in the 2000s was more unstable than in other countries, cf. Chart 2.2 (right-hand side).

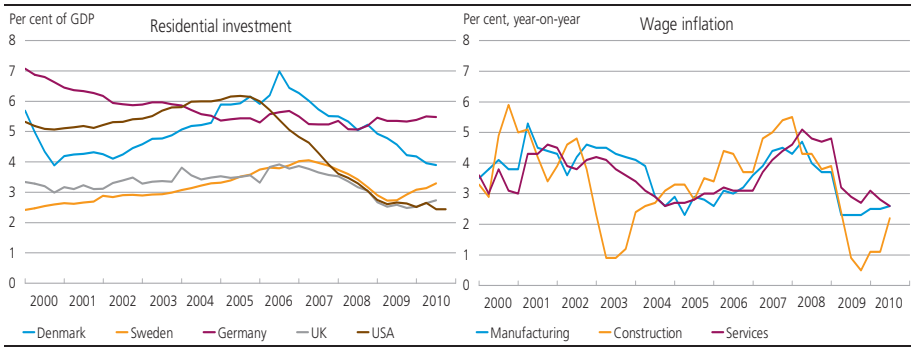
The surge in house prices up to 2007 created a strong construction boom. Residential investment as a ratio of GDP consequently reached a higher level in Denmark than in its most important trading partners, cf. Chart 2.3 (left-hand side). As shown in Chart 2.3 (right-hand side), the

REAL HOUSE PRICES IN DENMARK AND ABROAD (LEFT-HAND SIDE) AND PRIVATE CONSUMPTION IN DENMARK AND ABROAD (RIGHT-HAND SIDE) Chart 2.2



Source: OECD House Price Database and Reuters EcoWin.

RESIDENTIAL INVESTMENT AS A RATIO OF GDP IN DENMARK AND ABROAD (LEFT-HAND SIDE) AND WAGE INCREASES IN DENMARK (RIGHT-HAND SIDE) Chart 2.3



Source: Reuters EcoWin and the Confederation of Danish Employers.

strong demand for labour in the construction sector meant that for a period of time that sector took the lead as regards wages, which may have pushed up wage inflation in the other sectors. The overheating of the construction sector contributed to the general overheating of the Danish economy prior to the financial crisis when demand was not just stimulated by rising house prices, but also by low interest rates and accommodative fiscal policy, cf. Pedersen and Sørensen (2009).

As demonstrated by Dam et al. (2011), the strong price rises up to 2007 were to a high degree driven by the introduction of adjustable-rate loans and deferred-amortisation loans and by the freeze on nominal property value tax as from the beginning of 2002. Chart 2.4 illustrates the impact of this policy on the housing market and its expected impact on macroeconomic developments. The figures are based on medium-term projections of the Danish economy and the implied expectations of house-price developments in the coming years, as presented in Dam et al. (2011). This scenario is compared with a counterfactual scenario where the new loan types had not been introduced and there had been no freeze on property value tax. According to the analysis in Dam et al. (2011), the real house price would then have developed as shown by the blue curve in Chart 2.4 (top left-hand side). The Chart uses MONA, Danmarks Nationalbank's macroeconometric model, to simulate the economic development in the medium-term projection and in the counterfactual scenario where the effects of the housing bubble in the previous decade are practically eliminated.[1]

[1] The simulated house-price development in the counterfactual scenario is based on the analysis behind Chart 3.4 in Dam et al. (2011). Our counterfactual model experiment is vulnerable to the Lucas critique according to which a change of economic-policy regime (e.g. the transition to a regime which ensures higher house-price stability) may influence expectations and thus economic behaviour in a way which traditional macroeconometric models do not take into account.

MACROECONOMIC CONSEQUENCES OF THE HOUSING BOOM IN THE 2000S

Chart 2.4

Note: Own estimates based on MONA with new relations for house price and residential investment, cf. Dam et al. (2011). The baseline scenario is based on the forecast published in this Monetary Review, Part 1, with a technical projection for 2014-15, cf. Dam et al. (2011, section 5). The counterfactual scenario is based on the assumptions that deferred-amortisation loans and adjustable-rate loans were never introduced, and that property value tax was not frozen in 2002. These assumptions are followed up by a proportional correction of the unexplained residuals in house-price development from 2004 onwards, cf. the discussion in Dam et al. (2011, section 3).

Source: Danmarks Nationalbank.

It appears from Chart 2.4 that in the absence of a housing boom, unemployment would have been higher in the mid-2000s. On the other hand, competitiveness would have developed more favourably, resulting in stronger exports in the coming years, cf. the two lower parts of the Chart. The model calculations behind Chart 2.4 also indicate that the housing boom contributed significantly to a general boom in corporate investment, which will reduce demand for labour in the coming years because expansion of the capital stock to some extent replaces the need for labour in production. Together with the weakening of competitiveness, this explains why the housing boom will lead to higher unemployment in the coming years than might otherwise have been expected. Fluctuations in unemployment have thus been amplified by the housing boom: it pushed unemployment further down during a period when unemployment was already far below the sustainable structural level, and subsequently it seems to have increased unemployment in the wake of the international financial crisis which in itself generated a strong rise

in unemployment. In addition, the freeze on property value tax has weakened public finances. According to the model calculation, the freeze, viewed in isolation, results in a loss of public revenue of approximately kr. 10 billion in 2015, taking into account the derived effects on the economy. This revenue loss makes public spending cuts or higher taxes in other areas more imperative.

Microeconomic costs of fluctuating house prices

Not only do unstable house prices create macroeconomic instability, they may also lead to conversion costs for employees and firms. Large price fluctuations thus cause residential construction to fluctuate more than total output. This triggers a number of adjustment and conversion costs when the construction sector seeks to attract additional resources when construction is booming, and when spare resources are to be channelled from construction to other sectors during recessions when new residential construction has hit rock bottom.

In addition, house-price fluctuations may force consumers to adopt different patterns of consumption than they would actually have preferred. Fluctuating house prices lead to fluctuations in the user cost[1] of owner-occupied housing. If no costs were involved in changing housing consumption, individual households would be able to adjust their housing consumption immediately to changes in the user cost. In practice, moving to another home involves considerable costs in the form of money and time consumption, and people who move may also experience psychological costs because of their attachment to the place where they live. Due to these costs, many consumers will be "tied" to their existing housing consumption even though they would have chosen a different standard of accommodation if the current user cost had applied when they bought their home.

Accordingly, as a result of house-price fluctuations, many consumers may end up spending more or less than they actually want on housing consumption rather than other consumption. The Appendix explains how to quantify the resulting loss of welfare for consumers. The analysis shows that, among other factors, this loss of welfare is dependent on real house-price volatility and the correlation between house prices and interest rates. All other things being equal, the larger the house-price fluctuations, the larger the loss of welfare will be. According to the analysis, house-price fluctuations and their interaction with fluctuations

[1] The user cost equals the real house price multiplied by a factor consisting of the real interest rate after tax plus housing-related taxes and maintenance costs, where costs for taxes and maintenance are calculated per krone of property value. The user cost is thus a measure of the economic cost of owning a home.

in interest rates may have caused homeowners an average annual loss of welfare of up to 2 per cent of the value of owner-occupied housing consumption (corresponding to approximately kr. 2.5 billion in 2009 prices) due to the costs involved in adjusting housing consumption to changed house prices.[1]

House-price fluctuations and distribution of income

Due to the large fluctuations in house prices, periods of large real capital gains on owner-occupied housing are sometimes replaced by periods of large and often unforeseen capital losses. Such gains and losses may have a considerable impact on the distribution of consumption opportunities. For example, increases in house prices were substantially higher in the Copenhagen area than in the rest of Denmark up to 2007. So while an average household in Copenhagen and environs obtained tax cuts of approximately kr. 25,000 by virtue of the freeze on property value tax, the tax cuts obtained by an average household in northern Jutland amounted to only approximately kr. 5,000, cf. Chart 3.6 in Dam et al. (2011).

At the microeconomic level, such fluctuations may lead to more arbitrary redistribution depending on when individual households enter or exit the market for owner-occupied housing. Personal or family circumstances may often reduce an individual's flexibility to choose when to purchase or sell a home. The reduced flexibility is amplified by the fact that in many cases the market for rental housing functions poorly due to the regulation of rents, resulting in long waiting lists. Purchasing a home when prices are high or low can have quite a decisive impact on an individual's private finances and wealth. Large house-price fluctuations may thus lead to more or less arbitrary wealth redistribution across generations and regions, and between owners and tenants. All in all, this "housing lottery" entails unpredictable redistribution which counters the attempts of the political system to ensure more consistent smoothing of consumption opportunities, e.g. via the taxation and transfer system.

3. HOUSING MARKET, CYCLICAL FLUCTUATIONS AND STABILISATION POLICY

As we have seen, large house-price fluctuations may entail substantial economic costs. In this section we discuss whether it is possible to

[1] As explained in the Appendix, the estimated loss of welfare mentioned must be presumed to be on the high side.

dampen house-price fluctuations by changing the stance of macroeconomic stabilisation policy.

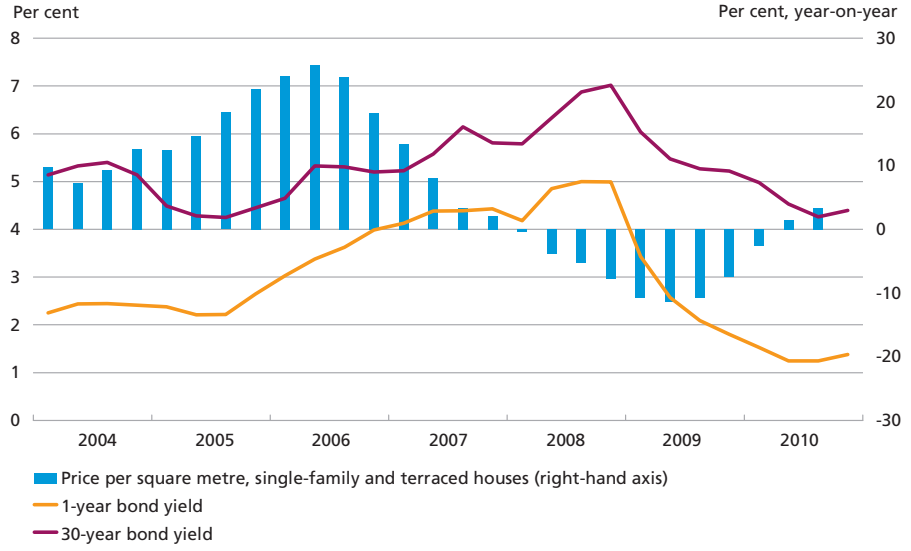
The extent of short-term house-price fluctuations is dependent on the size of the owner-occupied housing demand shocks to which the market is regularly exposed as well as the change in house prices required to restore short-term equilibrium in the market for owner-occupied housing when it is exposed to a shock of a given size.

As housing demand is determined by the development in total incomes, among other factors, shocks to the housing market may be dampened through a counter-cyclical macroeconomic stabilisation policy which reduces fluctuations in total output and employment.

However, experience from both Denmark and abroad clearly indicates that the general ability of monetary and fiscal policy to stabilise the housing market is insufficient. As a result of the fixed-exchange-rate policy, Danish monetary-policy interest rates are pegged to monetary-policy interest rates in the euro area. This does not leave Danmarks Nationalbank much scope for applying interest-rate adjustments as an instrument to counter undesirably large house-price fluctuations.

This issue is illustrated in Chart 3.1, showing the development in house prices and mortgage yields in the second half of the last decade. It is seen that mortgage yields declined throughout most of 2004 and 2005 which saw a considerable acceleration in the rate of house-price increases. The development in interest rates thus contributed to amp-

INTEREST RATES AND HOUSE PRICES — Chart 3.1



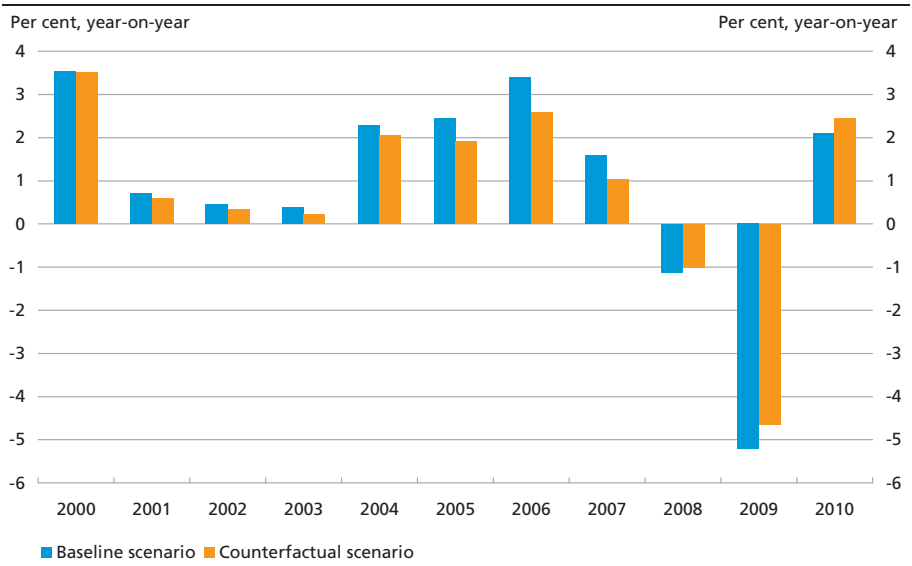
Source: Statistics Denmark and Danmarks Nationalbank.

lifying the unsustainable rise in house prices during that period. It also appears that even though house prices began to fall around the turn of the year 2007-08, interest rates continued to rise throughout most of 2008 due, among other factors, to Danmarks Nationalbank's obligation to defend the krone through interest-rate increases during the financial crisis in the autumn of 2008, thereby amplifying the housing market downturn.

Since monetary policy in Denmark is designed to keep the krone stable against the euro, Danish macroeconomic stabilisation policy must be implemented via fiscal policy. But as Chart 3.2 illustrates, rather tight fiscal-policy measures may be required to smooth the GDP fluctuations resulting from fluctuations in the housing market. The Chart shows the actual GDP growth rates in the Danish economy during the period 2000-10 compared with the growth rates which we would have experienced, according to the model calculation behind Chart 2.4, if the housing market had not been exposed to the fluctuations ensuing from the introduction of new loan types and the freeze on property value tax.

We see from Chart 3.2 that the housing boom and the subsequent downturn in the housing market led to a significant increase in growth rate fluctuations, cf. also the discussion in section 2. For example, the

SIGNIFICANCE OF THE HOUSING MARKET TO GDP GROWTH — Chart 3.2



Note: Own estimates based on MONA with new relations for house price and residential investment. The baseline scenario is based on the forecast published in this Monetary Review, supplemented with a technical projection for 2014-15, cf. Dam et al. (2011, section 5). The counterfactual scenario is based on the assumptions that deferred-amortisation loans and adjustable-rate loans were never introduced, and that property value tax was not frozen in 2002. These assumptions are followed up by a proportional correction of the unexplained residuals in house-price development as from 2004, cf. the discussion in Dam et al. (2011, section 3).

Source: Danmarks Nationalbank.

housing bubble resulted in additional GDP growth of 0.6 percentage points in 2007, virtually all of which was, at that point in time, attributable to the effects of deferred-amortisation loans and the freeze on property value tax. In order to neutralise this driver of growth, which occurred at an unfortunate time when the economy was already overheated, fiscal policy should have been tightened by the equivalent of a negative 1-year fiscal effect of about 0.5 per cent of GDP, i.e. quite a significant tightening.

As mentioned in section 2, stronger general cyclical fluctuations were not the only cost of large house-price fluctuations. Yet, much tighter fiscal-policy measures than those mentioned above would have been needed to halt the skyrocketing house prices in the middle of the last decade. This can be illustrated by a calculation based on the house-price relation for the Danish housing market estimated in Dam et al. (2011). A permanent drop of e.g. 6 per cent in household disposable income (achieved e.g. by raising taxes) would lead to house prices falling by 10 per cent in the medium term. Since the estimated relation entails that the full price reaction will not occur for a number of years, the income reduction must be considerably larger, up to 20 per cent, if the 10 per cent price drop is to be felt within two years. This would require strong fiscal-policy tightening measures, which would trigger a deep economic recession. The calculation is put into further perspective by the fact that it concerns a dampening of house prices of "only" 10 per cent. By way of comparison, real house prices rose by as much as 36 per cent from the 1st quarter of 2005 to the 4th quarter of 2006.

Experience from abroad in recent years also shows very clearly that a successful macroeconomic stabilisation policy will not in itself prevent large fluctuations in the housing market. In the OECD countries, the period from the late 1980s to the impact of the financial crisis on the real economy in the late 2000s has been referred to as the "Great Moderation", because it was characterised by fairly limited fluctuations in output and employment and relatively low and stable inflation. This favourable development is often attributed to a period of successful stability-oriented monetary policy in the major countries. Despite the general macroeconomic stability, a large number of countries did not manage to avoid unsustainably strong house-price increases followed by a severe downturn in the housing markets which had a strong negative impact on the dramatic recession in 2008-09. In fact, the long preceding period of macroeconomic stability may even have contributed to amplifying the fluctuations in the housing market by promoting the assumption that periods of plunging house prices were a thing of the past, thereby causing the risk elements of residential investment to be underestimated.

Since general macroeconomic stabilisation policy does not provide sufficient opportunities to stabilise the housing market, the two subsequent main sections focus on the question whether it is possible via economic policy to affect the structure of the housing market in such a way as to cushion the reaction of house prices to shocks to the market.

4. HOUSING TAXATION AND HOUSE-PRICE FLUCTUATIONS

As demonstrated by van den Noord (2005), among others, the reaction of house prices to housing demand shocks is dependent on the tax system. Under the tax rules in many OECD countries, including Denmark, interest on mortgage debt is deductible (in countries other than Denmark there is often a ceiling on permissible interest deductions, however). Mortgage interest tax relief reduces homeowners' costs of financing housing purchases, meaning that increases in house prices have a lower impact on current housing costs. Accordingly, mortgage tax relief causes housing demand to be less sensitive to house-price fluctuations. If more people wish to purchase a home due to an increase in total incomes, a higher increase in house prices is required to restore equilibrium in the housing market as a result of the mortgage tax relief. Box 4.1 further explains and illustrates this mechanism.

While the mortgage tax relief increases house-price volatility, all other things being equal, residential property taxation will have the opposite effect to the extent that taxes are levied on the basis of current property values and thus adjusted in step with the development in house prices. If an increase in house prices results in higher housing tax, such an increase will have a more significant impact on housing costs, causing housing demand to be more sensitive to house-price increases. Hence, housing taxes which follow the development in property values will reduce the house-price fluctuations caused by housing demand shocks.

The total effect of the tax system on house-price volatility is thus dependent on the total tax subsidy for owner-occupied housing consumption which is given as

$$\text{tax subsidy} = t \cdot r - s, \tag{1}$$

where r is the nominal interest rate before tax, t is the capital income tax rate which determines the tax value of the mortgage tax relief, and s is housing-related taxes as a ratio of the current property value. The tax subsidy in (1) indicates the total reduction of the user cost of owner-occupied housing consumption compared with a situation without tax. It should be noted that the tax subsidy for housing consumption is given in

HOUSE-PRICE FLUCTUATIONS AND TAX SUBSIDIES Box 4.1

In the following we show how tax subsidies for owner-occupied housing consumption causes larger fluctuations in the prices of owner-occupied housing. The real user cost of owner-occupied housing (bp) can be expressed as follows

$$bp = p^h \cdot u, \qquad u \equiv r - \pi + d - \pi^h - \left(t \cdot r - s\right), \tag{1}$$

where p^h is the real house price, r is the nominal interest rate, π is the general rate of inflation, d is the necessary costs for housing repairs as a ratio of the current property value, π^h is the expected real rate of increase in house prices (the expected real capital gain), t is the capital income tax rate, and s is housing-related taxes as a ratio of the current property value. The quantity $t \cdot r - s$ constitutes the tax subsidy for owner-occupied housing consumption, given that $t \cdot r$ indicates the tax value of the mortgage tax relief. If $t \cdot r - s$ is positive, the tax system reduces the user cost of owner-occupied housing relative to a situation without taxes.

Now assume that in accordance with the empirical analysis in Dam et al. (2011) owner-occupied housing demand K^D is an increasing function of the user cost and a decreasing function of the real disposable income *Y*, so that

$$K^D = K\left(bp, Y\right) = K\left(p^h u, Y\right), \qquad K_p < 0, \quad K_Y > 0, \tag{2}$$

where K_p and K_Y are the partial derivatives of the housing demand function $K(\bullet)$ in terms of the user cost and income, respectively. Equations (1) and (2) can be used to illustrate the short-term effect on the house price p^h of a change in housing demand stemming from a change in income. By linearising (2) (and keeping *u* constant), we find that

$$\Delta K^D = K_b \cdot u \cdot \Delta p^h + K_Y \cdot \Delta Y, \tag{3}$$

where the operator Δ indicates a change in the following variable. In the short term, the total supply of owner-occupied housing is approximately constant. To restore short-term equilibrium in the housing market after a change in income, the house price must therefore be adjusted to ensure that the total change in owner-occupied housing demand equals zero $\left(\Delta K^D = 0\right)$. If this condition is inserted in (3), the outcome after rearrangement is the following change in the house price that ensures equilibrium:

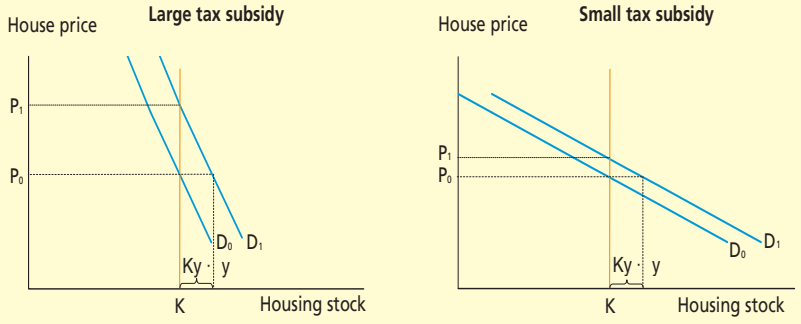
$$\Delta p^h = -\left(K_Y / uK_b\right) \cdot \Delta Y. \tag{4}$$

Equation (4) shows that the lower the normalised user cost *u*, i.e. the larger the tax subsidy $t \cdot r - s$ in equation (1), the larger will be the short-term change in the house price as a reaction to a change in income. The intuitive explanation of this outcome is given in the main text. Chart 4.1 provides a supplementary graphical explanation of the outcome. The vertical lines marked by $\overline{K}$ indicate the supply of owner-occupied housing which is completely inelastic in the short term when the housing stock is given. The declining curves marked by *D* are housing demand curves where the slope is $1/uK_b < 0$ according to equation (3). So the lower *u* is, i.e. the larger the tax subsidy for owner-occupied housing, cf. (1), the steeper will be the slope of the housing demand curve.

CONTINUED Box 4.1

Chart 4.1 illustrates a situation where income increases by the amount ΔY . According to (3), this will shift the housing demand curve to the right by the distance $K_Y \cdot \Delta Y$. This means that in the short term when housing supply is given, equilibrium in the housing market can only be restored if the house price increases from p_0^h to p_1^h , as shown in Chart 4.1. In the left-hand side of the Chart, the tax subsidy for owner-occupied housing consumption is assumed to be substantial, resulting in a steep housing demand curve. As a consequence, we see that an increase in income will trigger a large increase in the house price. In the right-hand side of Chart 4.1 a limited tax subsidy results in a flatter housing demand curve. In this situation we see that the same increase in income will result in a somewhat smaller increase in the house price.

SHORT-TERM ADJUSTMENT OF THE HOUSING MARKET TO DEMAND SHOCKS Chart 4.1



Equation (4) can be converted to

$$\frac{\Delta p^h}{p^h} = \frac{\varepsilon_Y}{u\eta_u} \cdot \frac{\Delta Y}{Y}, \qquad (5)$$

$$\varepsilon_Y \equiv \frac{\partial K}{\partial Y}\frac{Y}{K}, \qquad \eta_u \equiv -\frac{\partial K}{\partial u}\frac{1}{K} = -p^h \cdot \frac{\partial K}{\partial bp}\frac{1}{K},$$

where ε_Y is the income elasticity of housing demand, and η_u is the semi-elasticity of housing demand in terms of the normalised user cost. Accordingly, the parameter η_u indicates the relative change in housing demand when the normalised user cost defined in (1) is changed by 1 percentage point. In equation (5) house-price volatility is measured in terms of the relative change in the house price as a function of the relative change in income. It follows from the definition of η_u that the quantity $u\eta_u$ equals the elasticity of housing demand in terms of the user cost. As *u* is declining in the tax subsidy for owner-occupied housing, equation (5) thus shows that the relative fluctuations in house prices are amplified by increasing tax subsidies if the price elasticity of housing demand is an increasing function of the normalised user cost. This will be the case e.g. if the semi-elasticity η_u is constant. The housing demand relation estimated in Dam et al. (2011) meets this condition.

(1) whether or not (part of) the housing purchase is financed out of the homeowner's own funds. The reason is that the taxation of interest income reduces the yield that the homeowner might otherwise have obtained by placing his funds in interest-bearing assets. Accordingly, the taxation of interest reduces the opportunity cost of investing funds in an owner-occupied home, which is captured by the term $t \cdot r$ in (1), where t is the relevant marginal rate of tax on positive net capital income in respect of persons with positive financial net worth.

Van den Noord (2005) has calculated the size of the tax subsidy in (1) in a number of European OECD countries where comparable data were available and compared the subsidy with house-price volatility in the period 1970-2001.[1] According to van den Noord, it is clear that countries providing a higher tax subsidy for owner-occupied housing consumption tend to have experienced larger house-price fluctuations. In cooperation with van den Noord we have extended his analysis to cover the whole period from the beginning of 1970 to the end of 2009, incorporating data for Denmark that was not included in the original analysis. The size of the tax subsidy for owner-occupied housing consumption in individual countries is measured on the basis of the tax rules in 1999. This implies a certain degree of imprecision, as the tax rules in most countries, including Denmark, have changed over time. House-price volatility is measured by the average percentage deviation of real house prices from the underlying trend in each year of the period 1970-2009. Chart 4.2 illustrates how house-price volatility mirrors tax subsidy developments.

A regression analysis of the data plotted in Chart 4.2 shows that about 85 per cent of the difference in house-price fluctuations across countries can be explained by a simple regression equation of the form

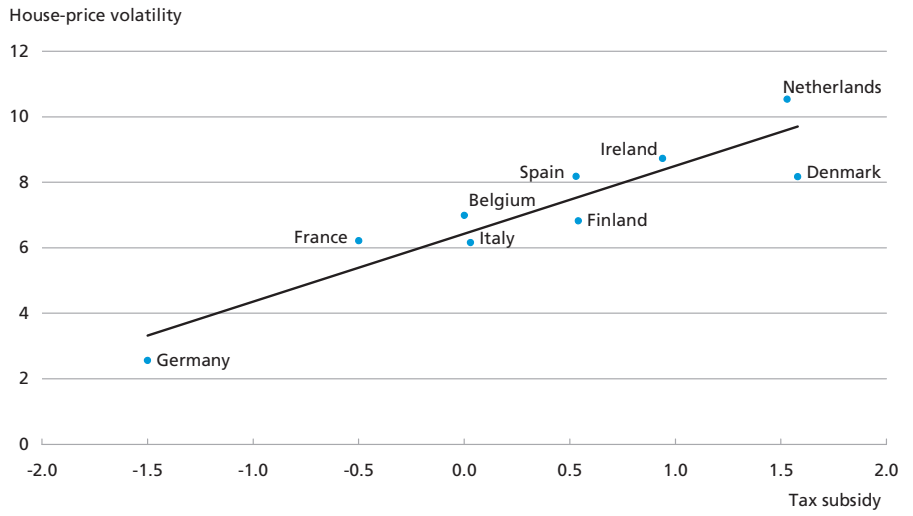
$$\sigma \approx 6.42 + 2.07 \cdot sub, \qquad (2)$$

where σ is house-price volatility, and sub is the tax subsidy defined in (1) in percentage points. The implications of equation (2) can be illustrated by an example. According to Chart 4.2, the tax subsidy for owner-occupied housing consumption in Denmark was just over 1.5 percentage points in 1999. According to (2), abolishing a tax subsidy of this size would reduce house-price volatility by just over 2 x 1.5 = 3 percentage points. This means that average house-price fluctuations around their long-term trend will be reduced from just over 8 to just over 5 percentage points.

[1] Van den Noord's analysis is based on data for Belgium, Finland, France, Germany, Ireland, Italy, the Netherlands and Spain.

HOUSE-PRICE FLUCTUATIONS AND TAX SUBSIDIES IN SELECTED OECD COUNTRIES

Chart 4.2



Note: The tax subsidy for owner-occupied housing consumption is calculated in accordance with the tax rules and levels of interest rates in 1999. The regression line inserted is estimated using ordinary least squares ($R^2 = 0.847$).
Source: Data supplied by Paul van den Noord and own estimates for Denmark.

So, in accordance with the previously published study by van den Noord (2005), we see a systematic tendency for countries with a larger tax subsidy to have experienced larger house-price fluctuations around their long-term trend, which was to be expected based on the theoretical reasoning above.

Tax subsidies and house-price fluctuations in Denmark: What is the effect of the freeze on property value tax?

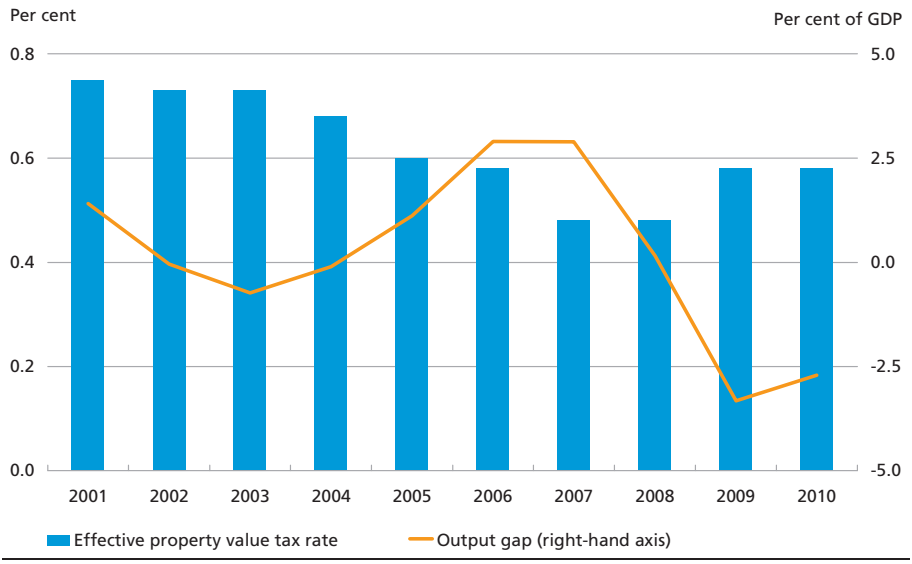
According to the analysis above, housing taxes will only dampen house-price fluctuations if a house price increase automatically triggers a tax increase and vice versa. In Denmark this automatic stabilisation mechanism has been deactivated for the time being with regard to government property value tax. This is attributable to the "nominal principle" of the tax freeze, which entails a freeze on property value tax in monetary terms. So, unlike the situation prior to the introduction of the tax freeze at the beginning of 2002, property value tax is no longer dependent on the current property value.[1]

[1] Specifically, the current form of the tax freeze implies that the calculation of property value tax is based on the *smallest* of the following three amounts: 1. The property valuation for 2001, subject to an addition of 5 per cent. 2. The property valuation for 2002. 3. The property valuation for the property concerned as at 1 October of the assessment year. In practice this means that property value tax constitutes a fixed nominal amount except in extraordinary cases when the current nominal property value falls below the 2001 level, subject to an addition of 5 per cent (or below the level in 2002).

Because of the freeze on nominal property value tax, real tax revenue is gradually eroded by inflation. Furthermore, the nominal principle implies that the effective property value tax rate (the tax share of the current property value) will decline when house prices go up, while on the other hand the effective tax rate will increase when house prices go down. As house-price fluctuations typically mirror the general cyclical developments, the nominal principle will therefore tend to amplify the cyclical fluctuations.

Chart 4.3 and Table 4.1 illustrate this. Chart 4.3 shows how the surging house prices in the mid-2000s led to a significant drop in the effective property value tax rate. This occurred during a period of soaring demand pressure as measured by the output gap (the percentage deviation between actual GDP and GDP under "normal" economic conditions) when dampening of demand was necessary to avoid overheating of the economy. The falling property value tax rate contributed to increasing demand pressure in several ways, however. Firstly, as result of the decrease in effective taxation, house prices increased more than they would otherwise have done. This created additional wealth increases which amplified the increase in private consumption, and the higher price increases also drove up residential investment. Secondly, due to the decrease in the effective property value tax rate, households obtained tax cuts which further stimulated private consumption. For example, it is

EFFECTIVE PROPERTY VALUE TAX RATE AND OUTPUT GAP — Chart 4.3



Note: The effective property value tax rate is calculated as revenue from property value tax as a ratio of the public valuation of the housing supply taxed in accordance with the "Law Model" of the Ministry of Finance. The output gap is estimated by the Ministry of Finance (2010).
Source: The Ministry of Economic and Business Affairs and the Ministry of Finance.

EFFECTS OF THE FREEZE ON PROPERTY VALUE TAX Table 4.1

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Property value tax of owner-occupied home valued at kr. 1.1 million in 2002	kr. 1,000 (2010 level)								
- with tax freeze	13	13	12	12	12	12	11	11	11
- without tax freeze	13	13	14	16	19	19	17	15	15
Total revenue from property value tax	kr. billion (2010 level)								
- with tax freeze	12	12	12	12	12	13	13	13	13
- without tax freeze	12	12	14	17	21	22	21	18	18

Note: The counterfactual property value tax in the situation without the nominal tax freeze is calculated on the basis of a simulated house-price development allowing for the fact that house prices would have been lower in a situation without a tax freeze. The simulation uses the house-price relation estimated in Dam et al. (2011). The tax revenue at 3 per cent property value tax on the value exceeding kr. 3,040,000 (2002 level) has been taken into account.

Source: The Central Tax Administration (SKAT), Statistics Denmark and own estimates.

evident from the two bottom rows of figures in Table 4.1 that at the height of the boom in 2006-07, households would have had to pay kr. 9 billion in extra property value tax (calculated at 2010 level), if the freeze on nominal tax payments had not been allowed to undermine the effective property value tax rate.

On the other hand, Chart 4.3 shows that the decline in house prices combined with the nominal principle of the tax freeze led to an *increase* in the effective property value tax rate in 2008 and 2009 as a result of the decline in house prices that started at the end of 2007. In parallel with this, it appears from Table 4.1 that the property value tax for a typical owner-occupied home would have *fallen* in 2008 and 2009 if there had been no freeze. So the freeze contributed to amplifying the sudden economic downturn which occurred in the wake of the international financial crisis.

Based on the analysis in the previous section, we can present a rough estimate of the contribution of the freeze to house-price volatility in Denmark. The point of departure is a calculation of the current tax subsidy for owner-occupied housing consumption, cf. (1). In Denmark, housing-related taxes consist of government property value tax and local-government land tax, which is charged on land values only. To adapt equation (1) to Danish conditions the expression of tax subsidy is therefore converted as follows:

$$\text{tax subsidy} = t \cdot r - D \cdot s^e - a \cdot s^g. \qquad (3)$$

The product $a \cdot s^g$ represents the effect of the land tax on the normalised user cost of owner-occupied housing where the parameter a indicates

the land tax proportion of the total property value, and s^g is the land tax rate. The quantity s^e is the effective property value tax rate which measures the property value tax as a ratio of the current property value. *D* is a dummy variable which assumes the value of 1 if the property value tax is charged on the current property value, and the value of 0 if the property value tax constitutes a fixed amount that is unrelated to the current property value, as has been the case in Denmark since the introduction of the tax freeze in early 2002. The inclusion of the dummy variable *D* is motivated by the analysis in Box 4.1, which showed that a housing tax will dampen house-price fluctuations only if it mirrors the development in house prices. Conversely, if the tax remains constant irrespective of the development in property values, as is currently the case with the Danish property value tax, it will not dampen the impact of shocks to housing demand on house prices. Hence, the effect of the nominal tax freeze on house-price volatility in Denmark can be analysed by changing the value of *D* in equation (3) from 1 to 0, as property value tax was charged on the most recent public property valuation before the introduction of the tax freeze.[1]

For persons with negative net capital income, the tax value of the mortgage tax relief is currently 33.5 per cent in an average local-government district. Therefore, in equation (3) we set $t = 0.335$. Moreover, we assume a nominal interest rate of 4 per cent ($r = 4$), which may be seen as an estimated average interest rate on short-term and long-term mortgage loans. The size of the tax subsidy for owner-occupied housing consumption implied in the income tax system then equals 0.335 x 4 = 1.34 per cent of the value of the property. In 2010, the average local-government land tax was 25.92 percentage points (i.e. $s^g = 2.592$). According to the most recent data available, land values for Denmark as a whole constitute approximately 29 per cent of the public property valuation of owner-occupied housing, and thus we set $a = 0.29$. In the year before the introduction of the tax freeze (2001) the effective property value tax rate was 0.75 per cent, cf. Chart 4.3. We therefore set $s^e = 0.75$.

By inserting these parameter values in (3), we find that the tax subsidy that is relevant to house-price volatility constitutes just under 0.6 percentage points of the property value under the current nominal tax freeze where $D = 0$. In a situation without a freeze on the nominal

[1] The tax subsidy measure set out here is relevant only when analysing the impact of the tax system on the volatility in house prices. When calculating the efficiency and revenue impacts of taxation, property value tax must always be recognised (i.e. *D*=1). On the other hand, it should also be borne in mind that property value tax, land tax and the tax value of the mortgage tax relief will to a large extent be capitalised in the price of land. Sørensen (2011) presents a method to calculate the efficiency and revenue impacts of tax subsidies while taking such capitalisation impacts into account.

property value tax ($D = 1$), where the effective property value tax rate applicable in 2001 had been maintained, the tax subsidy in (3) would have been reversed to a modest positive tax of approximately 0.15 percentage points.

By inserting these estimates for the variable *sub* in regression equation (2), we can present a rough estimate of the contribution of the nominal principle of the tax freeze to increasing real house-price fluctuations in Denmark. According to this calculation, house prices will on average deviate by just over 7.5 percentage points from their long-term equilibrium value as a result of the tax freeze on property value tax, whereas the average price deviation from the equilibrium value would only amount to 6 percentage points in the situation without a tax freeze. This means that the freeze on nominal property value tax has amplified the average annual house-price fluctuations by just over 1.5 percentage points, corresponding to an increase in house-price volatility of just over one fourth compared to a situation where a freeze had not been implemented.

These quantitative results should be interpreted with considerable caution as the underlying regression analysis is very simple and comprises only a limited group of OECD countries. In a recent OECD study, Andrews (2010) extended the previous analysis by van den Noord (2005) by including data for a larger number of OECD countries as well as more variables in addition to the tax subsidy to explain the differences in house-price volatility across countries. Andrews' quantitative analysis implies that a reduction of the tax subsidy by 0.75 percentage points – corresponding to the one analysed above – will reduce house-price volatility by just under 0.9 percentage points. The effect is smaller than the fall in volatility of just over 1.5 percentage points following from the simple regression analysis in (3), but it still constitutes a significant dampening of house-price fluctuations.

In order to assess the credibility of these quantitative results, it may be useful to examine the quantitative implications of an alternative calculation method based on the link that must be assumed to exist between the user cost and housing demand. The calculation method is described in Box 4.2.[1] In the numerical examples presented in the box, the freeze on property value tax increases house-price volatility to about the same extent as predicted by regression equation (2). It generally follows from the calculation method in Box 4.2 that the freeze leads to a higher increase in house-price volatility, the more the property value exceeds the progression limit for property value tax. Practical experience seems to

[1] This method is inspired by Møller (2005).

TAX FREEZE AND HOUSE-PRICE FLUCTUATIONS Box 4.2

In this box we show the effect of the nominal principle of the tax freeze on the size of the house-price fluctuations resulting from housing demand shocks.

Let B_0 and B_1 indicate the annual housing cost that the marginal home buyer is willing to pay for a home of a specific size and quality before and after a change in income, respectively. If the house price is P_0 and P_1, respectively, in the two situations, and if we reuse the notation from Box 4.1 and equation (3) in the main text, the following applies in a situation without a tax freeze

$$\frac{B_1}{B_0} = \frac{\left[r(1-t) + s^e + as^g + d\right]P_1}{\left[r(1-t) + s^e + as^g + d\right]P_0} \quad \Rightarrow \quad \frac{P_1}{P_0} = \frac{B_1}{B_0}. \tag{1}$$

The expressions in square brackets in (1) are the normalised user cost of owner-occupied housing consumption, which is the same before and after the house-price change in a situation without a tax freeze where the property value tax is charged on the current property value. Accordingly, equation (1) shows that a change in home buyers' willingness to pay – reflected in a change in the fraction B_1 / B_0 – will result in a proportionate change in the house price. For example, a 10 per cent increase in income which entails $B_1 / B_0 = 1,1$, will also cause a 10 per cent increase in house prices if interest and tax rates remain unchanged.

Now assume instead that there is a tax freeze which fixes the nominal property value tax payment at level E. Following the change in home buyers' willingness to pay, the house price must then satisfy the following relation:

$$\frac{B_1}{B_0} = \frac{\left[r(1-t) + as^g + d\right]P_1 + E}{\left[r(1-t) + as^g + d\right]P_0 + E}. \tag{2}$$

If $s_o^e \equiv E / P_0$ is defined as the effective property value tax rate applying at the outset, we find by rearrangement of (2) that

$$\frac{P_1}{P_0} = \frac{B_1}{B_0} + \left(\frac{B_1}{B_0} - 1\right)\left(\frac{s_o^e}{r(1-t) + as^g + d}\right). \tag{3}$$

Comparing (1) and (3) we see that in the situation with a tax freeze, fluctuations in the willingness to pay – i.e. fluctuations in the fraction B_1 / B_0 – will always result in larger house-price fluctuations measured as fluctuations in the fraction P_1 / P_0. It can also be inferred from (3) that the larger the part of the property value that exceeds the progression limit of the property value tax, the larger will be house-price volatility during a tax freeze, since s_o^e increases the more severely the property is affected by the progression.

The quantitative implications of the above formulas may be explained by a couple of numerical examples. Consider e.g. an owner-occupied home which has a value of kr. 1,000,000 from the outset, without a freeze on the property value tax, and for which the current maintenance costs amount to 1 per cent of the property value. At the plausible values of interest and tax rates assumed in the main text, the current annual housing cost of this property (or to be more precise: the user cost) will include interest expenditure after tax of 0.04 x (1-0.335) x 1,000,000 = kr. 26,600. To this should

CONTINUED Box 4.2

be added property value tax costs of 0.0085 x 1,000,000 = kr. 8,500, a land tax payment of 0.02592 x 0.29 x 1,000,000 = kr. 7,517, and maintenance costs of 0.01 x 1,000,000 = kr. 10,000. This generates annual housing costs after tax of kr. 52,617 in total.

Now assume that home buyers' willingness to pay increases by 10 per cent, e.g. as a result of increasing incomes, so that a buyer is willing to pay total current housing costs of 1.1 x 52,617 = kr. 57,879 kr. for the home concerned. In the absence of a nominal tax freeze, the property value tax and the other elements of the housing cost will vary proportionately with the current value of the home (possibly with a short delay in respect of the taxes and maintenance costs). As a consequence, a 10 per cent increase in the willingness to pay will also result in a 10 per cent increase in the value of the property, since the increase in the total housing cost will also be 10 per cent.

In case of a tax freeze, however, the property value tax will be fixed irrespective of any increase in the property value. Accordingly, a larger increase in the property price is required to generate a specific increase in the housing cost. In our example where the marginal home buyer is willing to increase his total annual housing cost by 10 per cent from kr. 52,617 to kr. 57,879, and where the property value tax is frozen at kr. 8,500 because of the tax freeze, the property price must therefore increase to the extent that the cost of interest, land tax and maintenance increases to kr. 57,879 - 8,500 = 49,379. Hence, the property price must increase from kr. 1,000,000 to about kr. 1,119,700, or just under 12 per cent. In comparison, the price would only have to increase by 10 per cent in the situation without a tax freeze. In the example, the freeze on property value tax consequently increases house-price volatility by just under one fifth, or almost 20 per cent. This estimate is almost identical with the estimate based on the regression equation (2) in the main text.

For properties with a value that exceeds the progression limit for property value tax, the nominal tax freeze has had a stronger effect on house-price volatility according to formula (3). If e.g. 25 per cent of the property value exceeds the limit of kr. 3,040,000 where the property value tax constitutes 3 per cent of the marginal property value, and if we stick to the previous assumptions concerning interest and other tax rates, etc., formula (3) shows that the freeze on property value tax has increased the price volatility for such a property by just over 30 per cent.

confirm this. As demonstrated by Dam et al. (2011), the last decade has shown a clear tendency for larger house-price fluctuations in the "expensive" parts of Denmark where, prior to the introduction of the tax freeze, a considerable number of properties were taxed at 3 per cent of the value increase due to the progressive element of the property value tax.

Stability-oriented property value taxation

Econometric analyses as well as simple reflections on the link between housing costs and house prices support the impression that for property value tax the nominal principle of the tax freeze has contributed signi-

ficantly to increasing house-price fluctuations. So the introduction of the nominal principle has dismantled an important automatic tax stabiliser, cf. also the discussion in connection with Chart 4.3 and Table 4.1.

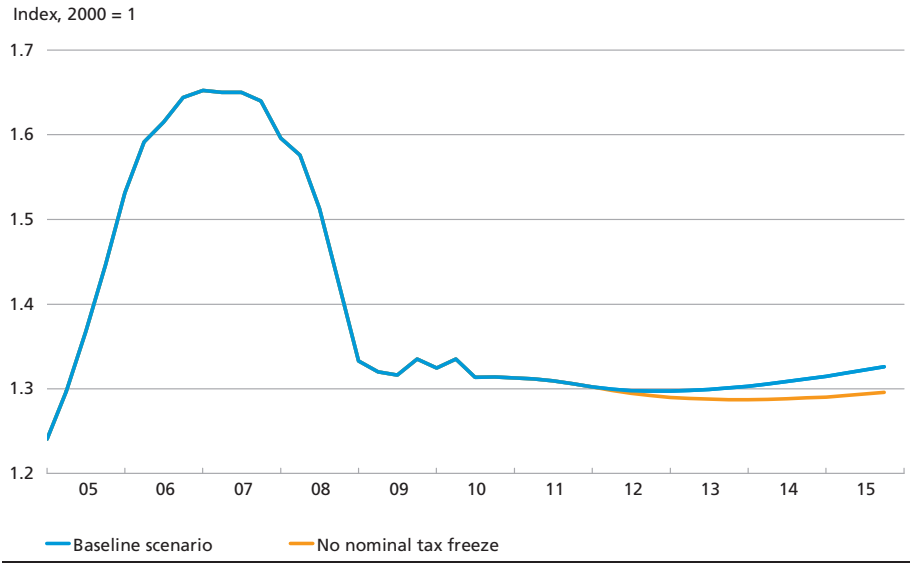
Due to these inexpedient and presumably unintended effects it is natural to consider abolishing the nominal principle. This may be done without raising the current property taxation, provided that a downward adjustment of the formal property value tax rate is made at the same time so total revenue remains unchanged in the short term. If the nominal principle were abolished, the nominal property value tax would again mirror the development in property valuations. This would contribute to stabilising the future development in house prices. However, at the time of reform, a certain dampening of house prices may be expected in as much as home buyers today calculate with lower real tax payments in future as a result of the nominal principle. If the reform is implemented during an upswing, however, the negative short-term effect on the housing market will be offset by the increase in housing demand resulting from rising incomes.

A temporary problem will arise if the principle of charging property value tax on the most recent property valuation is reintroduced. The problem is due to the fact that since the introduction of the tax freeze in early 2002, property values have risen much more steeply in and around the large cities than in the rest of the country. If the new downward-adjusted property value tax rate is fixed in such a way as to ensure that the total revenue at the time of reform remains unchanged, this may result in a significant tax increase for homeowners in the areas that have seen the highest increases during the last decade, while homeowners in other parts of the country will obtain tax cuts. This problem might be addressed by a transitional arrangement entailing a gradual adjustment to the new level of property value tax. When designing the transitional arrangement it is important to ensure that individual homeowners' tax payments mirror house-price developments from the start to immediately achieve the desired stabilising effect on house prices and economic development.

Lifting the freeze on property value tax would prevent tax revenue from being gradually eroded by inflation. Using the calculation method presented in Box 3.3 in Dam et al. (2011), it is possible to estimate with some uncertainty that a permanent freeze on the nominal property value tax would result in a loss of government revenue corresponding to a permanent fall in annual government revenue of just under kr. 8 billion in present current value terms. Preventing such loss of revenue would thus prevent significant deterioration of fiscal sustainability in the long term. At the same time, reducing the tax subsidy for owner-

SHORT-TERM EFFECT ON HOUSE PRICES OF LIFTING THE NOMINAL FREEZE ON PROPERTY VALUE TAX

Chart 4.4



Note: Own estimates based on MONA with new relations for house price and residential investment, cf. Dam et al. (2011). The baseline scenario is based on the forecast published in this Monetary Review, Part 1, supplemented with a technical projection for 2014-15, cf. Dam et al. (2011).
Source: Danmarks Nationalbank.

occupied housing consumption would lead to economic efficiency gains, cf. Sørensen (2011).

Chart 4.4 illustrates how lifting the freeze on nominal property value tax with effect from the beginning of 2012 may be expected to impact house prices in the short to medium term. The estimates in the Chart were achieved by incorporating the house price and residential investment relations as established and estimated by Dam et al. (2011) into Danmarks Nationalbank's macroeconometric model, MONA. The baseline scenario in Chart 4.4 assumes that the current tax rules remain unchanged and resembles the medium-term projection of the Danish economy in Chart 2.4. The alternative scenario in Chart 4.4 assumes that households will to some extent take account of the fact that they will miss out on future real tax cuts when the freeze on property value tax is lifted.[1] Accordingly, a certain negative impact on house prices can already be seen in 2012 when the nominal principle will be abolished. Even so, the effect on house prices will be relatively limited. In the longer term, the price effect will gradually disappear, because the supply of housing will be reduced as a result of a decline in new construction.

[1] To be more precise, 40 per cent of households are assumed to show such forward-looking behaviour. This corresponds to the proportion of home buyers who, according the analysis in Dam et al., do not act short-sightedly by attaching importance to the housing payment in the first year only.

Alternatively, it may be assumed that home buyers focus solely on the amount of real property value tax at the time of purchase,[1] i.e. they do not allow for the fact that in case the freeze is lifted they will miss out on lower real tax payments in future. Based on this assumption, there will be no significant effect on house prices within the time horizon under review, the reason being that the real property value tax will remain unchanged when the freeze is lifted.

Reducing the tax value of the mortgage tax relief: An alternative to lifting the freeze on property value tax?

The user cost of owner-occupied housing consumption includes interest after tax. Hence, an alternative to higher property taxation may be to reduce the tax subsidy of owner-occupied housing by lowering the rate of tax on investment income. Higher interest after tax would increase the change in the price of housing consumption resulting from a given change in the house price. According to the analysis in Box 4.1, this would dampen house-price fluctuations when housing demand is exposed to shocks.

For persons with negative net capital income, the current capital income tax rate is 33.5 per cent in an average local-government district, but pursuant to the latest tax reform this rate will be gradually reduced to 25.5 per cent up to 2019 for negative net capital income exceeding kr. 50,000 per person. As this nominal threshold is not subject to indexation, an increasing proportion of households' net interest costs will gradually acquire a tax value of 25.5 per cent.

A further reduction of the tax rate on negative net capital income is proposed in the public debate from time to time. This would further reduce tax subsidies of owner-occupied housing for the majority of homeowners who have net financial debt, but not for those with positive net capital income. For the latter group, the opportunity cost of investing in owner-occupied housing is the interest after tax that may alternatively be obtained by investing in interest-bearing assets. Accordingly, the user cost of owner-occupied housing consumption for persons with positive net capital income would not be affected by a lowering of the tax value of the mortgage tax relief.

A reduction of the negative net capital income tax rate entails a jump in marginal taxation of yields on financial savings when the net capital income is above zero. This will give asset owners an incentive to place their assets in owner-occupied housing rather than in financial

[1] This assumption would correspond to method I for modelling the impact of the freeze on property value tax in the calculations and discussion in Dam et al. (2011, section 3). The assumptions of the calculation that forms the basis of Chart 4.4 correspond to method II.

assets, thereby distorting the composition of savings. This inappropriate effect may be prevented by symmetrically reducing the tax on both positive and negative net capital income, thus ensuring a higher level of neutrality in total taxation of capital returns. However, lowering the tax on capital income would lead to greater wealth redistribution across generations than raising the property value tax, as members of the younger generations typically have net financial debt, while members of the older generations often have positive financial net worth. The vertical distribution of income will also be affected as a lowering of the capital income tax will exacerbate income inequality, because positive net capital income is concentrated particularly in the highest income brackets.

For these reasons, we focus on abolishing the nominal principle of the tax freeze as the most obvious method of reducing house-price fluctuations. Higher current property taxation is also recommended by OECD (2011) as the most effective and neutral method of reducing tax subsidies for owner-occupied housing.

5. HOME FINANCING AND HOUSE-PRICE FLUCTUATIONS

Based on international experience, the above-mentioned OECD study and the recent study by Andrews (2010) emphasise that in addition to tax rules, house-price volatility is also dependent on the terms and conditions for home financing. In Dam et al. (2011) we also find that the emergence of new types of home financing contributed to the soaring Danish house prices in the middle of the last decade. This raises the question of whether it is possible to reduce house-price fluctuations through appropriate home financing regulation. This issue will be discussed in the following.

Deferred-amortisation loans and house-price fluctuations

According to the analysis in Box 4.1, a lower normalised user cost (the user cost as a ratio of the house price) will cause house prices to react more strongly to housing demand shocks. At the same time, the empirical analysis in Dam et al. (2011) indicates that in addition to the "classical" user cost defined in equation (1) in Box 4.1, housing demand in Denmark is also dependent on the minimum first-year payments on mortgage loans offered by the loan types available at the time of purchase. To be more precise, the analysis shows that housing demand reacts to a modified user cost, bp^m, which can be expressed as follows

$$bp^m = r(1-t) + s + d + \alpha \cdot A, \qquad 0 < \alpha < 1, \tag{4}$$

where, as in previous equations, *s* is housing-related taxes, while *r* should be interpreted as a weighted average of the interest rates on long-term loans and 1-year adjustable-rate loans, respectively. The parameter *A* is the first-year (minimum) repayments on the loan as a proportion of the purchase price, and α is the proportion of such repayments that home buyers regard as a cost. In traditional economic theory α is assumed to be zero, i.e. repayments on loans are not regarded as a cost as they are offset by an equivalent wealth increase. However, if home buyers are liquidity constrained, wishing to increase their consumption in relation to the consumption level permitted by the credit facilities available, it may be rational for them to regard (part) of the repayments on loans as a cost, since the repayments constitute compulsory savings. To the extent that home buyers are short-sighted and consequently do not allow for the fact that larger repayments now result in lower interest costs later, they may also regard the repayments as a cost. The parameter α can be interpreted as the proportion of home buyers who are liquidity constrained or apply a short-sighted approach. Dam et al. (2011) estimate that in a Danish context α amounts to approximately 0.6.

We see from (4) that the repayment element $\alpha \cdot A$ affects the modified user cost and thus housing demand in the exact same way as the tax subsidy $t \cdot r - s$, only in reverse. As previously seen, there is empirical evidence that an increase in the tax subsidy will increase house-price volatility, cf. regression equation (2). The obvious assumption is therefore that a decrease in the repayment element $\alpha \cdot A$ will have a similar effect on house-price fluctuations. In Denmark it is estimated that the introduction of deferred-amortisation mortgage loans at the end of 2003 caused the parameter *A* in equation (4) to decrease from approximately 1.75 per cent to approximately 0.25 per cent when calculated as an average over a longer time period. At an estimated value of α of 0.6 this meant that the deferred-amortisation loans lowered the modified user cost by approximately 0.9 percentage points. If the user cost fell in parallel with an increase in the tax subsidy, this increased house-price volatility by approximately 0.9 x 2.07 = 1.9 percentage points according to equation (2).

As mentioned in section 4, the more sophisticated analysis in Andrews (2010) indicates that equation (2) overestimates the effect of the tax subsidy (and probably also of the deferred-amortisation loans) on house-price volatility by a factor of just under 1.8.[1] Adjusting for this effect, we find that the introduction of deferred-amortisation loans may have

[1] The factor is achieved as the estimated effect on volatility according to (2) in relation to the estimated effect according to Andrews' regression analysis.

amplified house-price fluctuations by just over 1 percentage point, i.e. a stronger effect than the estimated impact of the nominal principle of the tax freeze.

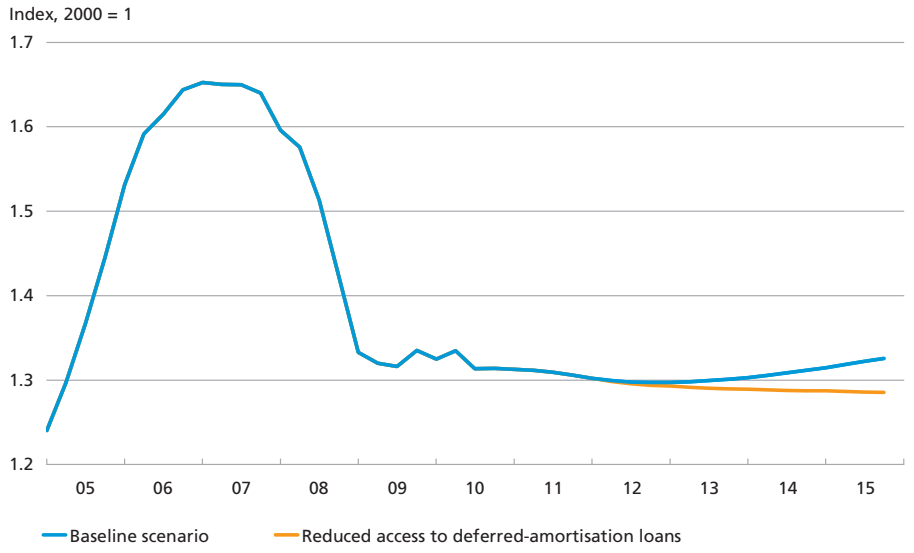
Besides, the increasing use of deferred-amortisation loans also makes homeowners and thus the economy as a whole more vulnerable to unexpected drops in house prices because the deferred amortisation reduces the build-up of home equity. Widespread use of deferred-amortisation loans will increase the number of homeowners who become technically insolvent in the event of a plunge in house prices. This is not just a problem for the households concerned but also for society at large. Technical insolvency may thus encourage homeowners to save up extraordinarily in periods of economic slowdown and decreasing house prices where the downturn would be amplified by consumption restraint. Furthermore, technically insolvent homeowners may not be able to afford to move. This will impede labour mobility, thus making it difficult to reduce unemployment in a downturn.

This speaks in favour of future mortgage loans for owner-occupied housing being granted solely with amortisation. Like lifting the freeze on property value tax, such a reform would reduce long-term fluctuations in the housing market. By ensuring the build-up of larger home equity, phasing out deferred-amortisation mortgage loans would also reduce the vulnerability of homeowners and society at large to unexpected negative shocks to the housing market. To avoid putting too much pressure on the housing market in the short term, access to deferred-amortisation loans should be phased out slowly, e.g. by reducing over a period of time the credit limit for new deferred-amortisation mortgage loans by 10 percentage points annually.

Chart 5.1 illustrates how such a gradual limitation of access to deferred-amortisation loans may be expected to impact house prices in the short to medium term. As in Chart 4.4, the estimate was achieved by incorporating the house price and residential investment relations as established and estimated by Dam et al. (2011) into Danmarks Nationalbank's macroeconometric model, MONA. The baseline scenario shown, in which the current access to deferred-amortisation loans is fully maintained, corresponds to the baseline scenario behind Chart 2.4. In the alternative scenario in Chart 5.1 it is assumed that from 2012 the upper limit for use of new deferred-amortisation mortgage loans will be reduced by 10 percentage points annually, starting from the current 80 per cent of the value of the property. Our analysis shows that this will only dampen house prices to a limited extent in the next few years.

As previously mentioned, average annual house-price fluctuations will be reduced by 1-2 percentage points in the long term if deferred-amort-

SHORT-TERM EFFECT ON HOUSE PRICES OF A GRADUAL PHASE-OUT OF DEFERRED-AMORTISATION LOANS — Chart 5.1



Note: Own estimates based on MONA with new relations for house price and residential investment, cf. Dam et al. (2011). The baseline scenario is based on the forecast published in this Monetary Review, Part 1, supplemented with a technical projection for 2014-15, cf. Dam et al. (2011). In the alternative scenario the credit limit for deferred-amortisation mortgage loans is gradually reduced by 10 percentage points annually, starting from 2012.
Source: Danmarks Nationalbank.

isation mortgage loans are phased out completely. In connection with the preparation of a specific proposal, maintaining limited access to this type of loan might be considered if it can be done without compromising the above objectives of the measure.

Cyclical regulation of home financing?

Another possible reform of home financing might be to regulate access to deferred-amortisation mortgage loans and adjustable-rate loans in relation to the cyclical position in the housing market. To illustrate this, we investigate the expected effects of three different types of restrictions on home buyers' access to credit facilities:

Mild cyclical brake: In periods of substantial house-price increases (real price increases of 5 per cent year-on-year or more), access to adjustable-rate mortgage loans and deferred-amortisation loans is restricted as from the start of the following year from the present 80 per cent to 60 per cent of the value of the home. In periods of dramatic real price increases (10 per cent year-on-year or more) access to adjustable-rate loans and deferred-amortisation loans is further restricted to 40 per cent of the value of the home. Access to fixed-rate bond loans is not affected, meaning that such loans may still constitute up to 80 per cent of the value of the home.

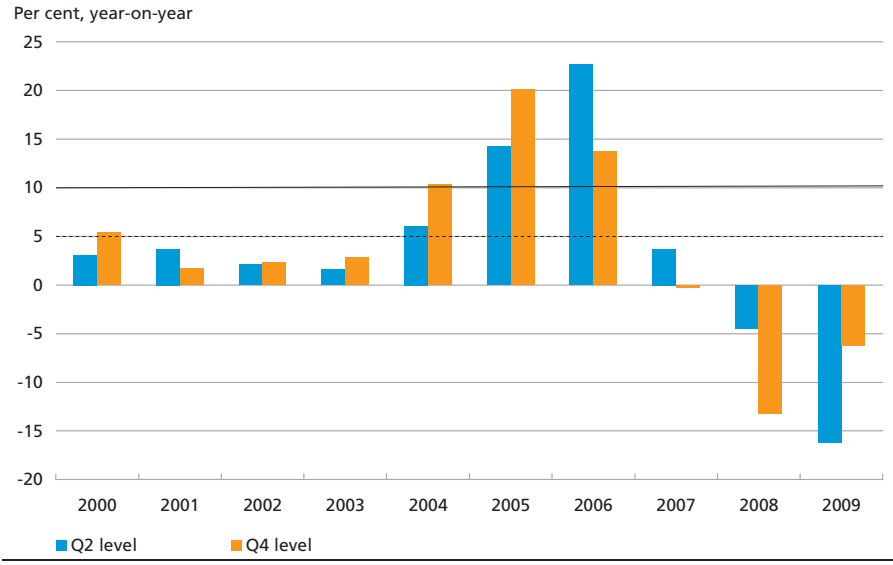
Severe cyclical brake: Here, access to adjustable-rate mortgage loans and/or deferred-amortisation loans is restricted from the present 80 per cent to 40 per cent of the value of the home in the event of real house-price increases of 5 per cent year-on-year, while access will be eliminated if the real price increases exceed 10 per cent year-on-year. Access to fixed-rate loans remains unchanged.

General restriction: In this scenario access to adjustable-rate loans and deferred-amortisation loans is generally restricted to 60 per cent of the value of the home, irrespective of the situation in the housing market. The analysis below assumes that the restriction is introduced as from the 4th quarter of 2003, i.e. at about the same time as the introduction of deferred-amortisation mortgage loans. The restriction does not change the 80 per cent LTV (loan to value) limit for fixed-rate loans.

As previously mentioned, the two former credit restrictions are assumed to be implemented from the end of the calendar year in which the unacceptably high rate of increase in house prices occurs, and it is assumed that they will be eliminated from the end of the calendar year in which the rate of increase in house prices has fallen below the acceptable limits stated. The analysis below allows for the fact that the official house-price indices from Statistics Denmark are published almost six months after the underlying home purchases/sales took place. The decision to change the mortgaging rules as from 1 January in the following year would thus have to be made on the basis of the rate of increase in house prices observed in the 2nd quarter of the preceding year.

Chart 5.2 illustrates the significance of the lag in available house-price information. It shows the observed annual rate of increase in real house prices in the 2nd and 4th quarters of every calendar year in the last decade. It is seen that the annual rate of increase in the real house price exceeded 5 per cent in the 4th quarter of 2000, even though the rate of increase in the 2nd quarter was somewhat below that level. As a consequence of the lag in access to information about house prices, a "cyclical brake" on credit access would not have been activated from 1 January 2001. This can almost be said to be an advantage as the years 2001, 2002 and 2003 were characterised by limited real house-price increases and relatively weak general economic activity throughout most of the period. But in the course of 2004 house-price increases began to escalate. In the 2nd quarter of 2004, the real annual rate of increase was just over 6 per cent, and in the 4th quarter it exceeded 10 per cent. If the latter information had been available at the end of 2004, access to the new loan types should, according to the above rules on "cyclical brakes", have been further restricted as from 1 January 2005 than actually warranted by the information available. From early 2006, when the rate of

RATES OF INCREASE IN THE REAL HOUSE PRICE Chart 5.2



Note: Based on quarterly house-price observations divided by the implied deflator for private consumption. The annual rate of increase is calculated as growth in the 2nd and 4th quarter, respectively, compared with the same quarters in the preceding year. The horizontal lines represent the mild cyclical brake (dashed), and the severe cyclical brake (full) in the model of cyclical credit facilities outlined in the text.

Source: Statistics Denmark.

increase in house prices peaked, the most extensive credit restriction would have been introduced, despite the lag in available house-price statistics, if the above rules on cyclical brakes had been followed.[1]

The potential problems ensuing from the unavoidable time lag in implementing cyclical credit restrictions are best illustrated by experience gained in the period 2006-07. Due to the high rate of increase in house prices observed in the 2nd quarter of 2006, the tight credit restrictions would have been maintained throughout 2007, even if the rate of increase in real prices became negative at the end of 2007. In an ideal world with perfect foresight of house prices, the credit restrictions would, however, have been removed in early 2007 to prevent the downturn in the housing market.

In Table 5.1 and Chart 5.3 we have used the house-price relation estimated in Dam et al. (2011) to simulate the effects of the three above types of credit restrictions while allowing for the lag in available house-price information mentioned. As appears, the two "cyclical brakes" would not have had any significant effect on house prices in 2005, as prices, according to the empirical analysis, react to changes in the finan-

[1] This assumes that the credit restriction introduced as from 1 January 2005 would not have pushed the annual rate of price increase in the 2nd quarter of 2005 below 10 per cent. But if this had been the case then such a strong cyclical brake would probably not have been needed in 2006.

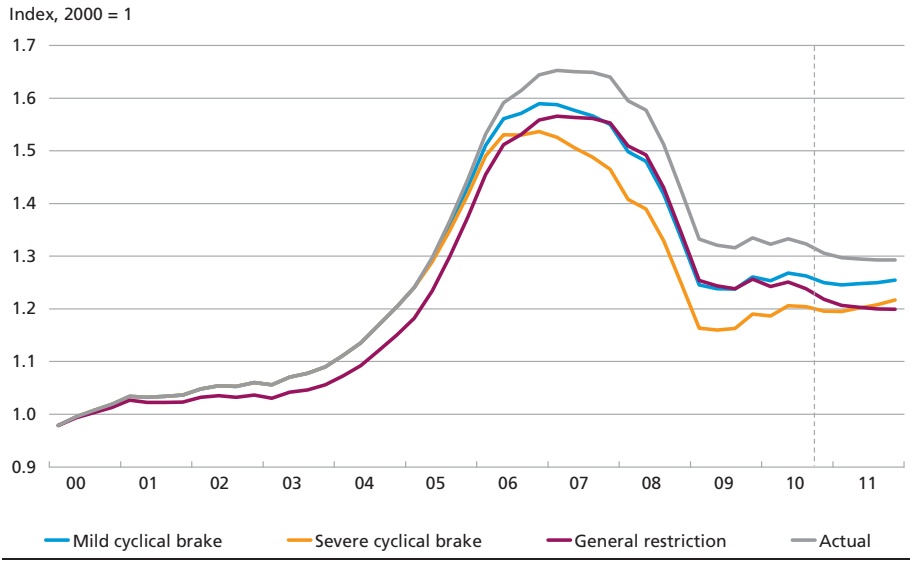
DEVELOPMENT IN THE REAL HOUSE PRICE UNDER DIFFERENT CREDIT RESTRICTIONS — Table 5.1

Percentage deviation from actual development	2005	2007	2009	2011
Mild cyclical brake	-0.5	-4.7	-6.1	-3.5
Severe cyclical brake	-1.0	-9.2	-11.8	-6.9
General restriction	-4.9	-5.3	-5.9	-7.1

Note: Counterfactual scenarios based on estimated house-price relation. The counterfactual scenarios are described in the main text above. The effect of adjustable-rate loans is not introduced until the 1st quarter of 2000. The estimates for 2011 are based on Danmarks Nationalbank's forecast from the 4th quarter.
Source: The MONA data bank and own estimates.

cing conditions with a certain lag. On the other hand, the general credit restriction, which is unrelated to cyclical conditions, would have had a certain (albeit limited) dampening effect on prices in 2005, as we assume it was introduced at the end of 2003 at the same time as deferred-amortisation loans. From 2006 onwards, all three types of credit restrictions (especially the "severe cyclical brake") have clearly dampened house prices. But it is also evident that the three different measures would only have taken the top off the price increases. So even the severe cyclical brake would not have prevented a significant increase in house prices in the middle of the last decade. However, the simulations in Table 5.1 and Chart 5.3 assume that the unexplained house-price "bubble element" during that period would not have been affected by

SIMULATED SCENARIOS FOR THE REAL HOUSE PRICE — Chart 5.3



Note: Counterfactual scenarios based on estimated demand relation. The counterfactual scenarios are described in the main text above. The effect of adjustable-rate loans is not introduced until the 1st quarter of 2000. Observations after the 3rd quarter of 2010 are based on Danmarks Nationalbank's forecast from the 4th quarter.
Source: The MONA data bank and own estimates.

the credit restrictions. In practice, the bubble element would probably have been dampened by the fact that a lower observed rate of price increase would have lowered expectations of large capital gains on housing. Accordingly, Table 5.1 and Chart 5.3 probably underestimate the dampening effect that the credit restrictions would have had on prices.

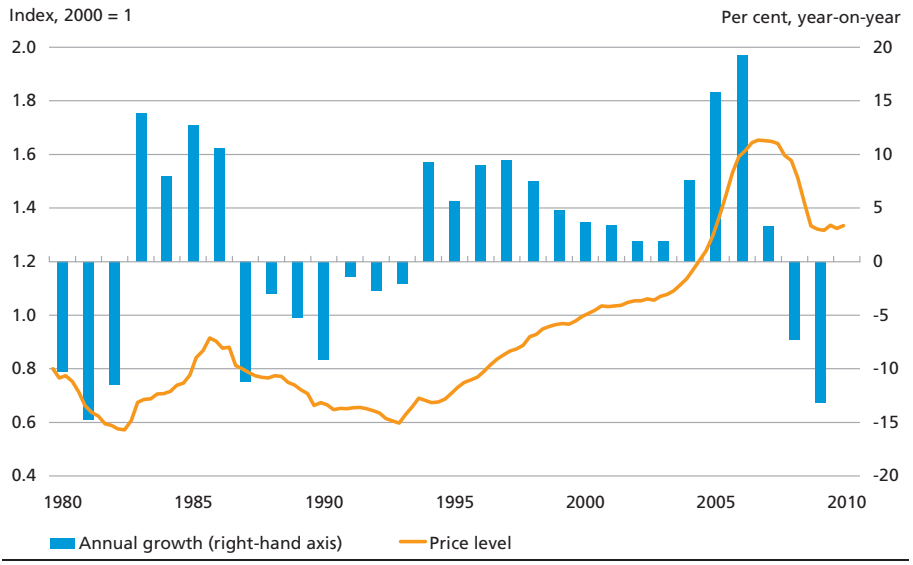
While restrictions on the use of the new loan types might have dampened the upswing in the housing market during the boom years in the middle of the last decade, they would have resulted in lower house prices and thus had a certain dampening effect during the downturn that occurred in the years following the financial crisis. However, our previous analysis in Chart 2.4 clearly indicates that a dampening of the house-price boom in the mid-2000s would have been likely to result in lower unemployment in the coming years due to Denmark's reduced spare production capacity and improved international competitiveness.

As indicated in Chart 5.3, there is an important difference between cyclical and general credit restrictions in as much as the dampening effect a general restriction would have on prices will increase over a number of years, irrespective of the development in the housing market, whereas the dampening effect of a cyclical loan brake will decrease as house prices stabilise. The desire to limit fluctuations in the housing market therefore points to a cyclical rather than a general credit restriction.

However, the two "cyclical brakes" in Table 5.1 are based on very simple rules depending solely on the *change* in house prices, irrespective of their starting level. Such simple rules may be sufficient if they are implemented in a situation where real house prices are not too far from their long-term equilibrium level. If, on the other hand, house prices are far from their long-term equilibrium, this should be taken into account when amending home financing regulations. As shown in Chart 5.4, house prices increased significantly in the period 1994-97, but the starting point was the trough in 1993 following a period of low growth in 1987-93. Against that background, it would hardly have been expedient to tighten the conditions for home financing in the first years after 1993.

This example illustrates the potential risk of simplistic and rigid rules governing cyclical regulation of credit. On the other hand, using a cyclical loan brake which is dependent on the rate of increase in house prices as well as their deviation from the long-term equilibrium level is difficult, as there is considerable uncertainty about the equilibrium level of house prices.

REAL HOUSE PRICE 1980-2010 Chart 5.4



Note: The price of single-family houses divided by the implied deflator for private consumption according to the national accounts.
Source: Statistics Denmark and the MONA data bank.

6. CONCLUSION

The analysis in this article has pointed out that large house-price fluctuations entail significant economic costs. The analysis also shows that fluctuations are amplified by the nominal principle for property value tax under the tax freeze and by the access to deferred-amortisation loans.

Against this background, we have discussed the possibility of stabilising the housing market by changing the rules on property taxation and home financing. Lifting the nominal principle of the tax freeze concerning property value tax would reduce house-price fluctuations, and as an added bonus it would help solve the fiscal-policy sustainability problem. Subject to an appropriate adjustment of the property value tax rate, it would be possible to eliminate the nominal principle without increasing total housing taxation at the time of transition. Re-introducing the principle that property value tax should be based on the most recent property valuation would contribute to more stable development in the housing market and thus in the economy as a whole. In the short term, such a reform would to some extent dampen house prices, but the effect is assessed to be very limited.

Gradually phasing out the use of deferred-amortisation loans would also contribute to reducing long-term fluctuations in the housing mar-

ket. By ensuring the build-up of larger home equity, phasing out deferred-amortisation loans would also reduce the vulnerability of homeowners and thus the economy to unexpected negative shocks to the housing market.

In principle, cyclical restrictions on access to home financing may reduce fluctuations in the housing market, but there is a significant risk that the timing and dosing of such measures will be wrong because of insufficient information about the current situation in the housing market and uncertainty about the long-term equilibrium level for house prices.

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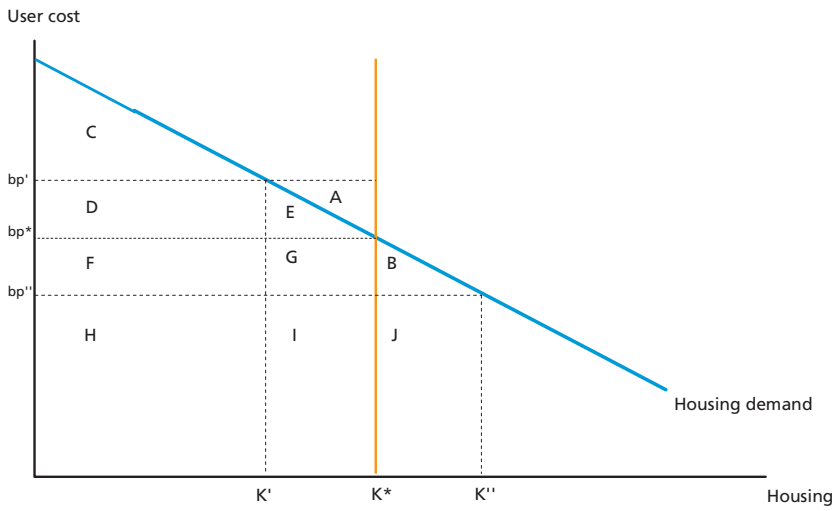
APPENDIX: WELFARE EFFECTS OF HOUSE-PRICE FLUCTUATIONS

This appendix documents the results concerning the welfare effects of house-price fluctuations referred to in the main text.

Chart A1 illustrates how fluctuations in the user cost of owner-occupied housing may inflict a welfare loss on consumers. The premise of the analysis is that large transaction costs may be associated with adjusting housing consumption to a modified user cost (e.g. monetary and psychological costs of moving). The declining curve in the Chart indicates how owner-occupied housing consumption of the representative household is dependent on the user cost in a hypothetical situation where no transaction costs are involved in adjusting housing consumption. For the sake of convenience, the housing demand curve is assumed to be linear, but this should just be seen as a simplified approximation. Each point on the housing demand curve indicates the amount a household is willing to pay to increase housing consumption by one unit (e.g. measured in square metres of a specific quality). Accordingly, the total area under the housing demand curve measures the maximum amount a household would be willing to pay for housing consumption of a specific extent. Chart A1 assumes that the user cost of a home of the quality concerned is bp^* at the time when the household enters the market for owner-occupied housing. So at that time the household chooses a home of size K^*. The area under the housing demand curve to the full vertical line above K^* – i.e. the sum of the areas C, D, E, F, G, H and I – thus indicates the maximum amount the household would pay for housing consumption corresponding to K^*. In comparison, the sum of the areas F, G, H and I – corresponding to the product of bp^* and K^* – indicates the actual economic cost associated

CONSUMER SURPLUS IN CONNECTION WITH OWNER-OCCUPIED HOUSING CONSUMPTION — Chart A1



with housing consumption of this extent. The difference between the two amounts is equivalent to the sum of the areas C, D and E. This quantity is called the consumer surplus and it is used in the theory of welfare economics as a measure of the welfare gains consumers achieve at a specific level of consumption when consumption is optimally adjusted to the current price.

Now assume that the user cost increases to level *bp'* in Chart A1. In the absence of adjustment costs, the household would then choose to reduce its housing consumption to level *K'*, thereby incurring a loss of housing consumption equivalent to the sum of the areas E, G and I, but on the other hand it would save housing costs equivalent to the sum of the areas A, E, G and I. The difference between the two amounts, i.e. the triangular area A, thus constitutes the gain the household would achieve by adjusting its housing consumption to the modified user cost, provided there were no adjustment costs. However, if the adjustment costs exceed an amount equivalent to the triangular area A, it would be better for the household to maintain housing consumption *K** unchanged. Area A would then constitute the welfare loss incurred by the household because it is too expensive to adjust its housing consumption to the modified user cost.

Conversely, if the user cost falls to level *bp"* in Chart A1, the household would want to increase its housing consumption to level *K"* in the absence of adjustment costs. For the household, the value of this additional housing consumption would amount to the sum of areas B and J, while the additional housing cost would only equal area J. The consumer surplus would thus increase by area B, but if the adjustment costs exceed this amount, the household would maintain housing consumption *K** unchanged and thus miss out on the additional consumer surplus B.

Note that this analysis is based on an opportunity cost assumption: If e.g. the user cost increases as a result of a higher house price, a homeowner who has already set up at the lower house price that used to apply, will not experience an increase in direct housing costs. But if housing consumption could be adjusted free of charge, the house-price increase would make it optimal for the homeowner concerned to move to a slightly smaller home and spend the mortgage equity made available on other consumption. The triangular areas A and B measure the welfare loss by not making this type of adjustment to a modified relative price of housing consumption.

Now assume that the real user cost fluctuates around trend level *bp**, and that the associated desired housing is *K** as illustrated in Chart A1. If the actual user cost *bp* deviates from the trend level for a period of time, and if the costs of adjusting housing consumption are sufficiently large, this will result in a welfare loss (*VT*) as seen in the Chart, which can be measured by the triangular area

$$VT = ½ \cdot (bp - bp^*) \cdot (K - K^*), \tag{1}$$

where *K* is the housing the household would prefer, if there were no adjustment costs, i.e. the housing that is reflected in the housing demand curve in Chart A1

next to the user cost *bp*. Given that $\partial K / \partial bp$ indicates the partial derivative of housing demand in terms of the user cost, the welfare loss in (1) can be expressed as follows

$$VT = ½ \cdot (\partial K / \partial bp) \cdot (bp - bp^*)^2. \tag{2}$$

If the welfare loss is compared with the trend value of total owner-occupied housing consumption $bp^* \cdot K^*$, (2) can be converted to

$$\frac{VT}{bp^* \cdot K^*} = \frac{\varepsilon}{2}\left(\frac{bp - bp^*}{bp^*}\right)^2 \approx \frac{\varepsilon}{2}(\ln bp - \ln bp^*), \qquad \varepsilon \equiv -\frac{\partial K}{\partial bp}\frac{bp^*}{K^*}, \tag{3}$$

where ε is the elasticity of owner-occupied housing demand in terms of the user cost, and where ln indicates the natural logarithm function. The average welfare loss per period, expressed as a proportion of private consumption, is shown by the mean value of the expression in (3). Given that $E[\cdot]$ is the mean value operator, the outcome is

$$E\left[\frac{VT}{bp^* \cdot K^*}\right] = \frac{\varepsilon \sigma^2}{2}, \qquad \sigma^2 \equiv E\left[(\ln bp - \ln bp^*)^2\right], \tag{4}$$

where σ^2 is the variance on the logarithm of the real user cost. The real user cost can be expressed as follows

$$bp = p^h \cdot u, \quad u \equiv r(1-t) - \pi + s + d - \pi^h. \tag{5}$$

In (5) p^h indicates the real house price, while *u* is the normalised real user cost consisting of the nominal interest after tax, $r \cdot (1-t)$, less the expected consumer price inflation, π, and the expected rate of increase in the real house price, π^h, plus the rate of depreciation *d* and housing-related taxes *s*, which are both calculated per krone of housing capital. Using the definition in the first equation in (5) and the definition of the variance on the real user cost, the average welfare loss in (4) can be expressed as follows

$$E\left[\frac{VT}{bp^* \cdot K^*}\right] = \frac{\varepsilon}{2}\left[\sigma_p^2 + \sigma_u^2 + 2\,\mathrm{cov}(\ln p^h, \ln u)\right]. \tag{6}$$

The quantity σ_p^2 is the variance on the logarithm of the real house price, σ_u^2 is the variance on the logarithm of the normalised real user cost, and $\mathrm{cov}(\ln p^h, \ln u)$ is the covariance between those two variables. All other things being equal, larger house-price fluctuations will therefore result in a larger loss of welfare. If house-price increases are primarily triggered by a fall in the interest rate, while decreasing house prices are mainly caused by interest-rate increases – i.e. if the covariance $\mathrm{cov}(\ln p^h, \ln u)$ in (6) is negative – the house-price fluctuations will prevent the user-cost fluctuations on owner-occupied housing stemming from interest rate movements, thereby reducing the welfare loss for

homeowners. On the other hand, house-price increases may occur mainly in periods of economic boom where real interest rates are also rising due to increasing demand for credit and/or monetary-policy tightening. Similarly, house prices may fall mainly during downturns during which interest rates will also tend to fall. In that case, house-price fluctuations will amplify the fluctuations in the user cost caused by interest rate movements, thereby increasing the welfare loss caused by fluctuations in the house price. This appears from the fact that a positive value of the covariance $\text{cov}\left(\ln p^h, \ln u\right)$ has a positive impact on the welfare loss in (6).

Equation (6) may be used to provide a quantitative estimate of homeowners' maximum average welfare loss as a result of fluctuations in real house prices. Using the Danish annual data from the ADAM data bank, the following is found for the period 1955-2009 (given that the mean value of the logarithm of the real house price is assumed to follow a linearly increasing trend):

$$\sigma_p^2 = 0.0338, \qquad \sigma_u^2 = 0.0343, \qquad \text{cov}\left(\ln p^h, \ln u\right) = -0.0145.$$

If, based on the discussion in Box 5.2 in Dam et al. (2011), the price elasticity ε is set at 1,[1] inserting those figures in (6) shows that historical house-price fluctuations have caused an average annual welfare loss of just under 2 per cent of the value of owner-occupied housing consumption. According to the national accounts, the imputed value of owner-occupied housing consumption amounted to kr. 127.5 billion in 2009. The average annual welfare loss can then be estimated at about kr. 2.5 billion in 2009 prices. This estimate is on the high side, however, given the assumption in (6) that consumers do not adjust their housing consumption to fluctuations in the user cost. Consumers for whom the area of the "welfare triangles" A and B in Chart A1 exceeds the adjustment costs, will in fact choose to adjust their housing consumption. For such consumers, the welfare loss in connection with fluctuations in the user cost will be given by the adjustment costs, which will be smaller than the measure of welfare stated in (6).

[1] Dam et al. (2011) argue that the uncompensated numerical price elasticity in housing demand is probably less than 1. But according to welfare economic theory, the consumer surplus should be calculated on the basis of the *compensated* price elasticity which exceeds the uncompensated elasticity due to the income effect of a price change. This is why we use an estimated numerical price elasticity of 1 here.