Adjustable-Rate Mortgages

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INTRODUCTION AND MAIN CONCLUSIONS

Traditionally, Danish mortgage-credit institutes have offered fixed-rate loans with a maturity of up to 30 years. However, in recent years "adjustable-rate mortgages" for which the rate of interest is not fixed, but is wholly or partly adjusted on an annual or biannual basis, have gained considerable ground. This poses two major questions to Danmarks Nationalbank. Has the impact of monetary-policy measures changed? Does this development affect financial stability?

The first question is probably the easiest to answer. The widespread use of these loans has most likely strengthened the impact of monetary policy on economic activity, since more households than before will see a change in their interest costs when the official interest rate is changed.

The answer to the second question is not as clear. Fundamentally, adjustable-rate mortgages have a different and more complex risk profile than traditional fixed-rate mortgage-credit loans. Borrowers should consult their advisors to weigh the certain immediate savings against the risk of higher future payments and a reduced non-mortgaged value of their property in the event of future increases in interest rates. If interest rates fluctuate as they did in the 1990s, the consequences in terms of payments and non-mortgaged value could be significant. This will not constitute a major problem for households with net worth or ample budgets, whereas the risk of facing financial problems is greater for households with tight liquidity. When used prudently, taking the risk exposure into account, adjustable-rate mortgages will not affect financial stability significantly, but there is a risk associated with this type of loan if it is merely seen as a cheaper source of finance and is combined with a tight budget.

MORTGAGE-CREDIT LOANS

Since the mid-19th century it has been the tradition in Denmark to finance the purchase and construction of real property via mortgage-credit loans. The legislative framework has been amended several times for many different reasons beyond the scope of this article. However, one centrepiece has always been adhered to. Mortgage-credit institutes grant loans against collateral in real property by selling bonds in financial markets. The borrower receives the proceeds from the bonds that are sold. The effective rate of interest on the loan is thus the same for the borrower and the bond owner. The institute runs no immediate market risk regarding the trend in interest rates, since the borrowers' instalments and interest payments to the institute correspond exactly to the institute's payments to the bond owners. In addition, the borrowers pay an administration fee to the institute.

Since the loan is granted against collateral in real property within certain statutory limits, the credit risk incurred by the institute is very modest, provided that the valuations of the mortgaged properties are realistic. If the borrower does not service the debt, the institute may effect an enforced sale of the property, according to a fixed procedure. The institute will only suffer a loss if the value of the property is below the value of the collateral.

The absence of any immediate market risk and the moderate credit risk make mortgage-credit bonds a very safe investment.

This is reflected in the fact that the yield on mortgage-credit bonds is only a little higher than the yield on government bonds. From the bond owner's point of view the greatest risk associated with traditional fixed-rate mortgage-credit bonds is that they are callable, since the borrower is usually entitled to redeem the loan at par. If the general level of interest rates falls, it can be an advantage for the borrower to redeem the old loan and raise a new one at a lower interest rate. Mortgage-credit bonds at a price close to par are therefore unlikely to rise in price, even if the general level of interest rates is falling, since the borrower can always redeem at par. A key reason that the yield on mortgage-credit bonds is higher than the yield on government bonds is that the latter are not callable.

Adjustable-rate mortgages were introduced in Denmark in the late 1990s. They are loans with a maturity of up to 30 years for which the interest rate is adjusted to match the prevailing market interest rate at fixed intervals, e.g. once a year for the following calendar year, and is often based on auctions of the underlying bonds in December. There are variants where e.g. the interest on one fifth of the loan is adjusted every year on the basis of a rolling 5-year loan, and there are products with biannual adjustment and an interest-rate cap for a certain period. A major difference from the traditional mortgage-credit loans is that the bonds are not callable, but can only be redeemed at par at the time of adjustment. Since the loans are still based on sale of the underlying bonds, the mortgage-credit institute does not run any immediate market risk in relation to the adjustable-rate mortgages, and the credit risk is still related to whether the value of the outstanding debt exceeds the value of the property. The demand for such a loan for a long-term investment like an owner-occupied property is most likely related to how in recent years the 1-year interest rate has been lower than the 30-year rate. There is no doubt either of the role played by the fact that the socio-economic conditions are generally deemed to be stable. The principle is that the borrower has to make a somewhat different assessment of expected future interest expenditure and the associated risk compared to traditional loans. The suite of products has thus been expanded for both borrowers and bond owners, entailing a risk exposure different from the traditional fixed-rate mortgage-credit loans and bonds.

STATISTICS

By far the majority of loans to Danish households are mortgage-credit loans, but mortgage credit is also an important source of financing for non-financial companies, cf. Table 1.

At end-March 2002 private individuals' mortgage debt was more than four times as high as their bank debt. More than 60 per cent of total mortgage-credit lending is to private households.

As mentioned previously, mortgage-credit loans were granted at a fixed interest rate throughout the term of the loan until the late 1990s,

DOMESTIC LENDING BY BANKS AND MORTGAGE-CREDIT INSTITUTES BY BORROWER, END OF PERIOD — Table 1

Kr. billion	Households			Non-financial companies	Others	Total
	Private individuals	Self-employed	Total			
Mortgage-credit institutes						
1995	...	...	561.7	205.8	32.8	800.3
2000	662.3	161.1	823.5	225.6	46.8	1,095.9
2001	727.5	173.0	900.5	246.8	44.5	1,191.8
2002 Mar...	739.6	176.3	915.9	251.0	44.1	1,211.0
Banks						
1995	...	...	159.0	84.5	111.4	354.9
2000	171.3	64.6	235.9	186.3	220.8	643.0
2001	175.6	74.1	249.7	228.8	221.9	700.4
2002 Mar...	173.2	74.8	248.0	235.5	229.3	712.8

Note: The Table does not include lending by foreign units of the institutions or loans from other sources of financing. However, by far the majority of the borrowing of private individuals' and the self-employed is covered by the Table.

Source: Danmarks Nationalbank.

DOMESTIC LENDING BY THE MORTGAGE-CREDIT INSTITUTES BY LOAN TYPES, END OF PERIOD

Table 2

Kr. billion	Adjustable-rate mortgages					Other nominal loans	Index-linked loans	Total
	Up to 1 year		More than 1 year					
	Kroner	Foreign exchange	Kroner	Foreign exchange	Total			
1999	36.4[1]	7.1[1]	13.9[1]	2.3[1]	59.7	877.5	113.7	1,050.9
2000	67.8	11.2	17.1	3.7	99.8	882.5	113.1	1,095.4
2001	118.5	33.0	67.9	19.6	239.0	843.2	109.6	1,191.8
2002 Mar.	127.0	39.2	86.6	29.0	281.8	819.6	109.6	1,211.0

Note: Adjustable-rate mortgages up to 1 year are loans which are subject to interest-rate adjustment within the next year, irrespective of their original maturity.

Source: Danmarks Nationalbank.

1 The distribution is partly an estimate.

apart from index-linked loans, which formerly were the main source of financing of subsidised housing. Fixed-rate loans still dominate, but adjustable-rate mortgages have gained so much ground in recent years that the volume of traditional fixed-rate loans has fallen not only in relative, but also in absolute terms, despite the considerable growth in total lending by the mortgage-credit institutes, cf. Table 2.

At end-March 2002 adjustable-rate mortgages totalled approximately kr. 282 billion, of which kr. 68 billion denominated in foreign exchange, mainly euro. Adjustable-rate mortgages thus accounted for more than 25 per cent of the nominal mortgage-credit loans. Most adjustable-rate mortgages are subject to annual or biannual interest-rate adjustment, but during 2001 and the first months of 2002 adjustment less frequently than annually became more widespread, so that more than 40 per cent of the adjustable-rate mortgages are now of this type. This applies to both krone-denominated and euro-denominated loans.

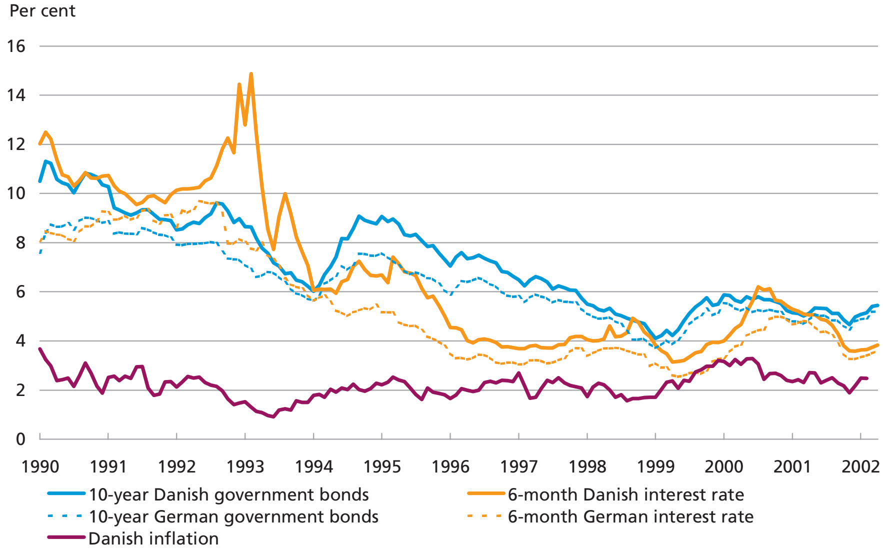
SHORT-TERM AND LONG-TERM INTEREST RATES

The increasing popularity of adjustable-rate mortgages is undoubtedly due to several factors, cf. the section on the risk exposure for loans at fixed and variable interest rates. This is a new product which must find its natural level. Marketing has concentrated on lower mortgage payments than for traditional fixed-rate loans, and the potential savings compared with loans from other sources than mortgage credit.

As Chart 1 shows, short-term interest rates are generally lower than long-term interest rates, but the Chart also shows that this is not a law of nature. Since 1990 inflation has constantly been fairly close to 2 per cent, while the 6-month interest rate has fluctuated between 3.1 per

SHORT-TERM AND LONG-TERM INTEREST RATES IN DENMARK AND GERMANY

Chart 1

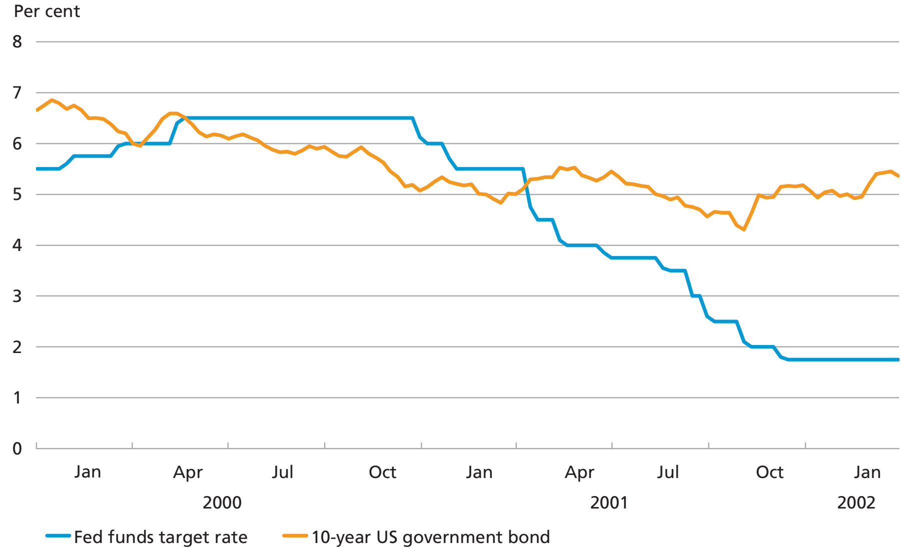


Source: Statistics Denmark and Danmarks Nationalbank.

cent and 14.9 per cent, with an average of 6.7 per cent, and the 10-year interest rate has fluctuated between 4.1 per cent and 11.3 per cent, with an average of 7.2 per cent. Since 1994 the average 6-month interest rate has, however, been 1.5 per cent lower than the average 10-year interest rate. It is evident that it is difficult to endorse a normal level of the spread between short-term and long-term interest rates. Such a spread depends on the global economic climate and whether there has been a particular need to adjust short-term interest rates in Denmark, e.g. in connection with unrest in the foreign-exchange markets. However, the experiences from the early 1990s should be applied to the decision between fixed-rate and adjustable-rate mortgages. No-one can rule out that situations that in some respects are similar could occur in the future. At the same time it is obvious that short-term and long-term interest rates do not always take the same course.

The central bank determines the very short-term interest rate. In Denmark and the euro area member states this means the rate of interest on loans to banks with a maturity of 14 days, and in other countries the rate of interest on equivalent overnight loans. The other interest rates are determined by supply and demand, but especially for shorter maturities the rates are strongly influenced by expectations of the central bank's future measures. If the central bank's 14-day interest rate is expected to be the same in two weeks as it is today, the 1-month inter-

US INTEREST RATES Chart 2



Source: Danmarks Nationalbank.

est rate today will tend to be identical to the 14-day rate. The longer the maturity, the weaker the correlation with the central bank's rate. An illustrative example of a weak correlation between short-term and long-term interest rates is recent years' development in US rates. The 10-year US interest rate was almost constant throughout 2001, despite the substantial lowering of the fed funds target rate from 6.50 to 1.75 per cent in the course of the year, cf. Chart 2.

ADJUSTABLE-RATE MORTGAGES AND THE IMPACT OF MONETARY POLICY

In theory, monetary policy affects the economy by influencing consumers' choice between present and future consumption, as well as companies' investment decisions. The higher the interest rates, the greater the incentive to increase savings, all other things being equal, and the higher the required return on investments, again leading to fewer investments. These conditions are not materially influenced by the prevalence of various loan types. The distribution of loans by maturity and by fixed and adjustable rates will reflect the interaction between the preferences of borrowers and lenders at the time in question.

In practice it is of importance that the interest payments of households and companies are influenced by the level of interest rates. The disposable income of borrowers with loans at adjustable interest rates is reduced if interest rates go up, while that of lenders, in this case the bond owners, increases. However, only a limited proportion of the bonds are owned directly by households since many investors are financial institutions or non-residents. The immediate loss of income to a household with a loan at an adjustable interest rate when interest rates increase will therefore not be directly matched by a corresponding increase in income for other households. In addition, the same change in the disposable incomes of borrowers and creditors may still influence overall consumption, since the liquidity of many consumers will be constrained. Higher interest rates give a squeeze on liquidity, and in that case borrowers will consume less. Therefore overall consumption may be reduced if creditors determine their consumption on the basis of long-term assessments of income and net worth.

These factors point to a direct income channel from changes in interest rates, which increases in significance the more popular loans at wholly or partly adjustable interest rates become. Monetary-policy measures have probably gained a greater impact on economic activity as a consequence of the increasing use of adjustable-rate mortgages.

In recent years, where adjustable-rate mortgages have become far more widespread than previously, real property prices have increased more strongly than expected from the housing-market models hitherto applied. This has led to consideration of whether the lower first-year payment for homes financed via adjustable-rate mortgages has pushed up prices. Adjustable-rate mortgages increase the probability of home buyers incurring higher financial risk than is the case with fixed-rate loans, since the counterpart of the lower first-year payment is uncertainty concerning e.g. the future payments on the loan, with a risk of significantly higher future payments if the interest rate increases significantly.

It is likely that this opportunity has boosted demand for homes that would be too expensive if financed via traditional fixed-rate loans. If so, this will lead to a certain increase in house prices. However, the models of the housing market are relatively complex, so that the price increases can also be due to other factors than adjustable-rate mortgages, e.g. a stronger sense of job security as a consequence of the very low unemployment in recent years. Irrespective of the possible impact on property prices it is the case that private consumption has increased less in the same period than the trend for incomes and net worth would justify. All in all, there is thus no sign that the wealth channel has become stronger in recent years.

In conclusion, the more widespread use of adjustable-rate mortgages entails that the financial structure in Denmark resembles the structure of the euro area more than before and that via the income channel the official Danish interest rates affect activity more than previously.

ADJUSTABLE-RATE MORTGAGES AND CAPITAL FLOWS

As Table 2 shows, at end-2001 adjustable-rate mortgages raised in foreign currency, in practice euro, totalled kr. 53 billion, against kr. 15 billion one year earlier. Virtually no traditional fixed-rate loans are euro-denominated. In the first quarter of 2002 the volume of adjustable-rate mortgages denominated in foreign exchange increased by a further kr. 15 billion.

Viewed in isolation, the issue of euro-denominated mortgage-credit loans entails a corresponding import of capital. However, "all other things being equal" is not likely to apply in this case. Not only resident borrowers, but also resident investors are becoming more international. The issue of euro-denominated mortgage-credit loans will only lead to net capital imports where the increased volume of euro-denominated adjustable-rate mortgages is held by non-resident investors. Compared to other capital movements arising from the increasing internationalisation, the numbers related to euro-denominated adjustable-rate mortgages may be considerable, but not larger than capital movements from so many other sources, e.g. the increasing placement of pension funds in foreign assets, non-residents' purchases of krone-denominated bonds, as well as corporate acquisitions and other direct investments. Such underlying capital movements may draw the exchange rate away from the central rate vis-à-vis the euro, and thereby initially lead to fluctuations in the foreign-exchange reserve and then in the spread to the ECB's interest rates. These capital movements are in addition affected by the size of the relevant interest-rate spread.

The option to convert adjustable-rate bonds to and from euro must generally be expected to entail stabilising "speculation".

Firstly, it is relevant to include the position of the krone in relation to its central parity vis-à-vis the euro. If the krone is stronger than the central parity, a future movement in the direction of the parity will mean that more kroner are needed when the loan is to be repaid than when it was raised.

Secondly, the interest-rate spread is of significance. If the spread is narrow, the interest saving from holding adjustable-rate mortgages denominated in euro will be more modest than if the interest-rate spread is wide. If there are signs of currency unrest, and Danmarks Nationalbank raises its official interest rates, borrowers will be able to avoid the higher interest-rate spread by converting the loans to euro, which of course requires an overall economic policy where borrowers' confidence in the fixed-exchange-rate policy is unabated. As stated above, the conversion may result in a net capital import and thereby contribute to stabilising the foreign-exchange market.

RISK EXPOSURES IN CONNECTION WITH FIXED AND VARIABLE INTEREST RATES

The following assesses some of the principles to be considered when choosing between home financing at fixed and adjustable interest rates, more or less irrespective of the current situation with low long-term interest rates and extremely low short-term interest rates. These issues will be included in the subsequent calculations and assessments.

Higher inflation

In theory, inflation is the dominant factor behind major interest-rate fluctuations. The higher the rate of inflation, the higher the rate of interest. However, this is a long-term correlation that may explain why interest rates in the 1990s were on average far lower than in the 1970s and to some extent the 1980s. Since the authorities attach so much importance to low inflation, a return to the inflation rates of former times is hardly likely, but in principle this risk should be taken into account when choosing between financing at fixed or adjustable interest rates.

A permanent increase in inflation will be accompanied by a generally equivalent increase in interest rates. This will make financing at adjustable interest rates far more expensive than financing at the present long-term rate. However, in the event of sustained higher inflation wages will also rise, so that for the workforce the risk related to financing at adjustable interest rates in the event of higher inflation mainly relates to how the payment on the loan will immediately increase significantly more than wages. Furthermore they cannot achieve the "debtor gain" of fixed-rate borrowers in that situation. This gain is partly a result of the decrease in the market value of the outstanding fixed-rate debt, and partly due to the fact that the nominal payment on the loan is fixed, while incomes tend to follow the general course of inflation. Consequently the real payment over time is lower than expected at the time that the loan was raised.

The retired and those approaching retirement age run a greater risk than the workforce with regard to financing at adjustable interest rates, since they do not have the same expectation that their income will increase with rising inflation over time. This will depend on the terms of individual pension schemes. Higher inflation and loans at adjustable interest rates would therefore pose not merely a nominal, but also a real risk for many pensioners and near-pensioners. Needless to say, the risk increases with the size of the loan, but even for smaller loans for e.g. housing improvements it is in principle relevant to consider the issue of whether future income is fixed in nominal terms when choosing the type of loan.

Sustained low inflation

As stated above, there is no prospect of a return to the inflationary society of the 1970s. The last 20 years have shown, not only in Denmark, but also globally, that the citizens of a country can reap large welfare benefits from generally stable prices[1]. This is a major consideration in the economic policies of all well-organised societies. Consequently, the risk of higher inflation and thereby higher interest rates may be relevant in principle, but hardly the most important issue to consider in relation to the risk exposure entailed by various types of financing.

If we solely consider the experience from the low-inflation years after 1990, it is evident that there are no clear laws of nature for the fluctuations in the short-term and long-term interest rates, cf. Charts 1 and 2. The rate of interest and the relationship between short-term and long-term interest rates depend on the trends of the economy, including external factors. It is thus problematic to take only interest-rate trends in very recent years into account when weighing the two loan types against each other. Anyone buying a home or otherwise raising or converting a large mortgage-credit loan should assess the impact on the household's finances if interest rates rise significantly above the current level for some years. The result of such a stress test should be taken into account on choosing a financing scheme.

In principle, the risk exposures for fixed and adjustable interest rates differ considerably. A survey of these issues becomes rather technical, but since this is a choice made by many households every day, it must be emphasised that although the issues may be technical, they are nevertheless of significant practical relevance for anyone making such a choice. Two main aspects should be considered: how are annual payments affected by changes in interest rates, and how is the non-mortgaged value affected? More indirect effects in terms of the impact on activity and employment of changes in interest rates will generally not be included in the following.

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[1] This is considered in Erik Haller Pedersen and Tom Wagener, Macroeconomic Costs and Benefits of Price Stability, Danmarks Nationalbank, *Monetary Review,* 3rd Quarter 2000.

If *only short-term interest rates rise,* the interest expenditure on an adjustable-rate mortgage will increase in the subsequent period. However, the payment on an annuity loan will increase less than the interest expenditure, since the instalments will fall immediately. The precise increase in the payment will depend on the actual composition of the loan, including whether it is adjusted annually or biannually, and whether its maturity is fixed. Naturally, the interest expenditure on an existing fixed-rate loan will not change. If the short-term interest rate influences property prices, the non-mortgaged value of the property will fall, regardless of the choice of financing scheme.

If *only long-term interest rates rise,* the payments on both fixed-rate and adjustable-rate loans will be unchanged. The non-mortgaged value of the property will remain roughly constant for borrowers with fixed-rate loans, since the property value and the market price of the outstanding debt will fall at more or less the same rate. Borrowers with adjustable-rate mortgages will see a decline in the non-mortgaged value, since the market value of the outstanding debt is virtually unaffected, whereas the property value will fall.

If *only short-term interest rates fall,* the interest expenditure on an adjustable-rate mortgage will fall in the subsequent period. The development in the payment will be the reverse of that described above if only short-term interest rates rise. The same will apply to the non-mortgaged value, irrespective of the choice of loan type. The payment on fixed-rate loans will remain unchanged.

If *only long-term interest rates fall*, the payment will remain unchanged for borrowers with adjustable-rate mortgages, while borrowers with fixed-rate loans will have the option of converting to a lower interest rate and thus a lower payment, depending on how much interest rates fall. Borrowers with adjustable-rate mortgages will benefit from a higher non-mortgaged value, as the price of the property will rise, while the market value of the loan will remain unchanged, and they will be able to convert to a fixed-rate loan at the new long-term interest rate, which may now be close to the previously applying variable rate. The market value of a fixed-rate loan will rise if the loan cannot be converted in the near future, while it will be unchanged if the conversion option is available. Consequently, the non-mortgaged value for borrowers with fixed-rate loans will either remain unchanged or rise.

In summary, the above brief outline shows that borrowers with adjustable-rate mortgages are more exposed to a risk of a change in their financial status if interest rates change than those with fixed-rate loans. This is evident with regard to changes in short-term rates, but those opting for adjustable-rate mortgages are also affected by changes in long-term interest rates via the non-mortgaged value of their property. In return for the greater uncertainty of future economic conditions, borrowers with adjustable-rate mortgages have generally obtained immediately less expensive financing, since the payment after tax has been lower than for fixed-rate loans, even though the instalments have been slightly higher.

There is no ready answer to the question of how best to weigh a present saving against future risks. This will depend on the financial circumstances of the individual household, including whether liquidity is tight or not. If part of the saving obtained by choosing adjustable-rate mortgages are used to increase instalments, e.g. via a shorter maturity, this may be a sound strategy, even if interest rates rise considerably for some years, since there will be capital reserves to break into. Likewise it must be regarded as unproblematic if the adjustable-rate mortgages replace loans at a higher variable rate from other sources. However, the review also shows that extensive use of adjustable-rate mortgages can present problems for households whose liquidity is so tight that it is difficult to manage the higher payment resulting from an interest-rate increase of just a few per cent or to manage a reduction of the property's non-mortgaged value.

A negative non-mortgaged value is particularly a problem to homeowners wishing to sell. In that case the owner will need to have other assets or to borrow in order to redeem the mortgage debt. A large number of homeowners with negative non-mortgaged value can therefore impede mobility within society.

The review shows that no clear advice can be given with regard to the choice of financing scheme. Various immediate payments and future risks must be considered. It is appropriate that households opting for adjustable-rate mortgages are able to manage a few years with an interest-rate level as in the first part of the 1990s, when inflation was also low. This is not to say that this will occur, but there is a risk that it might occur if, for some as yet unknown reason, interest rates come under pressure. The current level of interest rates must be deemed to be so low that the risk exposure is not symmetrical. The risk that global, and viewed in a narrower perspective, European, interest rates will rise is greater than the probability that they will fall. If European interest rates go up, Danish rates will follow suit.

SENSITIVITY ANALYSES

To give the above theoretical observations a more specific content the following presents calculations of how the annual payment and the

OWNER-OCCUPIED HOME USED IN THE CALCULATIONS Box

The starting point is the purchase of an owner-occupied home of 180 sq.m. in municipal category 4[1]. In 2001 the price per square metre for such a house was approximately kr. 8,500.[2] The market value of the house is therefore set at kr. 1.5 million in the calculations. The non-mortgaged value is assumed to be 20 per cent of the market value, i.e. kr. 300,000. Neither whether this amount is financed from other sources nor the loan terms are taken into account. The interest rate at the time of purchase is assumed to be 6 per cent for a 30-year fixed-rate bond loan and 4 per cent for a 30-year adjustable-rate mortgage with annual interest-rate adjustment. At these interest rates the net average monthly payment for an annuity loan (after tax deduction of interest payments) in the first year is kr. 5,245 for 100 per cent fixed-rate financing, and kr. 4,429 for the adjustable-rate mortgage[3].

[1] Comprising Odense, Esbjerg, Kolding, Randers, Århus and Aalborg.
[2] Cf. www.realkreditraadet.dk.
[3] The actual payment series are calculated, cf. Annex 1. The net payment increases over the term of the loan as a result of the falling interest element and thus the lower rate of interest deductibility over time. The sensitivity analyses therefore only take into account the changes in the average payment in the first year. The calculations do not take account of other loan costs (e.g. administration fees) than actual financing costs.

non-mortgaged value of a property will be affected by rising interest rates if a home is fully or partly financed with loans subject to annual interest-rate adjustment up to the statutory limit of 80 per cent of the market value. This is a kind of stress test. What will happen if interest rates rise and the home is financed in a given way? Thus, this is not a prognosis for the future development, but rather an attempt to visualise the risks to which homeowners with adjustable-rate mortgages can be exposed if interest rates go up, without assessing how likely this is, or taking into account how many households the calculations in such case would affect.

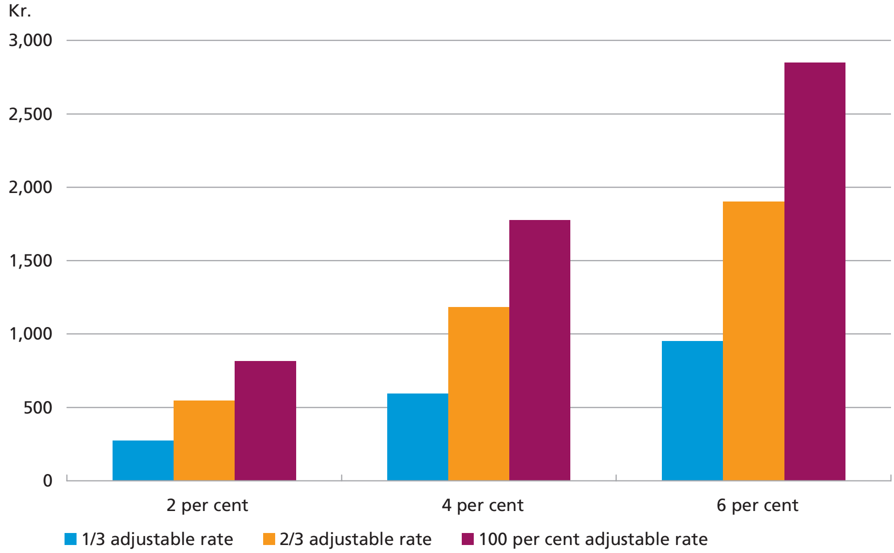
The calculations are carried out for a homeowner with negative net capital income with a rate of interest deductibility of 32.5 per cent.[1] The non-mortgaged value and the payment after tax in connection with rising interest rates are calculated for various degrees of financing with adjustable-rate mortgages.

Homeowners with adjustable-rate mortgages have in many cases exploited the current lower interest rates for adjustable-rate mortgages to pay higher instalments than the minimum requirements for 30-year annuity loans. Adjustable-rate mortgages can, as stated, also replace loans at variable interest rates with a higher rate and the same maturity. These factors are not taken into account in the analyses below.

[1] See Kristian Kjeldsen and Erik Haller Pedersen, Taxation of Asset Income and the Financial Markets, Danmarks Nationalbank, *Monetary Review*, 1st Quarter 2002.

INCREASE IN MONTHLY PAYMENT ON AN INCREASE IN INTEREST RATES BY 2, 4 AND 6 PER CENT

Chart 3



Note: The payment on a fixed-rate loan is unchanged on an increase in interest rates and is therefore not included. The assumptions are stated in the Box.

Source: Own calculations.

Effect on net payments

By choosing a fixed-rate loan the homeowner knows what the financing costs are throughout the term of the loan.[1] In other words, a homeowner taking out a 30-year fixed-rate loan knows what the monthly costs of servicing the loan will be for all 30 years. In contrast, the payment on a adjustable-rate mortgage varies with the interest rate. The level of interest rates has fluctuated considerably over the past 10 years, but naturally this cannot be seen as an indication that the same will be the case in the years to come.

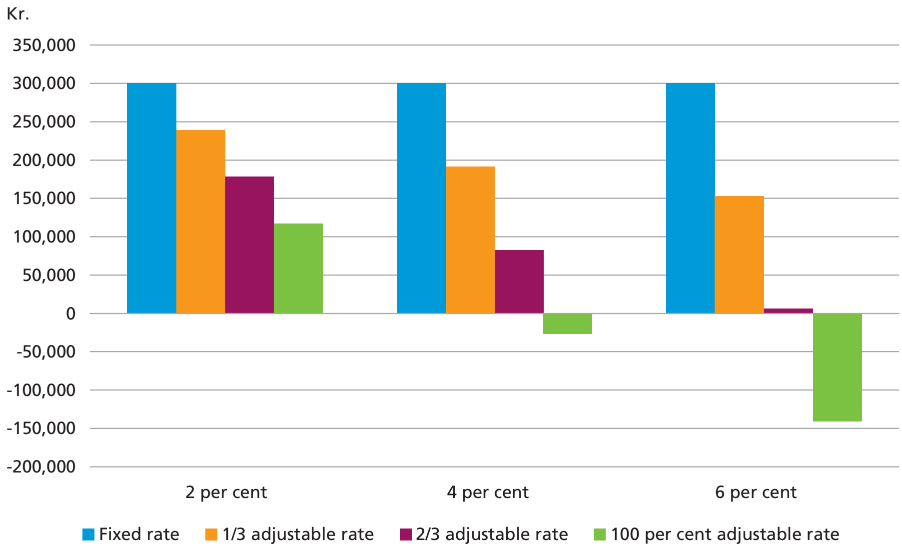
Chart 3 shows the changes in the net payment (after tax) when interest rates go up by 2, 4 or 6 per cent for various degrees of financing with adjustable-rate mortgages. As stated, the payment on a fixed-rate loan is not affected by rising interest rates.[2]

The Chart shows that an increase in interest rates by 2 per cent means a net payment of approximately kr. 800 more per month when all of the debt is financed at an adjustable rate. With an increase of 4 per cent, the net payment per month is approximately kr. 1,700 higher.

1 The option to remortgage when interest rates are falling is disregarded here. With a fixed-rate loan the homeowner is protected from higher financing costs in connection with rising interest rates, but may choose to remortgage if interest rates fall significantly.

2 The increases selected may seem high, but the resulting interest-rate levels are within the range seen in the 1990s.

NON-MORTGAGED VALUE ON AN INTEREST-RATE INCREASE
BY 2, 4 AND 6 PER CENT
Chart 4



Note: The assumptions are stated in the Box.
Source: Own calculations.

Effect on non-mortgaged value

Higher interest rates may lead to a decrease in house prices by two channels. Directly, as a result of the increased costs of financing house purchases, and indirectly, via dampened economic activity.

In the sensitivity analyses the direct effect on the non-mortgaged value of an increase in interest rates is calculated for a price drop corresponding to the decrease in the present value of the payments on the fixed-rate loan. It is thus assumed that the short-term rate increases *pari passu* with the long-term rate. The present value of the net payments will fall as a result of the higher discount rate. Any indirect effects are disregarded. It should be noted that the actual development in house prices in connection with an increase in interest rates does not necessarily reflect the decline in the present value of the payments.

As Chart 4 shows, the non-mortgaged value of an owner-occupied home financed exclusively via fixed-rate loans is maintained when interest rates increase. For an owner-occupied home financed exclusively via adjustable-rate mortgages the non-mortgaged value falls from kr. 300,000 to just over kr. 100,000 if interest rates rise by 2 per cent. If the rise is by 4 per cent, the non-mortgaged value becomes marginally negative.

Chart 4 shows that the non-mortgaged value is highly sensitive to rising interest rates. This is due to the gearing of newly-acquired owner-occupied homes, where the non-mortgaged value (the "equity") is considerably lower than the debt. When gearing is high, relatively small interest-rate fluctuations will lead to large fluctuations in the non-mortgaged value. With fixed-rate financing the homeowner is more or less protected from this loss of wealth.

Summary

Adjustable-rate mortgages constitute an expansion of the range of mortgage-credit products. This loan type has rapidly become very popular, as since the time of its introduction the first-year payment has generally been lower than for fixed-rate loans.

The extensive use of this type of loan has probably strengthened the impact of monetary policy, since more households than before will now be affected when the official interest rate is changed.

Adjustable-rate mortgages also have a fundamentally different and more complex risk profile than traditional fixed-rate mortgage-credit loans. Borrowers must consult their advisors to weigh the certain immediate savings against the risk of higher future payments and a reduced non-mortgaged value in the event of future increases in interest rates. If interest rates fluctuate as they did in the 1990s, the consequences in terms of payments and non-mortgaged value could be significant. This would not constitute a major problem for households with wealth or ample budgets, whereas the risk of facing financial problems is greater for households with tight liquidity, as the examples show. Many borrowers have been aware of these circumstances and have opted for loans will less frequent adjustment of interest rates. When used prudently, taking the risk exposure into account, adjustable-rate mortgages will not affect financial stability significantly, but there is a risk associated with loans of this type if they are merely seen as a cheaper type of loan than fixed-rate loans and are used in combination with a tight budget.

ANNEX 1

CALCULATION OF CHANGE IN MONTHLY PAYMENT AFTER TAX — Box 1

The average net payment (after tax deduction of interest) for the first year is calculated by first calculating the gross payment, which is the same throughout the term of a fixed-rate loan. The interest and instalment elements of the payment are calculated, and the net payment is calculated as the interest element multiplied by (1 – 0.325) plus the instalment element for a rate of capital-income tax of 32.5 per cent. This is illustrated in the formulae below:

$$payment^{gross} = \left(\frac{interest}{1-(1+interest\ )^{-360}} \cdot outstanding\ debt_0\right)$$

$$interest\ element_t = outstanding\ debt_t$$

$$instalment\ element_t = payment^{gross} - interest\ element_t$$

$$net\ payment_t = interest\ element_t \cdot (1-0.325) + instalment\ element_t$$

Where "interest" is the coupon rate of the loan (6 per cent for the fixed-rate loan and 4 per cent for the adjustable-rate loan before interest rates rise). "Outstanding debt" is the debt at the time of purchase.

This is illustrated for the first payment on the fixed-rate loan:

$$payment^{gross} \frac{0.06/12}{1-(1+0.06/12)^{-360}} \cdot 1{,}200{,}000 = 7{,}195\,kr.$$

$$interest\ element_1 = 1{,}200{,}000 \cdot 0.06/12 = 6{,}000\,kr.$$

$$instalment\ element_1 = 7{,}196 - 6{,}000 = 1{,}196\,kr.$$

$$payment_1^{net} = 6{,}000 \cdot (1-0.325) + 1{,}196 = 5{,}245\,kr.$$

Equivalent formulae are used to calculate the net payment on the adjustable-rate mortgages, which is kr. 4,429 at 4 per cent. If interest rates rise by 4 per cent, and 2/3 of the debt is at adjustable rates, the first payment is calculated as:

$$payment^{adjustable-rate\ element,\ gross} = \tfrac{2}{3} \cdot \frac{0.08/12}{1-(1+0.08/12)^{-360}} \cdot 1{,}200{,}000 = 5{,}870\,kr.$$

$$interest\ element_1 = \tfrac{2}{3} \cdot 1{,}200{,}000 \cdot 0.08/12 = 5{,}333\,kr.$$

$$instalment\ element_1 = 5{,}870 - 5{,}333 = 537\,kr.$$

$$instalment_1^{net} = \tfrac{1}{3} \cdot 5{,}245 + [(1-0.325) \cdot 5{,}333 + 537] = 5{,}885\,kr.$$

A 4 per cent increase in interest rates thus results in an increase in the net payment by:

$5{,}885 - (\tfrac{1}{3} \cdot 5{,}245 + \tfrac{2}{3} \cdot 4{,}429) = kr.\ 1{,}184$

if 2/3 of the debt is at adjustable rates.

CALCULATION OF CHANGE IN NON-MORTGAGED VALUE ON AN INCREASE IN INTEREST RATES — Box 2

In connection with rising interest rates the price of owner-occupied homes is assumed to decline to a level where the net payment on the fixed-rate loan is the same after the rise in interest rates. In other words, it is assumed that the decrease in price cor-responds to the decline in the present value of the net payments (PV). The non-mortgaged value of the home will remain unchanged after an increase in interest rates if it is financed via a fixed-rate loan, since the decrease in the market value of the debt matches the drop in the price of the house. If the house is 100 per cent financed via adjustable-rate loans, the non-mortgaged value will fall by the calculated decrease in price.

$$PV_{fixed\ rate}^{net\ payment,\ before} = \sum_{t=1}^{360} \frac{net\ payment_{fixed\ rate,t}^{before}}{(1+interest_{after\ tax}^{before})^t}$$

$$PV_{fixed\ rate}^{net\ payment,\ after} = \sum_{t=1}^{360} \frac{net\ payment_{fixed\ rate,t}^{before}}{(1+interest_{after\ tax}^{after})^t}$$

$$Decrease\ in\ non\text{-}mortgaged\ value = \alpha \cdot (PV_{fixed\ rate}^{net\ payment,before} - PV_{fixed\ rate}^{net\ payment,after})$$

Where α is the share of the total debt financed via adjustable-rate mortgages (the remainder, i.e. 1-α, is assumed to be financed via fixed-rate loans). "Interest before" is the interest after tax before the rise in interest rates, and "interest after" is the interest after the rise in interest rates. This is illustrated for a rise in interest rates by 4 per cent, with 2/3 of the debt financed via adjustable-rate mortgages:

$$PV_{fixed\ rate}^{net\ payment,before} = 1{,}200{,}000\,kr.$$

$$PV_{fixed\ rate}^{net\ payment,after} = 873{,}318\,kr.$$

$$Decrease\ in\ non\text{-}mortgaged\ value = \tfrac{2}{3} \cdot (1{,}200{,}000 - 873{,}318) = 217{,}788\,kr.$$

In other words, the non-mortgaged value after the rise in interest rates is kr. 300,000 – 217,788 = 82,212.