Danish Families in Mortgage Arrears

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1. INTRODUCTION AND SUMMARY

The vast majority of Danish families service their mortgage loans on time. According to data from the Association of Danish Mortgage Banks and the Danish Mortgage Banks' Federation, only 0.3 per cent of the total interest and principal payments that fell due in the 1st quarter of 2013 had not been paid three and a half months after the date they were due. This means that the amount of mortgage arrears has fallen by almost half relative to the peak during the financial crisis in 2009. Compared with the early 1990s, the level of arrears is considerably lower today.

However, the question is whether the arrears rate can be expected to remain at the current low level in future. Danish families have far more debt relative to income than families in other countries. This has caused some concern among observers as to whether the families will be able to service their debt, especially if the Danish economy is affected by another serious downturn. If a sufficient number of families turn out to be unable to meet their obligations to the mortgage banks, this could undermine confidence in the mortgage banks' credit standing.

In this article we use detailed microdata for Danish families to examine how difficulties in servicing mortgage loans depend on key financial variables for the individual family. Based on the estimation results, we assess how the families' mortgage arrears levels will develop in various scenarios for the Danish economy.

Our econometric analysis shows a clear correlation between a family's finances and the probability that the family will fall behind on its mortgage payments, even when controlling for a number of family-specific conditions. The smaller the family's disposable amount, the greater its income loss in recent years, the larger an income share it uses to service the debt, the smaller its holdings of liquid assets and home equity, and the smaller its pension wealth – the higher the probability of the family falling into arrears will be. Statistically, the effects are highly significant, but they are limited in terms of size. For most families, changes in the key financial variables have very little impact on the probability of arrears. This reflects that mortgage arrears are very rare, even among families whose finances are under pressure.

Based on these results, we estimate the expected development in the number of families in mortgage arrears in the event that the Danish economy is affected by another setback such as rising unemployment, interest rate increases or falling house prices. Our results indicate that even severe setbacks would cause only a slight rise in the number of families in arrears. Hence, we expect the level of mortgage arrears to remain low, and there are no indications that the high level seen in the early 1990s will return, even in the event of a severe economic downturn. Consequently, in our assessment, this poses no serious threat to the credibility of the mortgage credit system.

It should be noted, however, that this article focuses solely on household debt to mortgage banks. Arrears on other forms of debt, including household debt to banks and corporate lending by mortgage banks, have not been analysed due to lack of data coverage. There is no doubt that an economic downturn of the magnitude considered in our stress scenarios would give rise to substantial loan impairment charges in the overall financial sector. Our results merely indicate that the loan impairment charges will not be seen primarily in the mortgage credit sector. On the other hand, the banks' loan impairment charges are likely to be considerable, which emphasises the importance of Danish banks having sufficient capital buffers. At the same time, it should also be noted that a severe economic downturn that includes pronounced falls in private consumption and investment could result in increased loan impairment charges on mortgage banks' lending to the corporate sector.

2. WHY ANALYSE MORTGAGE ARREARS?

When mortgage banks provide loans to Danish home-owning families, they incur a credit risk. The risk arises because the borrowers will not always be able to repay their loans on the agreed terms. In such cases, the mortgage banks are at risk of incurring losses. If the losses are too many and too large, it may reduce the security of the mortgage credit system and thus weaken investor confidence in the creditworthiness of mortgage bonds.

When a family gets behind on its mortgage payments, this may lead to the home being sold through enforced sale, cf. Box 1. If the proceeds from the sale are insufficient to cover the mortgage bank's claim, the mortgage bank will incur a loss. In principle, the mortgage banks should therefore write down the value of the loan once the borrower falls into arrears. Over the last 20 years, the level of arrears has been strongly correlated with both the number of enforced sales and the total loan

IMPLICATIONS OF ARREARS Box 1

When borrowers get behind on their mortgage payments, the mortgage bank will try to collect the debt. If this fails, the property may ultimately be sold through enforced sale. But in many cases, the mortgage bank will try to find a solution with the borrower. A study by the Danish Financial Supervisory Authority shows that for families who are cooperative and take an active part in a solution plan, the opportunities to get out of arrears or to draw up a plan for the future repayment of their debt are better than for families who do not respond to the mortgage banks' requests, cf. Danish Financial Supervisory Authority (2011).

In the cases where defaulting on loans results in enforced sale, the process is usually relatively short. It typically takes less than nine months from the payment becomes overdue until the property is sold, cf. Gundersen et al. (2011). The relatively short period of time contributes to limiting the mortgage bank's potential loss and it is thus in a strong position to collect the debt. If the mortgage bank's claim is not covered by the sale of the property, it retains a claim against the borrower. In other words, the borrower has strong incentives to service the mortgage debt and avoid enforced sale.

When a homeowner falls into arrears, this generally means that the mortgage bank must write down the loan in question. Arrears are regarded as a breach of contract on the part of the borrower, which means that there is objective evidence of impairment for loans. However, there may also be objective evidence of impairment for loans in other situations, e.g. if the borrower is deemed to be in substantial financial difficulties. Objective evidence of impairment for loans may thus exist although the borrower has not yet fallen into arrears. When there is objective evidence of impairment for a loan, it must be written down by the difference between the book value before the loan impairment charges and the present value of the expected future payments. If, despite being in arrears, the borrower is deemed to be capable of making future payments on time, the loan impairment charges will be very small (or 0). This could be the case, e.g. if the arrears are purely attributable to the borrower's oversight or a temporary liquidity problem. On the other hand, if it does not look as if the borrower will be able to repay the loan, the need for loan impairment charges must be based on an estimate of the sales value of the mortgaged property less expected realisation costs.

Realised losses are seen when defaulted loans are removed from the balance sheet. Defaulted loans do not directly entail losses to bond holders, since the credit risk is initially borne by the mortgage bank. So in the event of a defaulted loan, the mortgage bank incurs the loss, not the owners of the underlying bonds. Even if the mortgage bank defaults, the bond holders are ensured a high degree of protection against losses. Bond holders can assert a claim against the mortgage bank and they rank before unsecured creditors in the event of default.[1] However, it cannot be ruled out that the bond holders ultimately risk incurring a loss if the mortgage bank defaults. Hence, if confidence in a mortgage bank is undermined due to higher credit risk, this may affect the bond holder through falling mortgage bond prices.

In the same way as mortgage banks, banks can request that a property be sold through enforced sale if the borrower defaults on a bank loan against the property as collateral. This applies whether or not the borrower has serviced the mortgage loan.

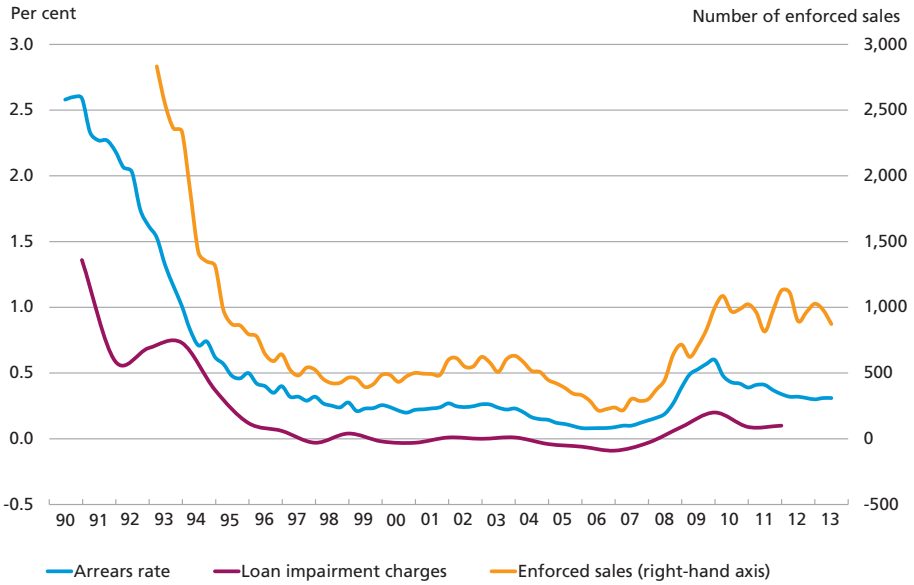
CONTINUED Box 1

However, banks are often less inclined to request enforced sale, since they take second place to the mortgage bank and are therefore subject to greater risk of not recovering their losses. Instead, banks typically wait for the value of the collateral to increase or for the mortgage bank to request that the property be sold through enforced sale.

[1] In the event of default, the mortgage bank's capital centres are divested from the insolvent estate and their operations continued by an administrator. The administrator is obliged under law – and has wide powers – to fulfil the mortgage bank's obligations to the bond holders. Since bonds and loans are issued according to the match funding principle, the payments of interest and instalments on the loans will correspond to the payments of interest and instalments on the bonds throughout the maturity of the loan for loans that are not to be refinanced. For loans that must be refinanced, the administrator is legally entitled to perform such refinancing. The borrower's rights remain unchanged, i.e. the loan still cannot be terminated by the mortgage bank/capital centre whereas the borrower can still redeem the loan.

impairment charges of the mortgage banks, cf. Chart 1. For example, the drop in arrears in the early 1990s was followed by a drop in both enforced sales and loan impairment charges, and the increase in arrears that began in 2007 was also followed by an increase in the number of

ARREARS, ENFORCED SALES AND MORTGAGE BANKS' TOTAL LOAN IMPAIRMENT CHARGES Chart 1



Note: The arrears rate indicates the percentage of the total payments that had not been made three and a half months after the due date. The calculation includes lending by all mortgage banks for owner-occupied dwellings and summer cottages. The calculation of the number of enforced sales includes single-family houses, owner-occupied flats and summer cottages only. Total loan impairment charges comprise lending to retail and corporate customers and are stated as a percentage of total loans and guarantees.

Source: Association of Danish Mortgage Banks, Danish Mortgage Banks' Federation and Statistics Denmark.

HOUSEHOLDS' ASSESSMENTS OF THE HOUSING BURDEN Table 1

Per cent	2005	2006	2007	2008	2009	2010	2011
Share of households stating that housing costs are "a heavy burden"	6	6	6	6	8	7	8
Share of households stating that housing costs are "a considerable burden"	20	21	22	24	24	23	24

Note: In the calculation, the share of households is weighted by the number of members.
Source: Statistics Denmark.

enforced sales and larger loan impairment charges.[1] The close correlation between arrears and loan impairment charges implies that the level of arrears is a relevant indicator of the soundness of the mortgage credit sector.

On the other hand, the share of families that are behind on their mortgage payments is a less suitable indicator of the number of families whose finances are squeezed. While a family in mortgage arrears is highly likely to be in a financial squeeze, the opposite is not necessarily true.[2] The share of families who subjectively perceive their own housing burdens as heavy is far larger than the aggregate arrears rate, cf. Table 1. One reason may be that most families with squeezed finances will attempt to remedy the problem by e.g. taking on extra work or cutting down on consumption before defaulting on their debt.

Mortgage arrears are also far less common than arrears on other forms of debt. Presumably, one reason is that banks are less inclined to require a property to be sold through enforced sale than mortgage banks, cf. Box 1. So from the borrower's point of view, the consequences of defaulting are greater for mortgage debt than for other debt, and the mortgage loan will typically be the last debt item on which a family chooses to default.

Due to the higher incidence of arrears on other debt, the level of loan impairment charges is substantially higher in banks than in mortgage

1 There is a certain time lag between changes in the arrears rate and changes in the number of enforced sales. This is because it typically takes a while before the mortgaged property is sold through enforced sale.

2 D'Alessio and Iezzi (2013) use microdata for Italian households to evaluate various indicators of a household's "over-indebtedness". Among the households that are more than three months behind on their debt, more than 80 per cent state that they find it "difficult" or "very difficult" to make ends meet. On the other hand, only just over 3 per cent of the households giving these answers have been in arrears for minimum three months.

banks, cf. Abildgren and Kuchler (2013), and cyclical fluctuations in the loan impairment charge ratio are also much more pronounced in banks. Arrears on families' debt to banks are not analysed in this article due to lack of data. Instead, the article focuses solely on the mortgage credit sector. Hence, our analyses aim to examine the expected impact on that particular sector in various scenarios for the development in the financial situation of families.

3. RELATED LITERATURE

The analyses in this article are closely related to two recent studies of the financial robustness of Danish families with mortgage debt: Andersen et al. (2012b) and Ministry of Business and Growth (2013). The overall conclusion of both these analyses is that the finances of most families with mortgage debt are resilient to strong increases in interest rates as well as protracted periods of unemployment. In both cases, the conclusions are based on rules of thumb of when a family can be viewed as financially robust. Andersen et al. (2012b) categorise a family as robust if its disposable amount exceeds an estimated minimum budget. The Ministry of Business and Growth bases its definition of robustness on whether the family spends less than half of its disposable income on servicing its debt. It is difficult to assess the accuracy of such rules of thumb without data indicating whether the families are actually finding it hard to service their debt. Hence, the advantage of the approach in this article is that we use such data in the form of information about the families' mortgage arrears. This enables us to assess more accurately the number of families in mortgage payment difficulties, so that our analyses complement the previous studies.

As far as we know, no published studies based on microdata analyse the level of mortgage arrears in Denmark. However, this topic is closely related to a wide international literature on household debt repayment behaviour in a broader sense. The dominant approach in this literature is based on the *strategic default model*. According to that model, defaulting on loans should be viewed as an active household decision. The decision is based on a trade-off between the pros and cons of continuing to service the debt. Examples of theoretical models based on this approach can be found in e.g. Kehoe and Levine (2001), Chatterjee et al. (2007) and Livshits et al. (2007).

The influence of the strategic model has caused a considerable part of the empirical literature to focus on measuring the potential gains that a household can achieve by defaulting on its loan. Fay et al. (2002) con-

EMPIRICAL STUDIES OF HOUSEHOLD MORTGAGE ARREARS IN OTHER COUNTRIES Box 2

Duygan-Bump and Grant (2009) use data from the European Community Household Panel to analyse the incidence of arrears across a number of European countries. From a Danish perspective, it is relevant to note that Denmark is clearly at the low end as regards the share of households in mortgage arrears, despite the fact that the share of households with mortgage loans is higher in Denmark than in the other countries in the survey. The authors demonstrate a clear correlation between the incidence of mortgage arrears and the institutional conditions which provide the framework for the legal process in connection with housing loan defaults. Households that are hit by negative shocks to e.g. income are less inclined to go into arrears in countries where the institutional framework ensures a fast and effective process. It is worth noting that Denmark – according to the authors' indicators – differs from most other countries in the survey by having a fast and cost-effective process in place. This may help explain the limited incidence of arrears in Denmark, as the consequences of mortgage default are felt by borrowers fairly quickly and are difficult to evade.

Aron and Muellbauer (2010) analyse mortgage arrears in the UK. Using aggregate data, they estimate a model for the level of arrears and use it to forecast future trends in various scenarios where e.g. the level of interest rates and unemployment are exposed to shocks. The model includes LTV ratios and a debt service ratio. The scenarios show that even relatively small interest-rate increases may lead to relatively large increases in the arrears rate, while rising unemployment has a smaller, but not immaterial impact on arrears.

Gathergood (2009) uses microdata to examine the mortgage arrears level among UK households. He finds that unemployment, long-term illness and divorce or the loss of a spouse give rise to the most serious problems. Moreover, he concludes that the majority of problem loans are relatively new, and that many households in arrears were already having problems at the time they took out the loans. Part of the arrears issue is consequently related to the screening of new borrowers.

Li et al. (2011) analyse the development in default on US mortgage loans in the wake of a reform of US legislation on personal bankruptcy in 2005. The reform restricted access to debt relief for unsecured debt, i.e. debt that is not secured by mortgage. The authors argue that US homeowners were thus deprived of a frequently used option to improve their liquidity position. According to the authors, this option was the only alternative to mortgage default for many households. Their empirical results support the finding that the reform contributed to a considerable rise in the mortgage default rate.

Lydon and McCarthy (2011) investigate Irish mortgage loans based on data from four Irish banks. They find that mortgages taken out for buy-to-let purposes, high LTV ratios and high repayment burdens lead to a higher probability of arrears.

Alfaro et al. (2010) analyse household debt default in Chile. They distinguish between mortgage default and default on unsecured consumer loans. The degree to which the two types of debt default are dependent on the variables applied differs considerably. Household income is the only variable that has the same effect on both types of default. Conversely, higher levels of education reduce the probability of mortgage default, but not of default on consumer loans.

struct a measure of the gain and find a positive link to the frequency of bankruptcy filings among US households.[1]

Other empirical studies focus on the importance of liquidity constraints and unexpected events such as unemployment. Elul et al. (2010) examine the role of illiquidity, unemployment and the loan-to-value ratio for homes in terms of the probability of mortgage default among US homeowners. Like Cohen-Cole and Morse (2010) and others, the authors conclude that illiquidity plays a key role in the households' tendency to default on their mortgage loans. Results of this kind are occasionally interpreted as being in conflict with the strategic default model. But the model specifically predicts that the probability of default will increase if the borrower becomes liquidity constrained, since there is a strong increase in the cost of continued payments in this situation, as pointed out by Elul et al. (2010).

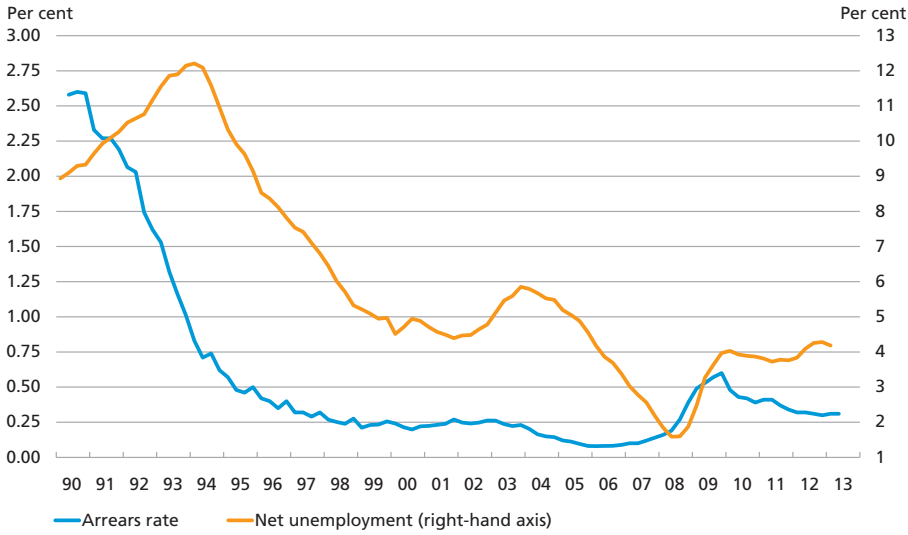
In Box 2, we briefly describe examples of other empirical studies of mortgage arrears in various countries.

4. ARREARS AND MACROECONOMIC DEVELOPMENT

As mentioned in the introduction to this article, mortgage arrears were much more common among Danish families in the early 1990s than they are today. The difference between then and now should to a large extent be viewed in the light of the macroeconomic development in the intervening period. First, unemployment was considerably higher in the early 1990s than it is today, cf. Chart 2. This was followed by a major drop in both unemployment and the arrears rate. When unemployment rose again in the wake of the financial crisis, the arrears rate also went up. Neither variable returned to the high level of the early 1990s, however. It should be noted that there is a certain time lag between changes in unemployment and changes in the arrears rate. In the 1990s as well as in 2008-09, the changes in the arrears rate preceded the changes in unemployment, reflecting the typical cyclical phenomenon that it takes some

[1] In empirical studies of housing loan defaults, the difference between the remaining balance on the loan and the property value is often interpreted as a measure of the borrower's gain from defaulting on the loan. This makes good sense in studies of US housing loans in particular, as US homeowners are usually not personally liable for their loans. So if the property value is lower than the remaining debt on the loan, borrowers can, in principle, obtain a capital gain by defaulting on their obligations and letting the lender take over the home. For the same reason, falling house prices are often mentioned as an important explanation of the rising number of mortgage defaults in the USA in the years preceding the financial crisis, cf. e.g. Bajari et al. (2008) and Mayer et al. (2009). These arguments cannot be directly applied to Danish mortgage loans, however. For Danish mortgage borrowers, it is not possible to obtain a capital gain by defaulting on the loan, since the mortgage bank can maintain a claim against the borrower even after the home has been sold. But this does not mean that the development in Danish house prices is irrelevant to the mortgage arrears rate; all other things being equal, higher house prices result in larger home equity for homeowners. In many cases, positive home equity can be used as a financial buffer, cf. also the next section.

ARREARS AND UNEMPLOYMENT, 1990-2013 Chart 2



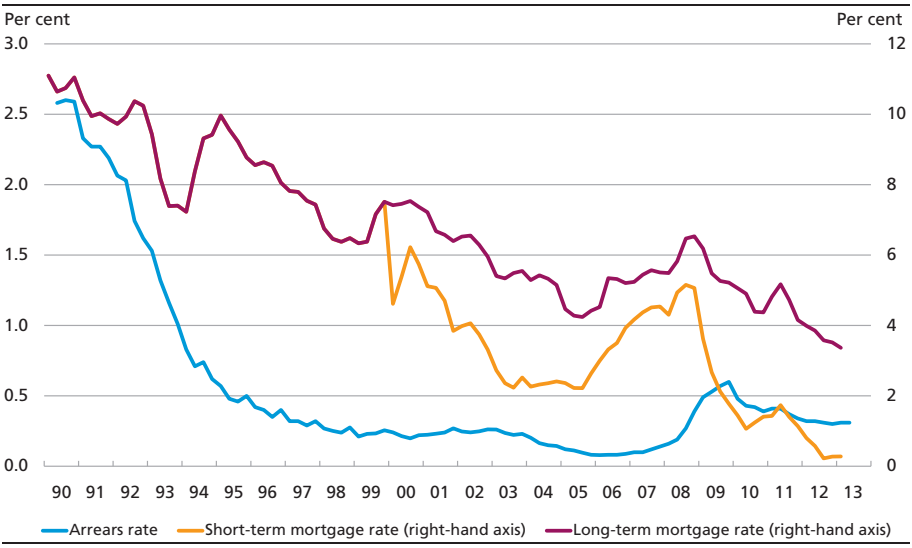
Note: The arrears rate indicates the proportion of the total payments that had not been made three and a half months after the due date. The calculation includes lending by all mortgage banks for owner-occupied dwellings and summer cottages.

Source: Association of Danish Mortgage Banks, Danish Mortgage Banks' Federation and Danmarks Nationalbank.

time before changes in economic activity pass through to unemployment.

Interest rates on mortgage loans have also fallen considerably since the early 1990s, cf. Chart 3. The actual *level* of interest rates will not necessarily impact the families' ability to service their debts to any great extent, since lower interest rates will typically be matched by higher house prices and thus a higher borrowing requirement. For those homeowners who have already taken out a mortgage, on the other hand, *changes* in the level of interest rates will have a strong impact. So, all else being equal, falling interest rates lead to reduced mortgage payments, which could make it easier for borrowers to meet their obligetions. The significance of this has grown in step with the more widespread use of adjustable-rate loans, which were introduced in 1996. This is illustrated by a relatively close correlation between the short-term mortgage rate and the arrears rate in the last couple of years, although the changes in the latter seem to occur with a certain lag. The time lag reflects firstly that, due to different fixed-interest periods, it takes some time for interest-rate changes to fully pass through to the finances of mortgage customers, and secondly that it may take a while from the time of the economic changes until the borrowers find themselves in financial difficulties and fall behind on their mortgage payments.

MORTGAGE INTEREST RATES AND ARREARS, 1990-2013 Chart 3



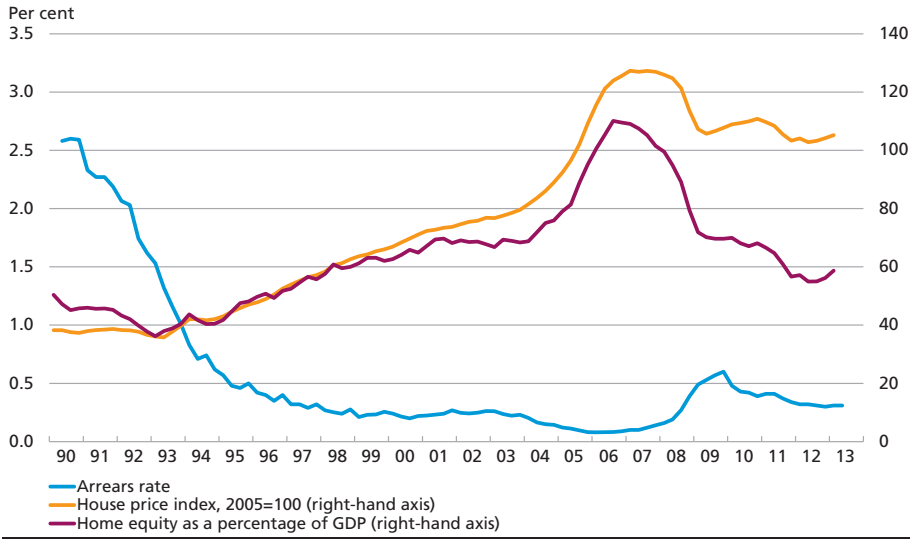
Note: The short-term mortgage rate was not compiled before 2000. The arrears rate indicates the proportion of the total payments that had not been made three and a half months after the due date. The calculation includes lending by all mortgage banks for owner-occupied dwellings and summer cottages.
Source: Association of Danish Mortgage Banks, Danish Mortgage Banks' Federation and Danmarks Nationalbank.

House price developments may also have a bearing on the frequency of mortgage arrears. All other things being equal, rising house prices lead to increased home equity in mortgaged properties. In some cases, positive home equity can be used as a financial buffer to soften the impact of temporary fluctuations in e.g. income. One reason is that it will often be possible to borrow against any home equity. In addition, positive home equity provides better options for converting mortgage debt into loans with lower payments here and now. For example, if the debt amounts to less than 80 per cent of the property value, it is frequently possible to convert to deferred-amortisation loans. This could counter a temporary loss of income.

If the debt exceeds 80 per cent of the property value, on the other hand, such conversion is not possible. The negative correlation between house prices and home equity on the one hand and the arrears rate on the other has been particularly evident in recent years, cf. Chart 4. In the period 2005-07, when house prices soared, the arrears rate thus bottomed out. When house prices subsequently dived, the arrears rate rose during 2008 and 2009, to the highest level since the mid-1990s.

In addition to the macroeconomic factors mentioned here, certain structural conditions also contributed to the arrears rate reaching an unusually high level in the early 1990s. The taxation value of interest costs was substantially reduced as part of the tax reform in the mid-1980s.

HOUSE PRICES, HOME EQUITY AND ARREARS, 1990-2013 Chart 4



Note: The development in property prices is not adjusted for inflation. Property prices are stated as an index where 2005=100. Home equity is calculated as a percentage of GDP, given in current prices. The arrears rate indicates the proportion of the total payments that had not been made three and a half months after the due date. The calculation includes lending by all mortgage banks for owner-occupied dwellings and summer cottages.
Source: Association of Danish Mortgage Banks, Danish Mortgage Banks' Federation and Danmarks Nationalbank.

Combined with a lower rate of inflation, this led to a sharp increase in real after-tax interest rates. At the same time, lending was restricted to 20-year mixed loans. In all probability, those initiatives led to more homeowners finding it difficult to service their debt in the ensuing period. The subsequent drop in the arrears rate – and the low level of the following years – should also be viewed in the light of structural changes. Cases in point include improved mortgaging access within the limit of 80 per cent of the property value in 1992, access to 30-year annuity loans in 1993 and the introduction of deferred-amortisation loans in 2003. All these initiatives may have contributed to keeping the arrears rate at a low level. We will get back to the importance of these and other structural conditions later in the article.

5. MICRODATA FOR FAMILIES' FINANCIAL SITUATION AND MORTGAGE ARREARS

The analyses in this article are based on detailed data about all outstanding mortgage loans for owner-occupied dwellings and summer cottages calculated at the end of 2009, 2010 and 2011. The information has been merged in an anonymised form with background data on the borrowers from Statistics Denmark and then aggregated at family level.

The merged data set enables us to identify approximately 4,700 families who were at least three and a half months behind on their mortgage payments in 2009. For 2011, the corresponding figure is around 3,350 families, or 0.31 per cent of the total number of families with mortgage debt.

Mortgage loans and arrears

The information about mortgage loans was provided by the mortgage banks and made available to Danmarks Nationalbank and the Ministry of Business and Growth, among others. A wide range of information is available for each loan, including on the remaining balance, the loan type and the maturity of the loan.[1] Moreover, the information includes the mortgage banks' assessments of the size of the remaining debt relative to the sales value of the property provided as collateral for the loan (LTV ratio). The mortgage banks use different methods to assess the property value. The methods have been approved by the Danish Financial Supervisory Authority.

Finally, the mortgage banks report any 105-day arrears on the June instalment, i.e. the amount owed by the borrower approximately three and a half months after the June due date. Only arrears exceeding kr. 1,000 are included, however. At the end of 2011, there were 4,240 outstanding loans that had been subject to 105-day arrears exceeding kr. 1,000 on the June instalment of 2011, cf. Table 2. This corresponds to 0.29 per cent of the total number of outstanding loans.

The information on arrears can be used to identify borrowers in mortgage arrears in a given period, i.e. from June of the year concerned and approximately three and a half months ahead. It should be noted, however, that with the information available it is only possible to identify *some* and not *all* of the borrowers who were behind on their mortgage payments during the year. The information from the mortgage banks does not include arrears relating to the other instalments of the year. If, for example, a borrower falls behind on his payment for the March instalment, but makes the June payment on time, the borrower will not be registered as being in arrears in the year concerned.[2]. Furthermore as previously mentioned, the mortgage information is reported at year-end. This means that information is only available about the loans still outstanding at the end of the year. If a borrower fails to make his

1 For a more detailed description of the material, see Andersen et al. (2012b).

2 In addition to 105-day arrears on the June instalment, most of the mortgage banks also provided information about any 45-day arrears on the September instalment. However, a delay of 45 days can be caused by many factors that do not necessarily have anything to do with an actual inability to meet payment obligations, and we consequently chose to focus on the 105-day arrears in this article.

MORTGAGE LOANS IN 105-DAY ARREARS ON THE JUNE INSTALMENT Table 2

	2009	2010	2011
Number of loans	5,886	4,947	4,240
Share of total number of outstanding loans, per cent	0.41	0.34	0.29

Note: The top row of the table shows the number of outstanding loans at year-end in 105-day arrears on payments exceeding kr. 1,000 for the June instalment of the year under review. The bottom row of the table shows how large a percentage of the total number of outstanding loans for owner-occupied dwellings and summer cottages these loans made up at the end of the year under review.
Source: Mortgage banks and own calculations.

mortgage payments in the month of June, and the loan is then settled by year-end, e.g. through enforced sale, the information about the arrears on the June instalment for the loan in question will not be included in the data material. Despite these limitations, we believe that the information available provides a reasonable basis on which to assess the extent of and reasons for mortgage arrears.[1]

Income, wealth and socio-economic background variables

The data material from the mortgage banks has been merged in an anonymous form with personal data from Statistics Denmark's personal and family income registers. The latter data is mainly based on information from the Danish Customs and Tax Administration (SKAT) and includes income, tax, wealth and debt. The content of the wealth and debt data is described in more detail in Box 3. Furthermore, we use a number of socio-economic variables from the population and education registers and the Integrated Database for Labour Market Research (IDA). Finally, we supplement the data with information on admissions to hospital from the register on hospitalisation rates.

Organisation and delineation

The economic unit of interest in this article is the *family*, and the data is consequently organised at family level. The statistical definition of a family appears from Box 4. For most variables, conversion from individual to family level is easy. For example, the family's income is calculated as the sum of the incomes of each member of the family. In terms of mortgage arrears, all loans for which the family members are liable

[1] In October 2011, the Association of Danish Mortgage Banks estimated that for the 2nd quarter of 2011, payments on around 6,000 loans were in arrears by 105 days. This number is somewhat higher than the 4,200 loans recorded in our data. Danmarks Nationalbank is currently cooperating with the mortgage banks and Statistics Denmark to compile detailed microstatistics for mortgage loans, including more exhaustive information about arrears, among other things.

REGISTER INFORMATION ON ASSETS AND LIABILITIES Box 3

Statistics Denmark's registers of personal income contain information on a number of debt items, including debt to banks and mortgage banks, debt to the Mortgage Bank of the Kingdom of Denmark, financing companies and local government as well as charge card debt and mortgage deed debt. The registers do not include information on debt to private individuals.

On the asset side, the registers contain information on deposits in banks, the market value of stocks and bonds, and mortgage deeds in the custody of a bank. They also contain information about the public valuation of real property.

The income registers have no information on a number of assets, including, notably, pension wealth. But individual pension wealth can be estimated on the basis of information from the Welfare Commission, Statistics Denmark and ATP statistics, among others, cf. Andersen et al. (2012a). In addition, the registers contain no information on cash holdings and the value of consumer durables, including cars, boats, household effects and art. Nor do they contain information on the value of private cooperative housing. This reflects that most data on income and wealth is derived from notices of assessment for individual persons, which do not contain information about such assets. Any debt incurred in connection with the acquisition of the above-mentioned assets will be included on the liabilities side of the registers, however.

STATISTICAL DEFINITION OF A FAMILY Box 4

The analyses in this article are based on Statistics Denmark's definition of "E-families".

According to this definition, a family consists of either one or two adults and any children living at home. Two adults are regarded as members of the same family if they are living together and meet at least one of the following criteria:

- Are married to each other or have entered into a registered partnership
- Have at least one common child registered in the Civil Registration System (the CPR)
- Are of opposite sex and have an age difference of 15 years or less, are not closely related and live in a household with no other adults.

Adults living at the same address who do not meet at least one of the above criteria are regarded as singles. Children living at home are regarded as members of their parents' family if they are under 25, live at the same address as minimum one of their parents, have never been married or entered into a registered partnership and do not themselves have children who are registered in the CPR.

A family meeting these criteria can consist of only two generations. If three or more generations live at the same address, the two younger generations constitute the family.

FAMILIES IN ARREARS Table 3

	All families			Families with no self-employed members, with full tax liability and with an annual income after tax of more than kr. 25,000		
	2009	2010	2011	2009	2010	2011
Number of families with June arrears	4,731	3,954	3,353	3,700	3,211	2,783
Share of total number of families with mortgage debt, per cent	0.44	0.37	0.31	0.38	0.33	0.29
Average amount of arrears among families in arrears, kr.	28,570	22,343	20,383	27,261	21,554	19,327
Total mortgage debt for families in arrears, kr. billion	6.9	5.4	4.5	4.8	3.9	3.4
Share of total mortgage lending for owner-occupied dwellings and summer cottages, per cent	0.53	0.40	0.33	0.43	0.33	0.29

Note: The table shows descriptive statistics for families in arrears by 105 days on payments exceeding kr. 1,000 for the June instalment.
Source: Own calculations based on data from mortgage banks and from Statistics Denmark.

are aggregated. The family is deemed to be in arrears if it is 105 days behind on payments exceeding kr. 1,000 on just one of those loans.[1]

According to our data, just over 4,700 families met this criterion in 2009, cf. Table 3. In 2011, the number had fallen to approximately 3,350, or 0.31 per cent of the total number of families with mortgage debt. These families accounted for a total mortgage debt of just under kr. 5 billion at the end of 2011, corresponding to 0.33 per cent of total mortgage lending for owner-occupied dwellings and summer cottages. As pointed out above, however, it is not possible to identify all the families who were behind on their mortgage payments for the June instalment. Hence, the actual number of families in arrears may be higher than indicated by the figures in Table 3.

For certain groups of families, the quality of the data on key financial variables such as income and wealth is lower than for other families. Accordingly, the following analyses include only families in which no adult members are self-employed, all adult members are liable to Danish income tax, and the total family income after tax is minimum kr.

[1] In the analyses in the following sections we sometimes need to be able to follow the individual families over time. In those cases the conversion to family level is not always that easy, because the family is not a constant unit. Existing families cease to exist, e.g. due to divorce, and new families are established when couples move in together or when children leave home. So when in the next sections we look into a family's arrears in previous and subsequent years, we base our analysis on the individual family members and follow them over time. If, say, just one of the present members can be associated with a loan in arrears in a subsequent year, the family is regarded as being in arrears that year, whether or not the family still exists as a unit at that time.

AVERAGE INCOME, WEALTH AND DEBT FOR FAMILIES IN THE DELINEATED DATA SET VERSUS OTHER FAMILIES, 2011 Table 4

Kr.	Families in the delineated data set	All families
Income after tax per adult	254,804	205,369
Liquid assets	278,028	315,426
Housing wealth, public valuation	1,777,958	1,075,200
Total debt	1,538,574	840,790

Note: The delineated data set includes the families with mortgage debt at the end of the year, with no family members who are self-employed, with full tax liability in Denmark and with a total annual income after tax of minimum kr. 25,000. Liquid assets consist of deposits in banks and the market value of stocks, bonds and mortgage deeds in the custody of a bank. Here, housing wealth is calculated on the basis of the public property valuation. Elsewhere in this article we use the mortgage banks' assessment instead. That is not the case here because the mortgage banks' assessments are only available for properties on which mortgages have been taken out, and comparisons across the two groups of families are therefore not possible on the basis of this calculation. In contrast, the public valuation is available for all properties.

Source: Statistics Denmark and own calculations.

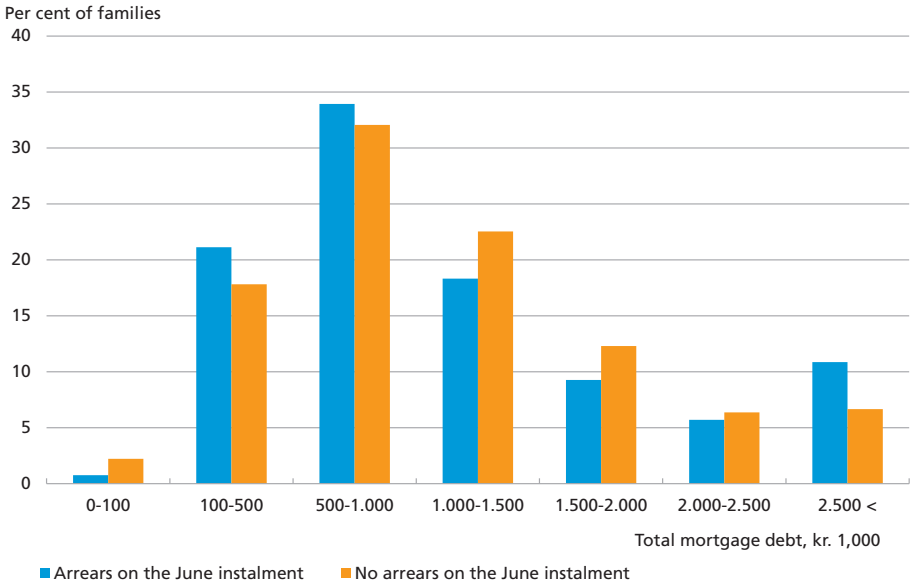
25,000. After this delineation, our data set includes almost 975,000 families in 2011, of which just under 2,800 families were in arrears by 105 days on the June instalment. The families in the delineated data set differ from the rest of the population in a number of respects. For example, they have higher income and wealth than the average family, cf. Table 4. At the same time, they have considerably more debt than the rest of the population. This is not surprising, since our specific focus is on the group of families with mortgage debt.

6. PORTRAIT OF FAMILIES IN ARREARS

For the families who were in arrears by 105 days on the June instalment of 2011, the average remaining debt on their mortgage loans more or less equalled that of other families with mortgage debt. But the size of the remaining debt varied slightly more among the families in arrears, cf. Chart 5. Hence, the percentage of families whose remaining debt was under kr. 1,000,000 at the end of 2011 was slightly higher in this group than among the families who were not in arrears. On the other hand, almost 11 per cent of the families in arrears had mortgage debt of more than kr. 2.5 million. Among the families not in arrears the corresponding figure was just under 7 per cent.

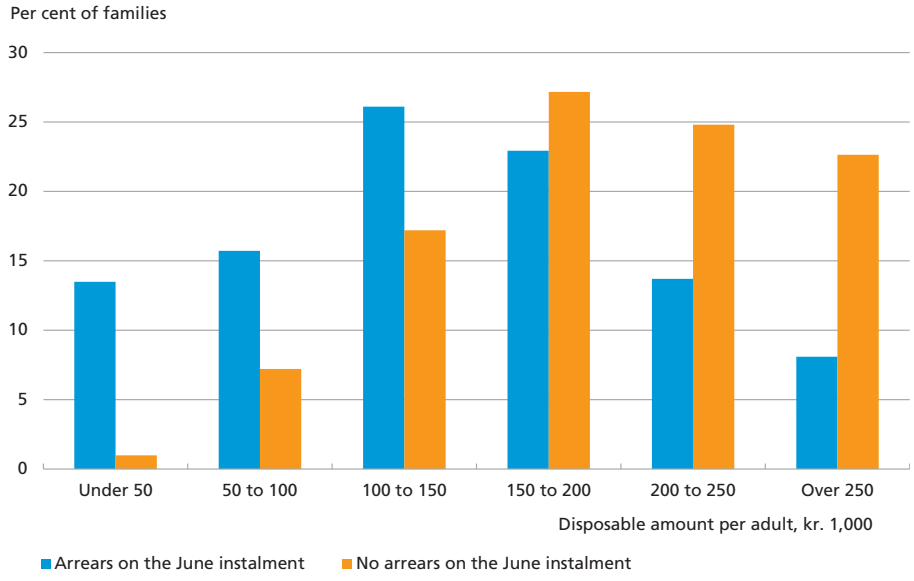
Families in arrears on the June instalment typically have a lower disposable amount per adult than the other families with mortgage debt, cf. Chart 6. In 2011, 13 per cent of the families in arrears had an annual disposable amount per adult of less than kr. 50,000, and more than half of the families in this group had a disposable amount of less than kr. 150,000 per adult. Among the families paying their mortgages for the June instalment on time, only around 2 per cent had a disposable amount

DISTRIBUTION OF REMAINING DEBT ON MORTGAGE LOANS, 2011 Chart 5



Source: Own calculations based on data from mortgage banks and from Statistics Denmark.

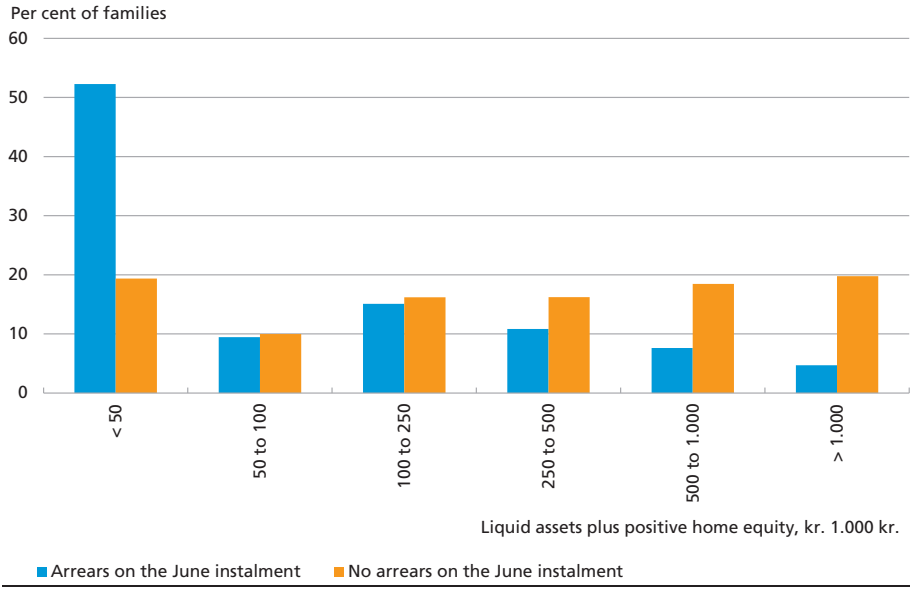
DISTRIBUTION OF DISPOSABLE AMOUNT PER ADULT AMONG MORTGAGE CUSTOMERS, 2011 Chart 6



Note: The disposable amount per adult is calculated as the family's total annual income less tax, interest payments, maintenance payments, repayment of social benefits, administration margins payable to mortgage banks and any principal payments on mortgage debt – divided by the number of adults in the family.

Source: Own calculations based on data from mortgage banks and from Statistics Denmark.

DISTRIBUTION OF LIQUID ASSETS PLUS POSITIVE HOME EQUITY IN MORTGAGED PROPERTIES, 2011 Chart 7



Note: Liquid assets consist of the family's deposits in banks and the market value of bonds, mortgage deeds, stocks and investment certificates in the custody of a bank. Home equity is calculated as the difference between 80 per cent of the property valuation (60 per cent for summer cottages) and the amount of mortgage debt on the property.
Source: Own calculations based on data from mortgage banks and from Statistics Denmark.

per adult of less than kr. 50,000 kr., and approximately 27 per cent had less than kr. 150,000 per adult at their disposal. Similar differences between the two groups applied in 2009 and 2010.

In terms of wealth, there is also a big difference between the two groups of mortgage customers, cf. Chart 7. Among the families who were behind on their mortgage payments for the June instalment of 2011, more than half had liquid assets of less than kr. 50,000 at the end of the year. This includes any positive home equity in the family's mortgaged property/properties.[1] Among the other families with mortgage debt, this applied to just under 20 per cent. At the opposite end of the scale, less than 5 per cent of the families in arrears had liquid assets and positive home equity of more than kr. 1 million compared with 20 per cent among the families with no arrears. In Box 5, we take a closer look

[1] Home equity is calculated for each property on which the family has taken out a mortgage. For owner-occupied dwellings, it is calculated as the difference between 80 per cent of the property valuation and the remaining debt on the property. For summer cottages, it is calculated as 60 per cent of the property value less the remaining debt. The reason is that it is possible to raise mortgage loans against up to 80 per cent of the value of owner-occupied dwellings, while the limit is 60 per cent for summer cottages. Only mortgage debt can be subtracted in the calculation since, due to a lack of data, it is not possible to take into account any bank loans raised against the property as collateral.

ARREARS AND PENSION WEALTH Box 5

Large holdings of assets can be used as financial buffers against e.g. temporary low-income periods. This is particularly true of liquid assets such as cash, bank deposits and securities. In many cases, any home equity can also be used, since, as previously mentioned, it is possible to raise loans against home equity.

Some assets are less liquid, however, so they are not always equally obvious to use in the event of difficulties in servicing mortgage debt. Pension wealth is a case in point. On the one hand, it is both difficult and costly to access accumulated pension contributions before the time of retirement. On the other hand, it seems unlikely that large pension wealth – and the resulting credit standing – makes no difference to a family's ability to get through a period of temporary financial difficulties.

In 2011, only few families in mortgage arrears had large pension wealth, cf. Table 5. The vast majority of families in arrears had total pension wealth of less than kr. 500,000 at the end of the year. This was particularly true of families with low disposable amounts or small holdings of liquid assets. Among this group, around one fourth of the families in arrears had pension wealth after tax of less than kr. 100,000.

FAMILIES IN ARREARS BROKEN DOWN BY PENSION WEALTH AFTER TAX, DISPOSABLE AMOUNT PER ADULT AND LIQUID ASSETS PLUS POSITIVE HOME EQUITY, 2011 Table 5

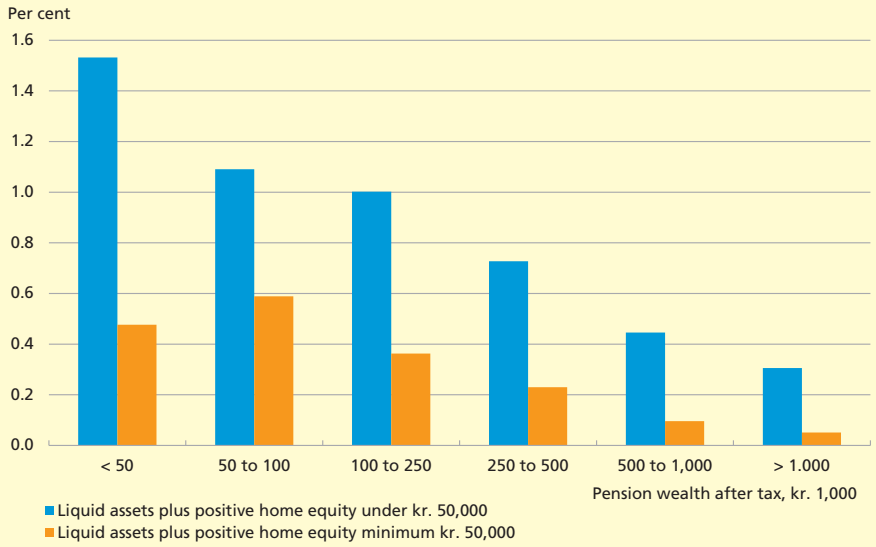
	Pension wealth after tax, kr. 1,000						
Total number of families	Under 50	50 to 100	100 to 250	250 to 500	500 to 1,000	Over 1,000	Total
Total	313	299	760	809	430	171	2,782
Annual disposable amount per adult under kr. 50,000	68	52	111	82	41	21	375
Annual disposable amount per adult minimum kr. 50,000	245	247	649	727	389	150	2,407
Liquid assets plus positive home equity under kr. 50,000	196	152	428	428	203	48	1,455
Liquid assets plus positive home equity minimum kr. 50,000	117	147	332	381	227	123	1,327

Source: Own calculations based on data from mortgage banks and from Statistics Denmark.

The same pattern is seen if we compare the number of families in arrears with the total number of families with mortgage debt in each group: The share of families in arrears is much larger among families with little or no pension wealth than among families with large pension wealth, cf. Chart 8. The difference is particularly pronounced among families with few liquid assets.

CONTINUED Box 5

SHARE OF FAMILIES IN MORTGAGE ARREARS BROKEN DOWN BY PENSION WEALTH AFTER TAX, 2011 Chart 8

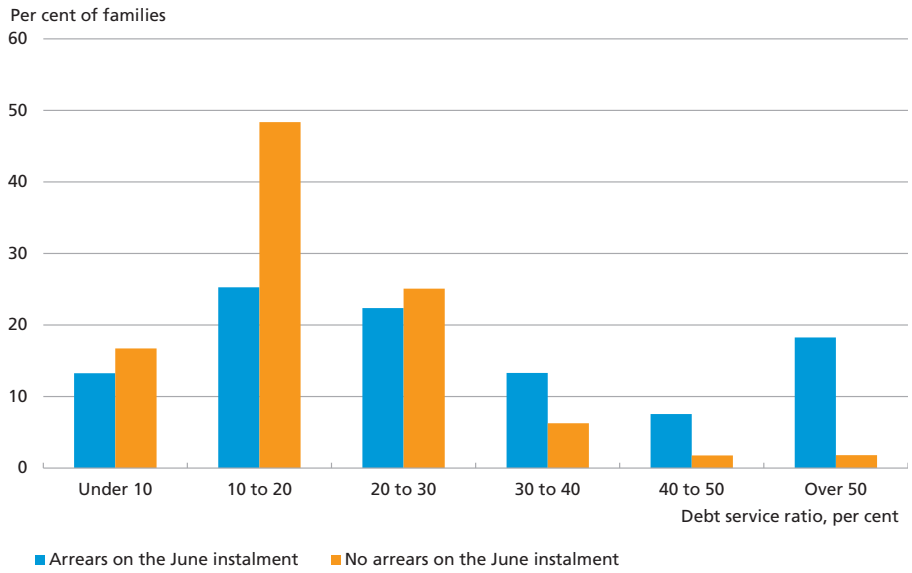


This correlation between the amount of pension wealth and the incidence of mortgage arrears may be attributable to several factors. One possible interpretation is that there is an actual causal effect of the amount of pension wealth on the probability of falling into arrears. But the correlation may also indicate that families with large pension wealth differ from families with little pension wealth in other ways. For example, families with large pension wealth often have high incomes and/or a strong propensity to save, and such underlying properties may be the cause of the correlation observed. We will get back to the impact of pension wealth on the probability of arrears in section 7, in which we explicitly control for a number of family-specific factors correlated with the amount of pension wealth that may impact the probability of a family falling into mortgage arrears.

at the relationship between the families' other types of wealth and the incidence of arrears.

Hence, the general picture is that families in arrears have a lower disposable amount and fewer liquid assets than other families with mortgage debt. That said, it is still remarkable that a number of families who are in arrears with their mortgage payments seem to have robust finances. In 2011, for example, approximately 20 per cent of the families in arrears had a disposable amount per adult of minimum kr. 200,000,

DISTRIBUTION OF DEBT SERVICE RATIO, 2011 Chart 9



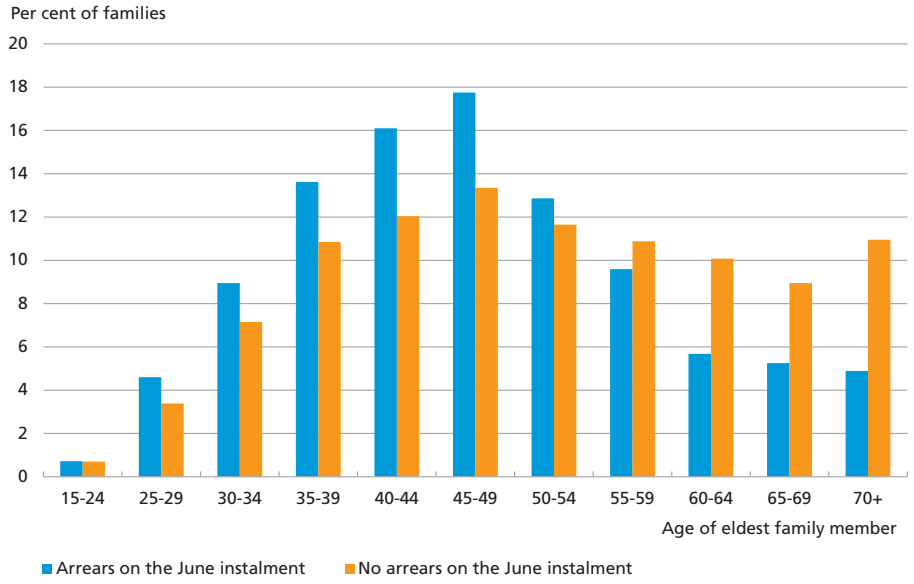
Note: The debt service ratio indicates the share of the family's income after tax that it uses to service its mortgage debt and pay interest on other debt.
Source: Own calculations based on data from mortgage banks and from Statistics Denmark.

and 20 per cent had liquid assets and positive home equity of minimum kr. 250,000 at the end of the year. This emphasises that tight finances are not the only possible reason why families with mortgage loans fall behind on their mortgage payments. When happening to families who seem to have robust finances, this is presumably attributable to social events such as divorce or illness. We will get back to the importance of such events later in the article.

Families in mortgage arrears typically spend a higher percentage of their income on servicing their debt than families who are not in arrears, cf. Chart 9. In 2011, approximately 26 per cent of the families in arrears spent minimum 40 per cent of their annual income after tax on mortgage payments and payments of interest on other debt. Less than 4 per cent of the families not in arrears spent such a large percentage of their income after tax on servicing their loans.

The age distribution among the families with mortgage debt shows that younger families are overrepresented among families who are in arrears, cf. Chart 10. In more than 60 per cent of the families who were behind on payments for the June instalment of 2011, the eldest member was under 50 years of age. Among the other families with mortgage debt, the corresponding share was less than 50 per cent.

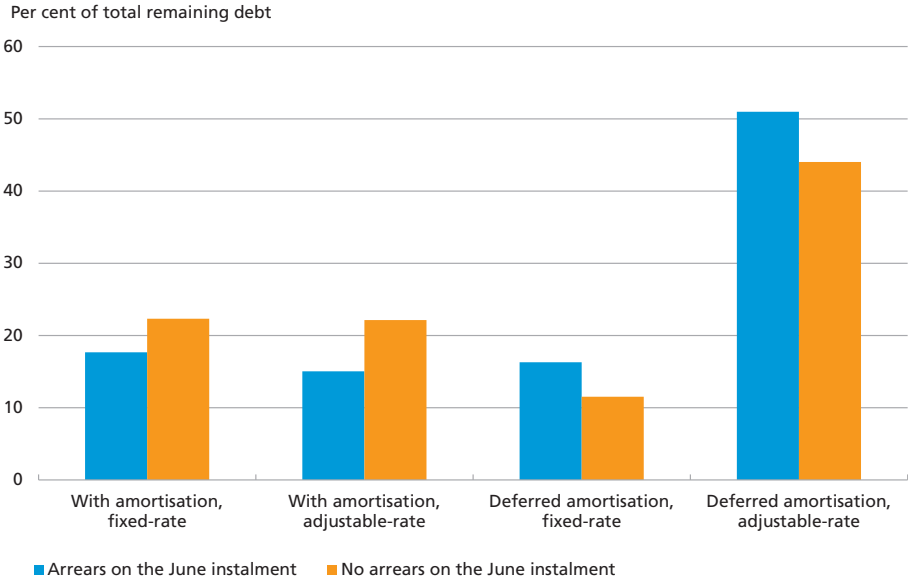
AGE DISTRIBUTION AMONG MORTGAGE CUSTOMERS, 2011 Chart 10



Source: Own calculations based on data from mortgage banks and from Statistics Denmark.

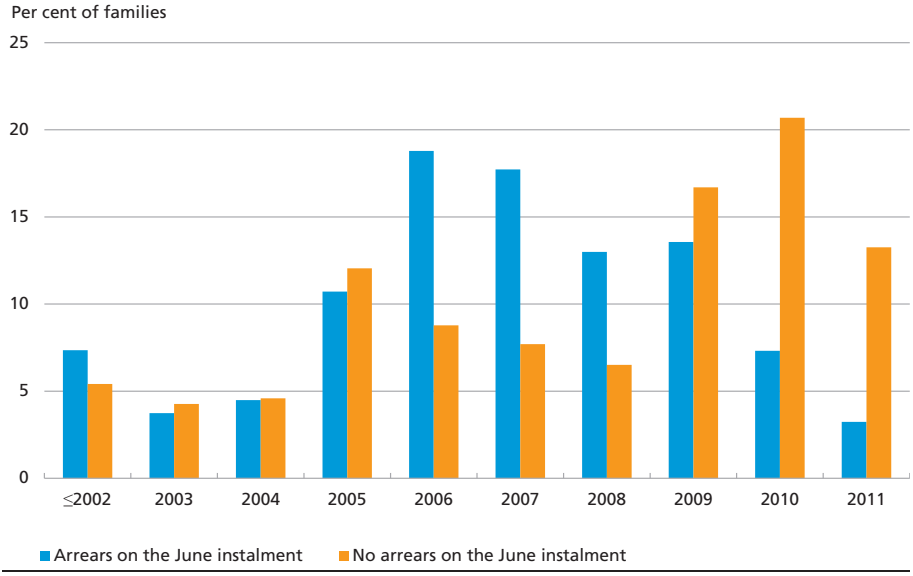
Chart 11 shows the families' total remaining mortgage debt at end-2011 broken down by loan type. Deferred-amortisation loans were somewhat more widespread among the families in arrears on the June instalment

MORTGAGE CUSTOMERS' REMAINING DEBT BROKEN DOWN BY LOAN TYPE, 2011 Chart 11



Source: Own calculations based on data from mortgage banks and from Statistics Denmark.

YEAR OF RAISING MOST RECENT MORTGAGE LOAN, 2011 Chart 12



Source: Own calculations based on data from mortgage banks and from Statistics Denmark.

than among other families. In the former group, around two thirds of the total remaining debt was associated with deferred-amortisation loans, while this was only the case for just over half of the remaining debt among the families not in arrears. The level of adjustable-rate loans, on the other hand, was more or less the same in the two groups of mortgage customers.

Chart 12 shows the distribution in terms of when the most recent mortgage loan was taken out for families in arrears and not in arrears, respectively, on the June instalment. Among the families in arrears, a very large percentage took out their most recent loan in either 2006 or 2007. This is due to the fact that house prices peaked in that period. Many of the families who purchased their homes at that time will consequently have seen major drops in the value of their properties, and many of them will not be able to repay their debt by selling the home.

In Table 6, we look into a number of characteristics of mortgage customers in arrears and not in arrears, respectively, on the June instalment of 2011. Compared with the other families with mortgage debt, the families in arrears comprise more singles, fewer persons with higher education and fewer pensioners. It is also worth noting that social events such as divorce, illness or prolonged unemployment occur more frequently among the families in arrears than among the other families.

PROPERTIES FOR FAMILIES WITH MORTGAGE DEBT, 2011 Table 6

Per cent	Families in arrears on the June instalment	Families not in arrears on the June instalment
Share with the following characteristics:		
- family with children	47.1	43.6
- two adults in the family	48.9	72.7
- at least one person with higher education in the family	21.5	44.8
- at least one pensioner in the family	10.5	21.0
- affected by divorce or the death of a spouse within the last two years	13.7	3.9
- affected by minimum six months' unemployment within the last two years	12.4	5.5
- at least one adult admitted to hospital during the last two years	27.3	24.2
- at least one adult received sickness or maternity benefits during the last two years	39.5	23.6
- residence in Copenhagen	5.9	7.0
- residence in Copenhagen's environs	7.8	8.3
- residence in North Zealand	9.5	9.4
- residence in East Zealand	5.7	4.9
- residence in West and South Zealand	25.4	12.4
- residence on Bornholm	1.0	0.9
- residence on Funen	7.6	9.2
- residence in South Jutland	9.7	13.3
- residence in East Jutland	11.6	15.3
- residence in West Jutland	5.3	8.0
- residence in North Jutland	10.6	11.3

Source: Own calculations based on data from mortgage banks and from Statistics Denmark.

Hence, in the group of families in arrears by 105 days on the June instalment of 2011, 46 per cent had been exposed to either divorce, the death of a spouse, admission to hospital or minimum six months of unemployment in 2010 and/or 2011. Among the other families, 31 per cent experienced at least one such event.

In many cases, social events such as the above have far-reaching consequences for a family's finances. It is therefore not surprising that a positive correlation is seen between those events and the incidence of mortgage arrears. The difference in frequency between the two groups is thus in accordance with the presumption that mortgage arrears are closely linked to tight finances.

Finally, Table 6 shows that the geographical distribution of the families in arrears on the June instalment differs somewhat from the corresponding distribution of other families with mortgage debt. What stands out is that around one fourth of all families in arrears on the June instalment of 2011 resided in West and South Zealand. In relative terms, only half as many of the other families with mortgage debt resided in

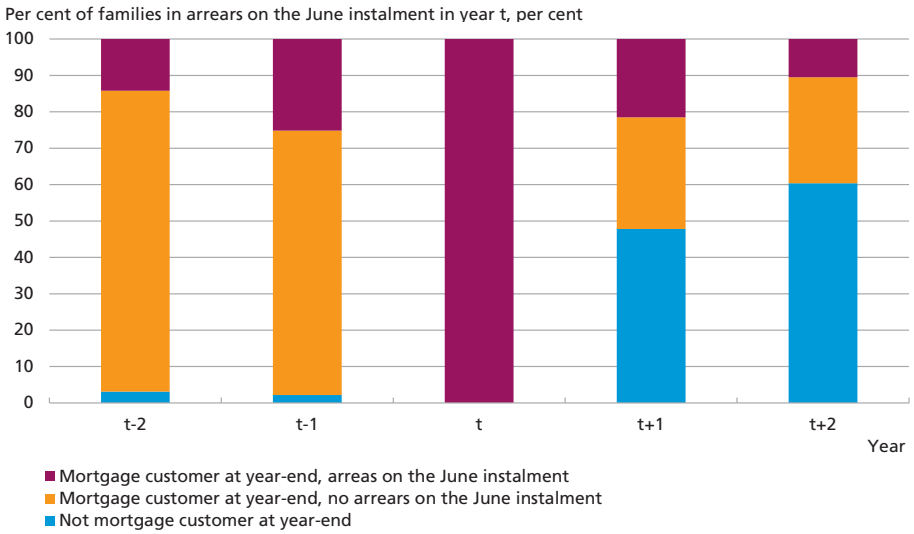
that part of Denmark. Families residing in Copenhagen, on Funen and in Jutland, on the other hand, are underrepresented among the families in mortgage arrears.

Falling into and out of arrears

The time dimension of the data from the mortgage banks can be used to examine the process for the families who fall behind on their mortgage payments for the June instalment of a given year. This enables us to analyse whether arrears on the June instalment is a recurring annual phenomenon for some families, or whether it is typically a one-off occurrence.

Among the families in arrears by 105 days on the June instalment of a given year in the period 2010-11, around one fourth were also in arrears on the June instalment of the previous year, cf. Chart 13. Of the remaining three fourths, the vast majority made their payments for the June instalment within 105 days in the previous year, while a small

MORTGAGE ARREARS IN PRECEDING AND SUBSEQUENT YEARS AMONG FAMILIES IN ARREARS IN THE CURRENT YEAR — Chart 13



Note: The chart shows the arrears history for families in arrears. The starting point is families in arrears by 105 days on payments exceeding kr. 1,000 for the June instalment in a given year *t*. The columns indicate the number of families who were behind on their payments in the preceding and subsequent years, the number of families who made their June payments on time, and the number of families who were not mortgage customers during those years. Column *t-2* is based on the families in arrears on the June instalment of 2011 and shows how many of them were behind on their payments for the June instalment of 2009. Column *t-1* is based on the families who were in arrears on the June instalment of 2010 and/or 2011 and how many of those were in arrears in June of the previous year. Similarly, column *t+2* is based on the families in arrears in June 2009, while column *t+1* is based on the families that were in arrears on the June instalment of 2009 and/or 2010. A family that was in arrears in year *t* is deemed to be in arrears in year *t+h* if just one of its adult members is part of a family that is behind on its payments for the June instalment of that year. This also applies if the original family no longer exists in year *t*+h, and similarly for preceding years.

Source: Own calculations based on data from mortgage banks and from Statistics Denmark.

minority had not taken out a mortgage at the time and therefore had no payments to make. So only a minority among the families were in arrears in both years.

Looking ahead in time, a similar pattern is seen. Among the families in arrears by 105 days on the June instalment of 2009 or 2010, only around 20 per cent also fell behind by at least 105 daysin the following year. However, this does not mean that all the other families reverted to making their payments on time. Almost half of the families in arrears on the June instalment of 2009 or 2010 no longer had a mortgage loan at the end of the following year. And one year further ahead, this share grows: Of the families in arrears in June 2009, only 40 per cent still had a mortgage loan at the end of 2011.

Unfortunately, the available data does not allow us to examine what happens to the families in arrears who are no longer mortgage customers in a subsequent year. But it is fair to assume that at least some of them see their home sold through enforced sale or have to sell their home against their own wishes. The high proportion of families in arrears who "disappear" from the mortgage credit market within just one year is thus consistent with the view that, for many families, the consequences of defaulting on mortgage loans set in fairly quickly.

7. WHY DO FAMILIES FALL INTO ARREARS ON THEIR MORTGAGE DEBT?

In this section we present an econometric model describing the probability of a family falling into arrears as a function of selected socio-economic variables. The primary purpose of the model is to calculate the change in the probability of falling into arrears when financial variables such as the family's disposable amount and holding of liquid assets change. This enables us to assess the total number of families in arrears under different assumptions pertaining to developments in their financial situation. In section 8 we present examples of such assessments based on specific macroeconomic scenarios.

Model specification and variables

The probability of arrears is estimated using a probit model. This section provides an overall description of the model and the variables included in it. Box 6 contains a more detailed description.

The model describes the relationship between the probability of a family falling at least 105 days behind on its payments for the June instalment and a number of explanatory variables. Among the explanatory variables, we are particularly interested in the following: The disposable amount per adult in the family is, as previously mentioned, closely

THE PROBIT MODEL: MODEL SPECIFICATION AND VARIABLE DEFINITIONS Box 6

The probit model describes the probability that a family will fall into arrears on the June instalment, conditional on a number of family-specific variables. Mathematically, the model is given by

$$\Pr(y_{it+1} = 1|x_{it}) = \Phi(x_{it}\,\beta),$$

where y_{it+1} is an indicator variable that assumes the value 1 if family *i* is in arrears by 105 days on payments exceeding kr. 1,000 for the June instalment of year *t*+1, and otherwise 0; x_{it} is a vector of explanatory variables for family *i* in year *t*; β is a vector of parameters; and $\Phi()$ is the distribution function for the normal distribution. The model is a standard model in applied econometrics and can be estimated using maximum likelihood estimation, cf. e.g. Wooldridge (2002).

The vector x_{it} contains the following explanatory variables:

Disposable amount per adult: The family's disposable amount is calculated as annual income after tax less interest costs, maintenance payments, repayment of social benefits, administration margins payable to mortgage banks and any principal payments on mortgage debt. Repayment on other debt is not deducted due to lack of data. The disposable amount is in kr. 10,000. For families with two adults, the amount is also divided by two. In the model specification, the disposable amount is interacted with a total of six dummy variables for the family's holding of liquid assets plus positive home equity. These dummy variables are described below. To avoid perfect multicolinearity (the "dummy variable trap"), the disposable amount is not included directly, i.e. without interaction terms.

Relative change in income after tax and interest: The family's income after tax and interest is calculated in year *t* and in each of the three preceding years. Each year, only income from the adult members of the family in year *t* is included. In this way, we avoid including family income fluctuations resulting from changes in the size of the family caused by, say, a child leaving home. The relative change in the family's income after tax and interest is calculated relative to the peak in the preceding three years. In the model, the variable is represented by a set of four dummy variables, representing loss of income after tax and interest of 0 to 10 per cent, 10 to 25 per cent, 25 to 50 per cent and more than 50 per cent, respectively. The reference category thus consists of families whose income after tax has either been unchanged or going up. In addition, we also include all families with retired members in the reference category. The purpose is to avoid a mix-up of the expected loss of income that is usually connected with retirement and loss of income attributable to e.g. unexpected unemployment.

Liquid assets plus positive home equity: Liquid assets consist of the family's deposits in banks and the market value of bonds, mortgage deeds, stocks and investment certificates in the custody of a bank calculated at year-end. Home equity is calculated at property level and then aggregated for the family's mortgaged properties. For owner-occupied dwellings, home equity is calculated as the difference between 80 per cent of the property value and the total remaining debt on the property at year-end. Only mortgage debt is included. For summer cottages, home equity is calculated as the difference between 60 per cent of the property value and the total remaining debt. The reason is that it is possible to raise mortgage loans against up to 80 per cent of the value of owner-occupied dwellings, while the limit is 60 per cent for summer

CONTINUED Box 6

cottages. The mortgage bank's assessment of the property is used as the property value, and properties on which no mortgages have been taken out are consequently not included in the calculation of home equity

Only positive home equity is included in the aggregation of liquid assets. To allow for any non-linearity in the relationship between liquid assets plus positive home equity and the incidence of arrears, the variable is represented by a number of dummy variables, each representing a particular interval. More specifically, we construct dummy variables for each of the intervals kr. 0 to 50,000, kr. 50,000 to 100,000, kr. 100,000 to 250,000, kr. 250,000 to 500,000, kr. 500,000 to 1 million, and kr. 1 million or more. The first dummy is excluded and used as a reference category.

Pension wealth after tax: The family's pension wealth is estimated using the method described in Andersen et al. (2012a). It is calculated after taxation, i.e. less the estimated future income tax on pay-outs. To increase comparability with the liquid assets plus positive home equity, we have chosen to include pension wealth in exactly the same way as the first variable, i.e. in the form of a number of dummy variables, each representing a particular interval. The intervals and the reference category are exactly the same as for liquid assets plus positive home equity.

Debt service ratio: The debt service ratio is calculated as the sum of interest, administration margins payable to mortgage banks and any principal payments on mortgage debt as well as interest on other debt, stated as a percentage of the family's annual income after tax. Due to lack of data, repayments on other forms of debt are not included in the calculation.

Homeowner: Dummy variable that assumes the value 1 if the family lives in an owner-occupied dwelling, and otherwise 0.

Two-adult family: Dummy variable that assumes the value 1 if there are two adults in the family, and otherwise 0.

Age of eldest family member: The age is stated at year-end.

Number of children: The number of children under the age of 25 who live at home.

Higher education in the family: Dummy variable that assumes the value 1 if at least one of the adults in the family has completed higher education, and otherwise 0.

Number of years since taking up residence: States the number of years since the family took up residence at the address where it is living at the end of year t. The number of years is stated at the end of year t.

Prolonged unemployment: Dummy variable that assumes the value 1 if at least one of the adult members of the family has been unemployed for minimum three months in the year under review, and otherwise 0.

Divorce or the death of a spouse: Dummy variable that assumes the value 1 if at least one of the adult members of the family has been exposed to divorce or the death of a spouse in the year under review, and otherwise 0.

Admission to hospital: Dummy variable that assumes the value 1 if at least one of the adult members of the family has been admitted to hospital during the year under review, and otherwise 0.

Disbursement of sickness benefits: Dummy variable that assumes the value 1 if at least one of the adult members of the family has received sickness or maternity benefits in the year under review, and otherwise 0.

CONTINUED Box 6

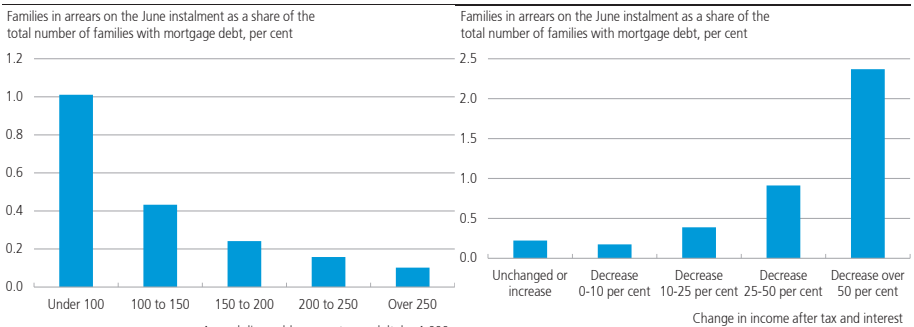
Area of Denmark: We construct a set of dummy variables for a total of 11 areas. Each variable assumes the value 1 if the family resides in the area under review, and otherwise 0. The dummy variable for Copenhagen is excluded and used as a reference category.

For a small number of families, the explanatory variables assume extreme values, often due to incorrect data. Although this applies to few families, very extreme values for key variables such as disposable amount and the debt service ratio may affect the estimates, blurring the actual relationship between these variables and the incidence of arrears. To avoid this, we exclude observations where the family's disposable amount is either under kr. -500,000 or over kr. 5 million; where the amount of liquid assets plus positive home equity exceeds kr. 20 million; or where the debt service ratio exceeds 1,000 per cent. This delineation reduces the number of observations by just over 1,000, or less than 1 per thousand of the total number of observations.

linked to the family's ability to service its debt, and we consequently expect a negative relationship between the size of the amount and the probability of falling into arrears. Indeed, such a relationship is clearly seen in a simple plotting of the two variables, cf. Chart 14 (left).

The strength of the above relationship may depend on the family's holding of liquid assets. For a family with substantial liquid assets, e.g. in the form of cash, equities or bonds, the size of the disposable amount will not necessarily affect the probability of arrears very much, since the family is able to compensate for a modest disposable amount by using its assets. This could also be the case if the family has considerable home equity, which it may pledge as collateral. Conversely, it is easy to imagine that the size of the disposable amount has a much greater impact

ARREARS RATE BROKEN DOWN BY DISPOSABLE AMOUNT PER ADULT AND RELATIVE CHANGE IN INCOME AFTER TAX AND INTEREST Chart 14



Note: The disposable amount per adult is calculated as the family's total annual income less tax, interest payments, maintenance payments, repayment of social benefits, administration margins payable to mortgage banks and any principal payments on mortgage debt – divided by the number of adults in the family.

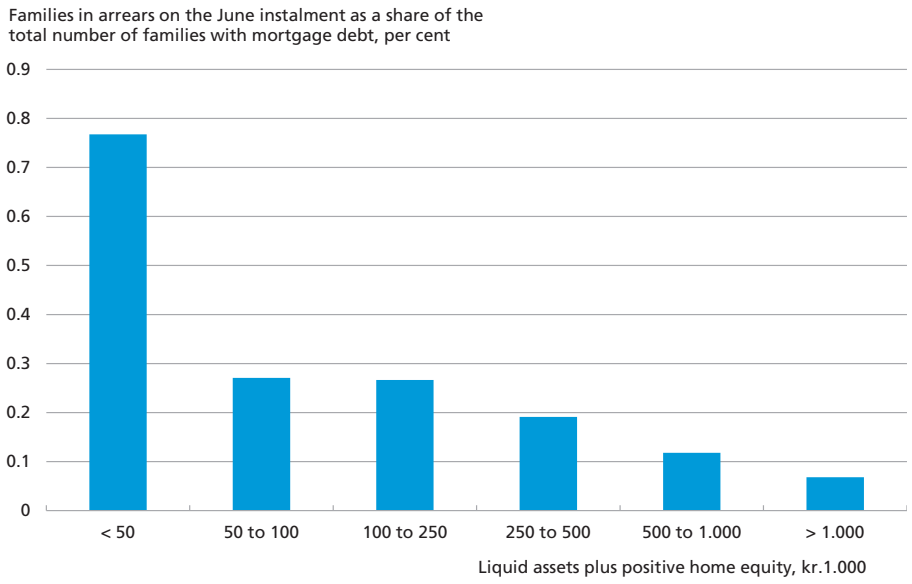
Source: Own calculations based on data from mortgage banks and from Statistics Denmark.

on the probability of arrears for families with few or no liquid assets and home equity. To capture such a difference, we include interaction terms between the family's disposable amount per adult and the family's holding of liquid assets plus any positive home equity in its mortgaged properties.

It is easy to imagine that not only the *level* of the disposable amount, but also the *change* therein may affect whether a family falls into arrears. A family that has had a large disposable amount for several years will presumably find it more difficult to adjust to a more modest amount of a given size than a corresponding family that has not been used to such a large disposable amount. To allow for this, we include variables indicating the relative change in the family's total income after tax and interest relative to the peak in the preceding three years. Chart 14 (right) shows a clear correlation between the relative change in income and the proportion of families in mortgage arrears when no adjustment is made for other explanatory variables.

As described above, we include the family's holding of liquid assets and any positive home equity interacted with the disposable amount. Obviously, the family's holding of assets may also have a separate impact on whether the family falls into arrears, as suggested in Chart 15. We

ARREARS RATE BROKEN DOWN BY HOLDINGS OF LIQUID ASSETS PLUS POSITIVE HOME EQUITY, 2011 Chart 15



Note: Liquid assets consist of the family's deposits in banks and the market value of bonds, mortgage deeds, stocks and investment certificates in the custody of a bank. Home equity is calculated as the difference between 80 per cent of the property valuation (60 per cent for summer cottages) and the amount of mortgage debt on the property.
Source: Own calculations based on data from mortgage banks and from Statistics Denmark.

allow for this by also including the liquid assets plus any positive home equity directly with no interaction with the disposable amount. Likewise, we also include a measure of the family's total pension wealth after tax. Large pension wealth gives the family a higher credit standing and may presumably serve as a financial buffer in some cases. This implies a lower probability of arrears. But as a general rule, pension wealth is much less liquid than other financial assets, and that could make it difficult to use in situations of financial stress. We consequently expect the amount of pension wealth to have less impact on the probability of arrears than the holding of liquid assets and home equity.

As another explanatory variable we include the family's debt service ratio. This ratio indicates the share of the family's annual income after tax that it uses to service its debt. If a family needs to spend a very large part of its disposable income to service its debt, this may cause financial difficulties, so we expect a positive relationship between the debt service ratio and the probability of arrears.

As control variables we include the age of the eldest family member, the number of children in the family, the number of years since it took up residence at the current address, and dummy variables for homeowner status, two-adult family, and higher education in the family. Besides, we include dummy variables for divorce or the death of a spouse, prolonged unemployment and illness. As explained in section 6, we assume that such social events primarily affect the probability of arrears via the resultant consequences for the family's finances. Since we have already controlled for the family's disposable amount, assets and debt service ratio, there is not necessarily any reason to expect a significant correlation between the social events and the incidence of arrears. However, the social events may have consequences that are not captured by the financial variables already included, but which impact the probability of arrears. For example, a divorce may lead to unexpected costs of separation and possibly legal assistance, while illness may entail pharmaceutical expenses, among other things. Such additional effects will be captured by the inclusion of the above dummy variables.

Finally, we include a set of dummy variables for the part of the country in which the family resides. As was the case for the social events, there is not necessarily any reason to expect a significant relationship between the geographical variables and the probability of arrears. Presumably, the primary reason why some geographical areas have a larger concentration of families in arrears than others is that the former areas have a larger share of families with tight budgets. Hence, this difference should be captured by the financial variables in our model. On the other hand, it cannot be ruled out that other geographical factors also play a

role. They might include regional differences in mentality and traditions among both mortgage banks and their local customers.[1] Any such local factors extending beyond economic differences between various parts of the country will be captured by the geographical dummy variables.

To avoid uncertainties when interpreting the results of the model, the timing of the dependent variable relative to the explanatory variables requires careful consideration. The dependent variable should thus reflect the incidence of arrears *after* the time of calculation of the explanatory variables. Otherwise there is a risk that the actual effect of the explanatory variables will not be captured by the measure used on the left-hand side of the model.[2] Since the arrears variable is based on the June instalment of a given year, while the explanatory variables are typically calculated for the entire year or at year-end, it is necessary to use data from two different years for left-hand variables and right-hand variables, respectively. If the explanatory variables are calculated for year *t*, the binary arrears variable is thus based on data from year *t*+1 in all the reported estimations.

The time lag between the dependent variable and the explanatory variables means that data from one year is "lost" in the estimations. With data for each of the three years 2009-11, data from two years is available in the estimations, i.e. *t*=2009 and *t*=2010.

Estimation results

Table 7 reports average marginal effects for the explanatory variables in the model.[3] The marginal effects indicate the change in the probability of arrears when each of the variables is changed.[4] Column 1 in the table presents the results from our preferred estimation, in which we use data from both 2009 and 2010. In columns 2 and 3 we divide the sample and estimate the model separately for each of the two years.

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1 In a study of home purchase loans in New York City, Chan et al. (2013) find that the neighbourhood characteristics affect the mortgage default rate, even when adjustment is made for differences in the characteristics of the individual borrower. The authors interpret the results as evidence of a "contagion effect", because high default rates in an area reduce the social stigma associated with defaulting on a mortgage.

2 To illustrate this, we consider a hypothetical example in which a family is subjected to income loss in October of a given year and subsequently falls into mortgage arrears. If the variable on the left-hand side of an econometric model is based on arrears on the June instalment of the *same* year, it will obviously not capture the actual effect of the income loss.

3 We do not report the actual parameter estimates in this text. The reason is that it is difficult to explicitly interpret the parameter estimates, and we consequently choose to focus on the average marginal effects. The parameter estimates can be seen in the Appendix, however.

4 For continuous variables, the marginal effect indicates the change in the probability of arrears in the event of a marginal increase in the variable concerned. For the dummy variables in the model, the marginal effect indicates the change in the probability of arrears when the dummy is changed from 0 to 1. In both cases the marginal effects are *average* effects. In other words, we started by calculating a marginal effect for each family, evaluated at the actual values of the explanatory variables for the family in question. We subsequently calculated the average for all the families included in the estimation for each variable.

AVERAGE MARGINAL EFFECTS IN PROBIT MODEL — Table 7

Percentage points	2009 and 2010	2009	2010
Variable			
Disposable amount per adult, kr. 10,000	-0.013*** (0.001)	-0.016*** (0.001)	-0.010*** (0.001)
Decrease in income after tax and interest between 0 and 10 per cent	0.001 (0.010)	-0.005 (0.014)	0.016 (0.015)
Decrease in income after tax and interest between 10 and 25 per cent	0.078*** (0.013)	0.080*** (0.018)	0.086*** (0.020)
Decrease in income after tax and interest between 25 and 50 per cent	0.320*** (0.023)	0.287*** (0.029)	0.381*** (0.037)
Decrease in income after tax and interest over 50 per cent	0.787*** (0.048)	0.717*** (0.061)	0.869*** (0.076)
Liquid assets plus positive home equity between kr. 50,000 and kr. 100,000	-0.289*** (0.020)	-0.322*** (0.028)	-0.253*** (0.029)
Liquid assets plus positive home equity between kr. 100,000 and kr. 250,000	-0.338*** (0.017)	-0.352*** (0.024)	-0.324*** (0.025)
Liquid assets plus positive home equity between kr. 250,000 and kr. 500,000	-0.420*** (0.017)	-0.426*** (0.024)	-0.412*** (0.024)
Liquid assets plus positive home equity between kr. 500,000 and kr. 1,000,000	-0.486*** (0.017)	-0.497*** (0.024)	-0.473*** (0.024)
Liquid assets plus positive home equity over kr. 1,000,000	-0.550*** (0.016)	-0.556*** (0.023)	-0.544*** (0.023)
Pension wealth after tax between kr. 50,000 and kr. 100,000	-0.016 (0.024)	-0.009 (0.034)	-0.019 (0.034)
Pension wealth after tax between kr. 100,000 and kr. 250,000	-0.061*** (0.020)	-0.084*** (0.028)	-0.029 (0.029)
Pension wealth after tax between kr. 250,000 and kr. 500,000	-0.140*** (0.020)	-0.164*** (0.029)	-0.107*** (0.029)
Pension wealth after tax between kr. 500,000 and kr. 1,000,000	-0.224*** (0.021)	-0.237*** (0.030)	-0.205*** (0.029)
Pension wealth after tax over kr. 1,000,000	-0.259*** (0.022)	-0.283*** (0.032)	-0.230*** (0.031)
Debt service ratio, per cent	0.002*** (0.000)	0.002*** (0.000)	0.002*** (0.000)
Homeowner	-0.316*** (0.011)	-0.347*** (0.016)	-0.291*** (0.016)
Two adults in the family	-0.159*** (0.010)	-0.193*** (0.015)	-0.123*** (0.014)
Age of eldest family member	0.007*** (0.000)	0.006*** (0.001)	0.007*** (0.001)
Number of children	0.099*** (0.004)	0.104*** (0.007)	0.094*** (0.006)
Higher education in the family	-0.168*** (0.010)	-0.171*** (0.014)	-0.162*** (0.014)
Number of years since taking up residence	-0.003*** (0.000)	-0.004*** (0.001)	-0.003*** (0.001)

CONTINUED Table 7

Percentage points	2009 and 2010	2009	2010
Prolonged unemployment	0.039***	0.035*	0.035*
	(0.014)	(0.020)	(0.018)
Divorce or the death of a spouse	0.190***	0.169***	0.209***
	(0.019)	(0.028)	(0.025)
Admission to hospital	0.116***	0.127***	0.103***
	(0.010)	(0.015)	(0.014)
Disbursement of sickness benefits	0.098***	0.110***	0.086***
	(0.010)	(0.015)	(0.014)
Copenhagen's environs	0.061***	0.041	0.086***
	(0.019)	(0.028)	(0.027)
North Zealand	0.075***	0.059**	0.094***
	(0.019)	(0.027)	(0.026)
East Zealand	-0.005	-0.025	0.015
	(0.035)	(0.050)	(0.047)
West and South Zealand	0.186***	0.196***	0.178***
	(0.026)	(0.038)	(0.035)
Bornholm	0.276***	0.276***	0.277***
	(0.019)	(0.027)	(0.025)
Funen	0.012	-0.024	0.049**
	(0.017)	(0.024)	(0.024)
South Jutland	0.009	0.008	0.012
	(0.016)	(0.024)	(0.022)
East Jutland	0.007	0.000	0.016
	(0.016)	(0.023)	(0.022)
West Jutland	-0.020	-0.038	0.000
	(0.018)	(0.026)	(0.024)
North Jutland	0.046***	0.038	0.055**
	(0.017)	(0.026)	(0.023)
Estimation method	Pooled probit	Probit	Probit
Year, explanatory variables	2009-10	2009	2010
Year, dependent variable	2010-11	2010	2011
Avg. estimated probability of arrears, per cent	0.31	0.33	0.29
Number of observations	1,871,562	928,865	942,697

Note: The table shows the average change in the calculated probability of arrears in the event of a change in each of the explanatory variables. For continuous explanatory variables, marginal changes are considered. For dummy variables, the change is from zero to one. The average change is calculated by first calculating the marginal effect for each family, evaluated at the actual values of the explanatory variables for the family in question. The average is then calculated for all the families included in the estimation. Standard errors are denoted in parenthesis. *, ** and *** indicate levels of statistical significance of 10, 5 and 1 per cent, respectively.

Source: Own calculations based on data from mortgage banks and from Statistics Denmark.

The marginal effects have the expected signs for all variables; in most cases the statistical uncertainty is small, and, overall, the magnitude of the effects is the same in all three columns. The level of the family's annual disposable amount per adult is negatively correlated with the prob-

ability of arrears. According to our estimates, reducing the disposable amount by kr. 10,000 per adult in the family will increase the probability of arrears by approximately 0.01 percentage point for an average family. Statistically, the effect is highly significant, but from an economic point of view it is very modest. This can also be said about changes over time in the family's income after tax and interest. Families that have seen a fall in income of more than 10 per cent relative to the peak in the preceding three years have a higher probability of falling into arrears than families whose income has remained unchanged or been rising, and statistically the difference is clearly significant. If the fall in income is between 10 and 25 per cent, however, the difference only amounts to approximately 0.08 percentage point. Even a sharp drop of minimum 50 per cent will, according to our estimates, entail an average increase in the probability of arrears of only around 0.8 percentage point.

Similar results are found for the family's liquid assets plus positive home equity: These estimates show a clear statistical correlation, as families with large assets have a lower probability of falling into arrears than families with no or few liquid assets. But the difference between the top category (more than kr. 1,000,000) and the bottom category (less than kr. 50,000) only amounts to just under 0.6 percentage point. As expected, we find a similar, yet slightly weaker correlation for less liquid pension wealth. For example, the probability of arrears for families with pension wealth of more than kr. 1 million is just 0.3 percentage point lower than for families with pension wealth after tax of less than kr. 50,000.

The family's debt service ratio also has a statistically clearly significant, but economically modest, effect on the probability of the family falling into arrears. On average, the probability of arrears increases by approximately 0.002 percentage point when this ratio increases by 1 percentage point.

The marginal effects of the control variables show, among other things, that mortgage arrears are less frequent among homeowner families and families with two adults than among non-owners and singles, and that higher education is associated with a lower probability of arrears. The marginal effects of illness and divorce or the death of a spouse are clearly statistically significant. This indicates that such social events increase the probability of getting into financial difficulties, not only through their impact on the financial variables included in our model, but also through derived effects not captured by our other explanatory variables. Prolonged unemployment is also positively correlated with the probability of arrears, but the marginal effect is modest, and a highly significant result is achieved only when we use data from

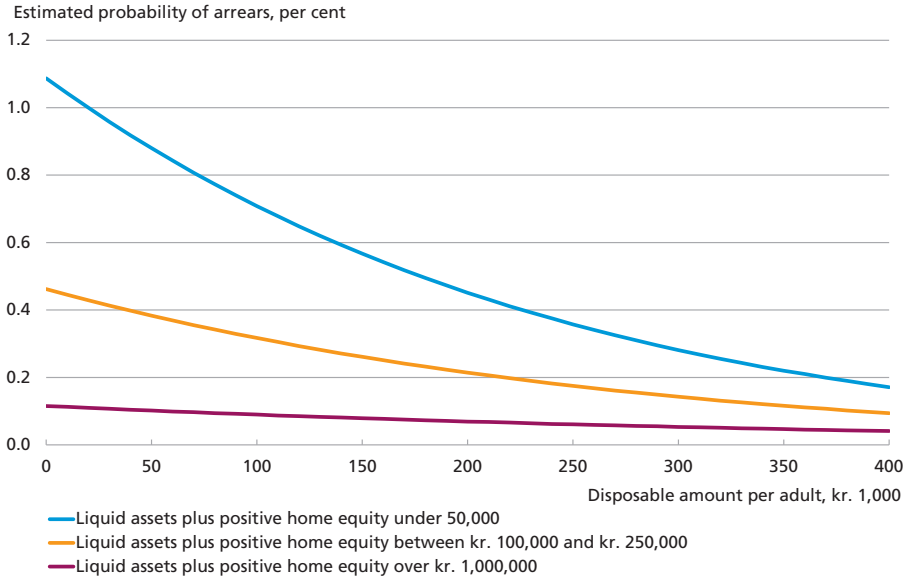
both 2009 and 2010. We interpret this as evidence that the most important effects of unemployment are captured by our key financial variables.

Finally, the estimates for the geographical variables show clear regional differences in the incidence of arrears, even when allowing for differences in the families' finances. The most pronounced cases in point are West and South Zealand and Bornholm where the probability of arrears for an average family is 0.2 and 0.3 percentage points higher, respectively, than for a family in Copenhagen with the same characteristics. It should be emphasised again that these differences cannot be explained by differences in the families' disposable amounts, debt service ratios, holdings of liquid assets and positive home equity or pension wealth, as we have controlled for precisely those factors. So the estimated regional differences must be attributed to geographical variation in conditions that are not captured by our control variables. This could be geographical patterns in the families' behaviour or variation in terms of how the mortgage banks handle the financial difficulties of customers in different parts of the country. They may also be attributable to differences in the state of the housing market: In areas with stagnant markets it may take a long time to sell a home. If they have difficulties servicing their debt, families in such areas may find it harder to solve the problems by selling their homes than families in areas with more activity in the housing market.

As mentioned, the marginal effects of the key financial variables are modest. To illustrate this, let us suppose that 10,000 randomly selected families are replaced by a corresponding number of families that are completely identical in all respects, except that their annual disposable amount is kr. 10,000 lower. According to our estimates, the expected effect will be a rise of one in the number of families in arrears. Among other things, the modest marginal effects reflect that the share of families in arrears on their mortgage debt is very small, even among those groups of families whose finances can be said to be tight.

It is worth remembering, however, that the reported effects are the *average* effects among all the families in the analysis. For some groups of families a smaller disposable amount may thus give rise to a considerably larger increase in the probability of arrears than suggested by Table 7. This is illustrated in Chart 16. Here, the average estimated probability of arrears is plotted as a function of the family's disposable amount per adult, subject to the size of the family's liquid assets plus positive home equity. Firstly, the chart illustrates that families with no or few liquid assets generally have a higher probability of falling into arrears than families holding substantial assets. In addition, the chart shows that the

DISPOSABLE AMOUNT AND ESTIMATED PROBABILITY OF ARREARS Chart 16



Note: The chart shows the average calculated probability of arrears for various combinations of disposable amount and holdings of liquid assets plus positive home equity. For each combination, an estimated probability of arrears is calculated for each individual family, given the family's other characteristics. The probability is calculated under the assumption that the family has had the disposable amount in question (or less) for minimum three years, so that the dummy variables for income loss all assume the value zero. After the probability of arrears has been calculated, the average for all families is calculated.

Source: Own calculations based on data from mortgage banks and from Statistics Denmark.

impact of the disposable amount on the probability of arrears is greater, the smaller the holding of liquid assets is. For a family whose liquid assets and home equity totals less than kr. 50,000, the average calculated probability of arrears thus amounts to less than 0.2 per cent when the disposable amount exceeds kr. 370,000, but it increases to just over 1 per cent as the disposable amount approaches zero. On the other hand, the calculated probability of arrears for families with liquid assets plus positive home equity of more than kr. 1 million remains largely unchanged when the disposable amount is reduced. As expected, the relationship between the disposable amount and the probability of arrears is stronger, the smaller the holding of liquid assets and home equity is. Hence, a given change in the disposable amount will affect some families more than others.[1]

[1] In the model estimation this is reflected by the fact that the parameter estimates for the coefficients on the interaction between the disposable amount and liquid assets plus positive home equity are numerically greater for the lowest categories of liquid assets, cf. Table A.1 in the Appendix. Formal statistical tests show a clear significant difference between the coefficients on the interaction terms. A null hypothesis of identical coefficients on the first two interaction terms cannot be rejected, however. The same applies to the null hypothesis of identical coefficients on interaction terms 3, 4 and 5.

Robustness test and out-of-sample predictions

One potential problem concerning the above estimations is that the families themselves exercise some influence over the size of their disposable amount in a given year. For example, restructuring debt from mortgage loans with amortisation to deferred-amortisation loans may lead to a substantial increase in the disposable amount, and some families will also have the option of taking on extra work if they need a higher income. It seems likely that families who find it difficult to pay their mortgage debt will be more inclined to take such initiatives than other families. If the mortgage payment difficulties occurred already in year *t* – the year in which we measure the key financial variables – this may give rise to problems of reverse causality, making it hard to identify the actual effect of those key variables. As a robustness check, we therefore estimate the model without including the families who were 105 days in arrears on their mortgage debt in June of year *t.* The main results of this estimation are seen in column 2 of Table 8. To facilitate comparison with the main results of our preferred estimation, these are presented in column 1 of the table. The marginal effects reported in column 2 are generally weaker than the corresponding effects in our preferred estimation. The estimates all have the same sign in the two estimations, however, and they are also of more or less the same size in all cases. So the

MARGINAL EFFECTS IN ALTERNATIVE ESTIMATIONS — Table 8

Percentage points	Basic specification	Conditional on no arrears in year *t*	Including families who are no longer mortgage customers at end-*t+1*
Disposable amount per adult, kr. 10,000	-0.013***	-0.009***	-0.024***
	(0.001)	(0.001)	(0.001)
Decrease in income after tax and interest between 0 and 10 per cent	0.001	-0.001	-0.018
	(0.010)	(0.009)	(0.013)
Decrease in income after tax and interest between 10 and 25 per cent	0.078***	0.067***	0.119***
	(0.013)	(0.012)	(0.016)
Decrease in income after tax and interest between 25 and 50 per cent	0.320***	0.245***	0.459***
	(0.023)	(0.020)	(0.026)
Decrease in income after tax and interest over 50 per cent	0.787***	0.567***	1,127***
	(0.048)	(0.041)	(0.053)
Liquid assets plus positive home equity between kr. 50,000 and kr. 100,000	-0.289***	-0.236***	-0.477***
	(0.020)	(0.018)	(0.023)
Liquid assets plus positive home equity between kr. 100,000 and kr. 250,000	-0.338***	-0.270***	-0.537***
	(0.017)	(0.016)	(0.020)
Liquid assets plus positive home equity between kr. 250,000 and kr. 500,000	-0.420***	-0.346***	-0.631***
	(0.017)	(0.015)	(0.020)

CONTINUED Table 8

Liquid assets plus positive home equity between kr. 500,000 and kr. 1,000,000	-0.486*** (0.017)	-0.405*** (0.015)	-0.727*** (0.020)
Liquid assets plus positive home equity over kr. 1,000,000	-0.550*** (0.016)	-0.452*** (0.015)	-0.822*** (0.019)
Pension wealth after tax between kr. 50,000 and kr. 100,000	-0.016 (0.024)	-0.023 (0.021)	0.004 (0.027)
Pension wealth after tax between kr. 100,000 and kr. 250,000	-0.061*** (0.020)	-0.051*** (0.018)	-0.060*** (0.022)
Pension wealth after tax between kr. 250,000 and kr. 500,000	-0.140*** (0.020)	-0.121*** (0.018)	-0.169*** (0.023)
Pension wealth after tax between kr. 500,000 and kr. 1,000,000	-0.224*** (0.021)	-0.186*** (0.019)	-0.293*** (0.024)
Pension wealth after tax over kr. 1,000,000	-0.259*** (0.022)	-0.204*** (0.020)	-0.349*** (0.026)
Debt service ratio, per cent	0.002*** (0.000)	0.002*** (0.000)	0.003*** (0.000)
Estimation method	Pooled probit	Pooled probit	Pooled probit
Year, explanatory variables	2009-10	2009-10	2009-10
Year, dependent variable	2010-11	2010-11	2010-11
Avg. estimated probability of arrears, per	0.31	0.24	0.52
Number of observations	1,871,562	1,859,349	1,929,586

Note: The table shows the average change in the calculated probability of arrears in the event of a change in each of the explanatory variables. The calculation method is as specified in Table 7. All estimations include the same control variables as specified in Table 7. Column 1 in the table presents results based on our preferred estimation, equivalent to column 1 in Table 7. Column 2 presents the results of an estimation in which families who are in arrears in year *t* have been excluded. Column 3 presents the results of an estimation in which families who were mortgage customers at the end of year *t*, but who were no longer mortgage customers at the end of *t+1* have been included. For those families, the arrears variable in year *t+1* is set at 1 if the family was 45 days behind on its mortgage payments for the September instalment of year *t*, and otherwise at 0.

Source: Own calculations based on data from mortgage banks and from Statistics Denmark.

overall picture is not changed by the exclusion of families in arrears in year *t*.

Another potential problem arises because, as previously mentioned, we only have information about existing mortgage loans at the end of the three years for which data is available. This could give rise to a selection problem. The problem is that the variable analysed, i.e. the incidence of arrears, may have a systematic impact on whether or not the loan appears in our data set. Some of the families that fall into arrears in June are likely to sell their home by the end of the year, possibly through enforced sale, so the mortgage loan in the home concerned will no longer exist at the time of calculation of our data set. In that case our data will not reflect the actual number of families in arrears, and the remaining families in the data set will not necessarily be representative of the total group of families that were mortgage custo-

mers at the beginning of the year. As a result, the estimated probability of arrears may be too low, and we may underestimate the impact of financial variables on the incidence of arrears.

To address this problem, we perform an estimation which includes all families with mortgage debt at the end of year *t* – including the families with no mortgage debt at the end of year *t*+1. The problem with the latter group is that we have no information about whether they were in arrears on the June instalment in year t+1, and this raises the question of which value the explanatory variable should take on for those families. Here, we make use of the fact that most mortgage banks have reported the incidence of 45-day arrears on the September instalment, since mortgage payment difficulties in September are likely to be positively correlated with subsequent difficulties in June. So if the above-mentioned families were in arrears by 45 days on payments exceeding kr. 1,000 for the September instalment of year *t*, we set the indicator variable for 105-day arrears in June of year *t*+1 at the value 1, and otherwise 0. The main results of this estimation can be seen in column 3 of Table 8. It shows that the number of observations increases by almost 60,000 when families with no mortgage debt at the end of year *t*+1 are included. At the same time, the average estimated probability of arrears increases to 0.52 per cent, reflecting that a relatively large share of the newly added families were 45 days in arrears on the September instalment of year *t*. The marginal effects of the financial variables are now numerically greater than before. As expected, the estimated relationship between the financial variables and the incidence of arrears is somewhat stronger when we include the families who were no longer mortgage customers at the end of year *t*+1. The difference in relation to our basic specification is not enough to materially change the conclusions, however.

A third potential problem is related to the choice of estimation method. King and Zeng (1999, 2001) demonstrate that commonly used estimation methods such as logit models and the probit model used here may produce problematic results when used to analyse the incidence of relatively rare events. Since the share of families in mortgage arrears is less than 1 per cent, this may be a relevant objection to our results.[1] We consequently performed estimations allowing explicitly for this problem as suggested by Tomz et al. (1999) and King and Zeng (1999, 2001). The results, which for the sake of brevity we have chosen not to bring here,

[1] The problem is that the methods typically underestimate the real probability of such rare events occurring. This applies primarily to analyses with few observations, however, so with approximately 1.9 million observations it is hardly a major problem in our case.

are very close to the corresponding results of the probit model and thus do not lead us to change our conclusions.

As a final test of the model properties we investigate whether the model is capable of predicting the arrears level in years which are outside the estimation period (out-of-sample predictions). Since data is available for two years only, there is limited room for making such assessments, but it does give us some idea of the quality of the model. The procedure is as follows: First we estimate the model for *t*=2009, i.e. with explanatory variables from 2009 on the right-hand side and arrears in June 2010 as the dependent variable. We then combine the parameter estimates from this estimation with the actual values of the explanatory variables for the families in 2010. For each family this results in an estimated probability of the family being in arrears by 105 days on payments exceeding kr. 1,000 for the June instalment of 2011. We can then compare these estimated probabilities with the actual arrears from June 2011. The results of this exercise are shown in Table 9. Given the actual values of the explanatory variables in 2010, the average probability of arrears is estimated at 0.26 per cent. By comparison, the actual share of families in arrears on payments for the June instalment of 2011 was 0.29 per cent. Translated into the number of families, the results are 2,448 (estimated) and 2,738 (actual), respectively. These figures should be viewed in the light of the fact that among the families included in our analysis, 0.33 per cent, or 3,030 families, were in arrears by 105 days on

OUT-OF-SAMPLE PREDICTIONS BASED ON ESTIMATION WITH T=2009 Table 9

	Expected value based on estimation with *t*=2009 and actual values of explanatory variables in 2010	Actual realised value among the families in the analysis
Share of families 105 days behind on payments in June 2011, per cent	0.26	0.29
Number of families 105 days behind on payments in June 2011	2,448	2,738
Total mortgage debt for families 105 days behind on payments in June 2011, kr. billion	2.86	3.48
Avg. probability of arrears for families 105 days behind on payments in June 2011, per cent	1.97	100.00
Avg. probability of arrears for families not 105 days behind on payments in June 2011, per cent	0.25	0.00

Note: The figures in the first column are the predicted values based on the estimates from our model with t=2009, combined with actual values of the explanatory variables in 2010. The last two rows report the average calculated probabilities of the family falling into arrears in June 2011 for two groups of families, i.e. (1) the families that were actually in arrears in June 2011, and (2) the families that were not in arrears in June 2011. If the model had been able to predict the incidence of arrears perfectly, this would have resulted in a value of 100 per cent for the first group and a value of zero for the last group.

Source: Own calculations based on data from mortgage banks and from Statistics Denmark.

the June instalment of 2010. So in this case, the model provides a correct prediction of a fall in the number of families in arrears from 2010 to 2011. But the predicted fall is somewhat greater than the actual development.

If, on the other hand, we focus on the predictions of the model for the *individual* family, Table 9 clearly shows that the model is far less informative at this level. This is evident first of all when we consider the families who actually fell into arrears in June 2011. If the model had been able to make a perfect prediction, the calculated probability of arrears would have been 100 per cent for all those families. However, the average predicted probability is only 2 per cent, so the model could not have predicted that these particular families would fall into arrears. All the same, the calculated probability is higher for the families who actually fell into arrears than for those who did not. For the latter group, the average calculated probability of arrears is 0.25 per cent. A model with perfect ability to predict would have resulted in a calculated probability of arrears of 0 for this group. So all things considered, the results indicate that the model is able to provide a fair assessment of *the number of* families that can be expected to fall into arrears, but not *which* particular families. From a macroeconomic perspective, however, the first question is the most relevant one.

8. HOW ROBUST ARE DANISH FAMILIES WITH MORTGAGE DEBT?

The estimated probit model can be used to calculate the change in the probability of arrears for each family when the explanatory variables change. Hence, we can use the model to assess how the number of families in arrears will change in different scenarios for the development in the Danish economy.

As a source of inspiration for such scenarios we have chosen to focus on two historical cases in which the Danish economy was subject to particularly strong turbulence. The first case is the oil crisis in the early 1970s and covers the period from the 2nd quarter of 1973 to the 1st quarter of 1975. Both unemployment and mortgage interest rates rose considerably during this period, while stock prices and real house prices fell. The second case covers the period from the 3rd quarter of 2008 to the 2nd quarter of 2010 during the financial crisis. This period was also characterised by falling house prices and rising unemployment, supplemented by substantial drops in equity prices. In Box 7 we provide a more detailed description of each case and of the macroeconomic scenarios they inspire. It should be emphasised that it is not our intention to draw

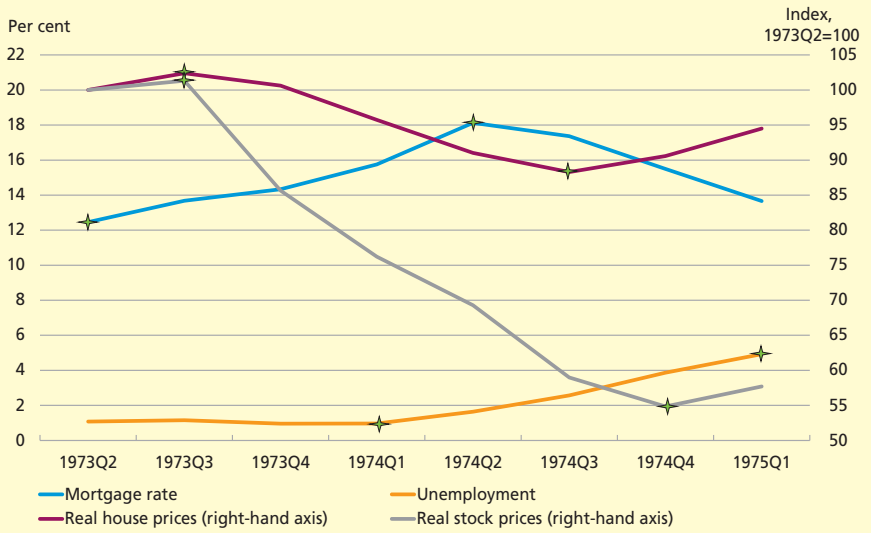
SETTING UP SCENARIOS OF DEVELOPMENT IN THE DANISH ECONOMY Box 7

We analyse the effect on the incidence of families' mortgage arrears in two scenarios. Both scenarios are based on the Danish economy in 2011. We then add hypothetical changes in four macroeconomic variables, i.e. interest rates, unemployment, house prices and stock prices. The changes are inspired by historical cases in which the Danish economy was subject to particularly strong turbulence.

Scenario 1: "Oil crisis scenario"

From the 2nd quarter of 1973 to the 2nd quarter of 1974, mortgage rates rose from approximately 12 per cent to approximately 18 per cent, cf. Chart 17. This was soon followed by a significant drop in stock prices to a level at end-1974 approximately 46 per cent below the peak in the 3rd quarter of 1973, adjusted for inflation. At the same time, real house prices fell by 14 per cent in the course of one year. After three quarters, the downturn was further aggravated as unemployment began to rise. From the trough of approximately 1 per cent of the labour force in early 1974, unemployment rose to almost 5 per cent in the course of one year.

HISTORICAL CASE 1: 2ND QUARTER OF 1973 – 1ST QUARTER OF 1975 Chart 17



Note: The stars indicate the peaks and troughs for each variable within the period under review.
Source: Danmarks Nationalbank and the MONA data bank.

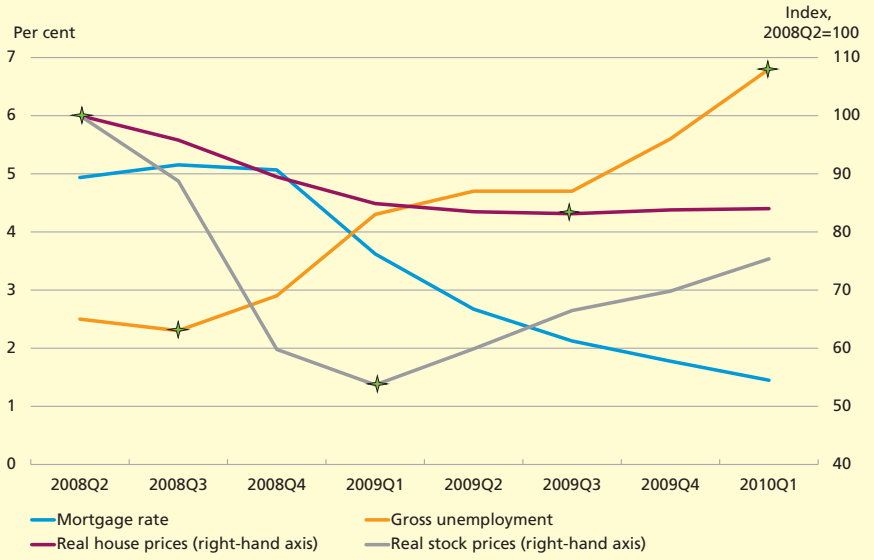
Based on developments in the early 1970s, we set up a scenario in which interest rates rise by 5.7 percentage points compared with the level at end-2011, and gross unemployment rises by 4 percentage points. At the same time, stock prices plummet by 46 per cent, while house prices fall by 14 pct.

Scenario 2: "Financial crisis scenario"

In the 3rd quarter of 2008, gross unemployment amounted to 2.3 per cent of the labour force, cf. Chart 18. 18 months later, in the 1st quarter of 2010, it had risen to 6.8 per cent. From the 2nd quarter of 2008 to the 1st quarter of 2009, stock prices, adjusted for inflation, plummeted by 46 per cent, while real house prices fell by 16.5 per cent from the 2nd quarter of 2008 to the 3rd quarter of 2009.

CONTINUED Box 7

HISTORICAL CASE 2: 2ND QUARTER OF 2008 – 1ST QUARTER OF 2010 Chart 18



Note: The stars indicate the peaks and troughs for each variable within the period under review.
Source: Danmarks Nationalbank and the MONA data bank.

Based on the above, we set up a scenario in which gross unemployment rises by 4.5 percentage points, while house prices and stock prices drop by 16.5 and 46 per cent, respectively. In the historical case serving as an inspiration to us, the changes in unemployment and stock prices described are offset by a significant drop in mortgage rates. But in view of the very low level of interest rates in 2011, it is not realistic to think that a fall of this magnitude could repeat itself. For this reason, interest rates are left unchanged in the scenario compared with the 2011 level.

direct parallels to the circumstances characterising the selected periods. The cases discussed only serve to illustrate that, historically, there have been examples of sudden concurrent changes in a number of macroeconomic variables, so it cannot be ruled out that changes of this magnitude may occur again.

Once the scenarios have been constructed, the next step is to translate the hypothetical developments in the macroeconomic variables into hypothetical values of the explanatory variables in the probit model for each family. This requires a number of assumptions concerning how the macroeconomic changes unfold at the micro level.

Changes in house and stock prices are assumed to be identical for all, so that all families experience the same percentage change in the value

of their homes and stock holdings. For the house prices, we thus ignore e.g. geographical asymmetries, which is a clear simplification. The changes in house and stock prices result in new hypothetical values for the families' holdings of liquid assets plus positive home equity.

A mortgage rate increase is assumed to affect all the families who have loans with fixed-interest periods of one year or less. However, we take into account that many variable-rate loans have interest-rate caps that limit the maximum increase in the rate of interest. For loans with fixed-interest periods of more than one year, on the other hand, the interest rate does not change unless the rate for the loan was actually adjusted in 2011. The results achieved thus reflect the immediate short-term effect of changes in the short-term mortgage rate. Furthermore, we assume that all other lending rates develop in parallel with the mortgage rate. This means that all other interest rates, including bank interest rates, change by the same number of percentage points as the mortgage rate. The change in interest rates affects payments on the families' debt, prompting calculations of hypothetical values for the disposable amount per adult, the relative change in income after tax and interest, and the debt service ratio. At the same time, it is taken into account that changing interest expenses will affect the families' tax payments.

Changes in unemployment are assumed to affect all families with the same probability, taking into account that only persons in employment can be hit by unemployment. In Box 8 we describe in more detail how a given increase in macro unemployment is modelled at the micro level. For those families who are hit by unemployment, we assume that the family's main income earner loses his/her earned income for 12 months. This is a very strong assumption which will, in many cases, not give a true and fair view of the situation for a typical family hit by unemployment. But the assumption serves as a useful benchmark, as it is a near-worst-case scenario for both the individual family and the overall effect of the rise in unemployment, cf. Box 8. The loss of earned income is assumed to be replaced by unemployment benefits if the main income earner is entitled to such benefits. This can be determined by unemployment insurance information from Statistics Denmark. For persons with no unemployment insurance, the rules on social benefits are applied to determine whether the main income earner is entitled to such benefits. The change in income prompts calculations of hypothetical values for the family's disposable amount per adult, the relative change in income after tax and interest, and the debt service ratio. When these variables are recalculated, the change in the main income earner's tax payments due to the change in income is also taken into account. In addition, the

MICROECONOMIC MODELLING OF RISING UNEMPLOYMENT Box 8

It is a particular complication of rising unemployment that it hits some families while others are unaffected. And unlike the case of interest-rate increases, we have no objective criteria for determining which families should belong to which group. Furthermore, a given rise in unemployment can be composed in many different ways. For example, a rise of 1,000 full-time equivalents may indicate that an additional 1,000 persons were unemployed throughout the year, or that 52,000 persons were unemployed for an extra week. So to translate a rise in macro unemployment to the micro level, we must determine both *how many* and *which* families are affected.

In the macroeconomic scenarios, the rise in unemployment is formulated as a change in the unemployment rate for the entire labour force. The first step is to translate this change into a number of full-time equivalents. This is done by multiplying the change in the unemployment rate by the number of persons in the labour force among the families included in the analysis.

The next step is to determine how to distribute the rise in the number of unemployed full-time equivalents on families. First, we assume that no more than one person in each family is hit by unemployment, thereby disregarding the possibility that both adults in a family may be hit by unemployment at the same time, which is obviously a simplification. Given this limitation, we must then determine whether the rise in unemployment should be composed as a short period of unemployment distributed on many families, or whether it should rather be modelled as a long period of unemployment for a smaller number of families. In order not to underestimate the importance of rising unemployment, we choose an approach that maximises the expected effect on the number of families in arrears. Consequently, we assume that the number of affected families is equivalent to the rise in unemployment in full-time equivalents. This means that a rise in unemployment of, say, 1,000 full-time equivalents is modelled by taking 1,000 families and having one person in each family who is unemployed throughout the year. This concentrates the rise in unemployment on a limited number of families, producing – due to the non-linear relationship between the disposable amount and the probability of arrears in the probit model – a greater overall effect than if the rise was spread over a larger number of families. To increase the effect, we also assume that in each of the affected families it is the person with the highest income who becomes unemployed. Based on these assumptions, we calculate the change in the arrears probability for each family hit by unemployment.

Finally, we must determine which families will be affected. By definition, it is only possible for persons in employment to become unemployed. Consequently, we assume that only families in which the main income earner was in full employment in 2011 can potentially be hit by unemployment. This is defined by the main income earner not having been unemployed, not having received pension, early retirement benefits, disability pension, sickness or maternity benefits, social benefits, unemployment benefits or student grants, and having a positive earned income. For the sake of simplicity, we also assume that the probability of being affected by unemployment is the same for all families in this category. Technically, the expected isolated effect of rising unemployment can then be calculated as follows: Let y_i^l denote the estimated probability of arrears for family *i* if the family is hit by unemployment, and let y_i^b denote the corresponding probability if the family is not hit by unemployment. The total effect of rising unemployment is then given by

CONTINUED Box 8

$$\sum_{i \in D} \delta_i (y_i^l - y_i^b)$$

where *D* is the number of families that can potentially be hit by unemployment, and δ_i is an indicator variable that assumes the value 1 if the family is hit by unemployment, and otherwise 0. Obviously, the exact value of the above expression depends on which families are hit by unemployment. But assuming that the probability is the same for all families, it is easy to calculate the *expected* value of the expression. Let that *n* denote the number of families to be hit by unemployment (equivalent to the rise in the number of full-time equivalents), and let that *N* denote the number of families that can potentially be hit. The expected effect of the rise in unemployment can then be calculated as

$$\frac{n}{N} \sum_{i \in D} (y_i^l - y_i^b).$$

The total expected effect on the number of families in arrears is then obtained by adding up the value of the above expression and the estimated effects of the other changes in the scenario.

dummy variable for prolonged unemployment is set at the value 1 when the family is hit by unemployment.

Overall, for each scenario, hypothetical values are calculated for five financial variables, i.e. the family's disposable amount per adult, the relative change in income after tax and interest, holdings of liquid assets plus positive home equity, the debt service ratio and the dummy variable for prolonged unemployment. All the other explanatory variables are assumed to be unchanged in relation to their actual values in 2011.[1]

The latter assumption entails that the families' wealth is not affected by changes in savings behaviour. This is clearly a simplifying assumption. Thus, in the event of a prolonged period of financial adversity, many families are likely to use their liquid assets and/or to borrow against any positive home equity, which will gradually reduce such assets. But it is extremely difficult to set realistic assumptions on how fast this process would be for each family, and we consequently disregard this effect. Coupled with the assumption that only loans with

[1] Therefore, the calculations should, strictly speaking, be viewed as a counterfactual assessment of the way the number of families in arrears would have developed if the Danish economy had been exposed to the described scenarios in 2011. But they could also reasonably be regarded as an assessment of the expected development in the incidence of arrears if the developments in the scenarios should occur today.

short fixed-interest periods are affected by the interest-rate changes this means that the changes in the explanatory variables should be perceived as the *immediate* consequences of the macroeconomic assumptions in the scenarios.

The hypothetical values of the explanatory variables can be combined with the parameter values from the estimated probit model so that we can calculate hypothetical probabilities of arrears for each family. The hypothetical probabilities can then be compared with corresponding probabilities based on the actual values of the explanatory variables. The difference between the two probabilities indicates the change in the family's probability of arrears in the scenario concerned. By aggregating this difference for all families in 2011, we achieve a measure of the expected rise in the number of families in arrears. Again, this is the *immediate* effect of the macroeconomic assumptions described.

In Table 10 we outline each of the two scenarios. The first scenario, in which both unemployment and interest rates are rising, while house prices and stock prices are going down, includes approximately 52,000 families who are hit by unemployment. For these families the average disposable amount per adult is reduced by approximately kr. 115,000, while the debt service ratio increases by almost 16 percentage points for the typical family in this group. For the families that are not hit by unemployment, the annual disposable amount is reduced by approximately kr. 16,000 on average. The average holdings of liquid assets plus positive home equity fall by around kr. 140,000 in this scenario. The changes in the families' financial position result in an increase in the average calculated probability of arrears of 2.1 percentage points for the families hit by unemployment and 0.2 percentage point for the rest. The expected number of families in arrears on payments for the June instalment consequently increases by around 2,800. The total mortgage debt for families in arrears by 105 days is expected to increase by kr. 5.3 billion. In relative terms, these figures are fairly large, representing almost a doubling of the arrears level. But in absolute terms, the effects are very modest. According to our calculations, total mortgage debt for the families in arrears will still amount to less than 1 per cent of total mortgage lending to households.

In scenario 2, the changes in unemployment and house prices are slightly greater than in scenario 1, while the change in real stock prices is the same. On the other hand, the interest-rate level is now assumed to remain unchanged. Overall, this results in less pronounced effects than in scenario 1. Hence, the expected rise in the number of families in arrears is now approximately 1,200. The difference in relation to scenario 1 reflects that changes in the level of interest rates have a fairly large im-

EXPECTED EFFECTS IN SCENARIOS — Table 10

	Scenario 1	Scenario 2
Macroeconomic assumptions		
Change in interest rates, percentage points	5.7	0.0
Change in gross unemployment, percentage points	4.0	4.5
Change in house prices, per cent	-14.0	-16.5
Change in stock prices, per cent	-46.0	-46.0
Changes in explanatory variables		
Number of families hit by unemployment	51,804	58,280
Average change in annual disposable amount per adult if the family is not hit by unemployment, kr.	-15,922	0
Average change in the annual disposable amount per adult if the family is hit by unemployment, kr.	-114,616	-94,752
Median change in debt service ratio if the family is not hit by unemployment, percentage points[1]	5.2	0
Median change in debt service ratio, if the family is hit by unemployment, percentage points[1]	15.6	5.95
Average change in holding of liquid assets plus positive home equity, kr.	-140,918	-158,679
Expected consequences		
Average change in probability of arrears for families not hit by unemployment, percentage points	0.19	0.04
Average change in probability of arrears for families hit by unemployment, percentage points	2.06	1.47
Average change in probability of arrears for all families taken as one, percentage points	0.29	0.13
Expected increase in the number of families in arrears by 105 days on the June instalment	2,816	1,236
Expected increase in total mortgage debt for families in arrears by 105 days on the June instalment, kr. billion	5.28	1.83

Note: The probabilities of arrears in each scenario are calculated by combining the parameter estimates from column 1 of Table A.1 with hypothetical values of the explanatory variables. The changes in the probabilities are measured in relation to a baseline scenario where the same parameter estimates are combined with the actual values of the explanatory variables in 2011. In the baseline scenario the average probability of arrears is 0.36 per cent, the expected number of families in arrears is 3,621, and the expected size of the total mortgage debt of the families in arrears is kr. 3.9 billion.

Source: Own calculations based on data from mortgage banks and from Statistics Denmark.

[1] Both scenarios include a few families for whom the hypothetical income after tax will be very small when the main income earner of the family is assumed to be hit by unemployment. This results in very high debt service ratios for those families. Accordingly, the average value of this variable is not very informative, and we consequently report the median changes instead.

pact on the arrears rate, at least when compared with the other macroeconomic variables we have focused on.

In view of the magnitude of the macroeconomic changes in the two scenarios, the impact on the arrears level is very modest. This is because the coefficient estimates for the key financial variables in our preferred version of the probit model are numerically small. Accordingly, the estimated probability of arrears for a given family does not change very much when the values of the key financial variables change. As described in section 7, the estimates increase somewhat if instead we use a version of the probit model which includes the families who are no longer mortgage customers at the end of year t+1 in the analysis. But

even if we use these estimates instead, the expected consequences in the scenarios are still limited. In scenario 1, the expected number of families in arrears now increases by approximately 4,000, while the expected increase in scenario 2 is 1,600 families.

It is worth noting that the modest effects in the scenarios are in accordance with actual experience from recent years. Despite an unusually sudden slowdown in the Danish economy, the increase in the arrears level from 2008 to 2009 was moderate, and the aggregate arrears rate never reached the level of the early 1990s. Coupled with the microdata analyses in this article, this strengthens the presumption that even severe setbacks in the Danish economy will not lead to a surge in the number of families in arrears.

The question remains of why mortgage arrears are so much less common today than in the early 1990s. Since that period is not covered by our microdata for the incidence of arrears, it is hard to give a firm answer to this. Presumably, a number of different factors each contribute to explaining the difference. Firstly, the introduction of new loan types such as adjustable-rate loans and loans with deferred amortisation has given mortgage customers new opportunities to adjust to economic changes. Undoubtedly, this is also one of the reasons why some families have found it easier to cope with temporary periods of tight finances. Moreover, in 1992, access was granted to free mortgaging of the home within the 80 per cent limit of the property value. This enabled homeowners to draw on any positive home equity in case of temporary financial problems. In 1993, mortgage banks were again given access to provide 30-year fixed-rate annuity loans for owner-occupied dwellings. Since 1986, borrowing had taken place via 20-year mixed loans. In addition, mortgage banks tightened the procedures for customers in financial difficulties in the early 1990s. This may have contributed to a change in behaviour among some mortgage customers, since the consequences of defaulting on loans were now greater and set in more quickly.

Finally, there is a third potential explanation, which is related to the duration of the macroeconomic recession. The downturn in the late 1980s and early 1990s was the longest downturn in the Danish economy in the last 200 years, cf. Abildgren et al. (2011). A number of families therefore experienced a prolonged period of financial squeeze in those years, and, as previously mentioned, declining inflation and the tax reform in the mid-1980s contributed to a sharp increase in real after-tax interest rates. Undoubtedly, many homeowners' holdings of liquid assets were heavily reduced as a result of this. As stated, our calculations should be regarded as an assessment of the immediate effects of a sudden slowdown in the economy. On the other hand, it is extremely diffi-

cult to allow for the potential long-term effects resulting from the gradual wearing down of the families' financial buffers. Against this background it could be argued that in the longer term the number of families in arrears would rise more than envisaged in our results if the Danish economy were to be affected by a downturn of the same duration as in the early 1990s.

Another possible objection to our results is that non-linear effects of changes in the financial variables and/or interaction effects between different variables may exist which are not properly captured by our model. If the effects of various negative shocks to the economy reinforce each other in a way that the model does not take into account, there is a risk that our analysis underestimates the overall effect on the probability of arrears.

The above objections are both fair and relevant, but in our opinion neither has the potential to seriously change the main conclusion of the analysis: that even severe economic setbacks will lead to only a limited rise in the number of families in mortgage arrears. We therefore expect the arrears rate to remain at a considerably lower level than in the early 1990s, even in the event of a prolonged setback in the Danish economy.

In summary, we can conclude that the vast majority of Danish families service their mortgage loans on time – even when their finances become tighter. So a sharp increase in the incidence of mortgage arrears is not likely, and the threat to the credibility of mortgage bonds from that quarter is limited. However, this does not imply that the families' financial behaviour is immaterial to the overall credit risk in the mortgage credit sector. In an analysis of household consumption decisions, Bang-Andersen et al. (2013) find that private consumption responds strongly to changes in both house prices and the level of interest rates. A decline in private consumption will weaken Danish firms, potentially leading to increased losses on lending by mortgage banks to the corporate sector.

In addition, it is important to make it clear that we have solely reviewed the consequences for mortgage arrears. Hence, our results do not say anything about the expected consequences for the families' compliance with their debt commitments to e.g. banks. By combining the macroeconomic assumptions in our scenario 1 with estimation results from Abildgren and Damgaard (2012), it is possible to calculate an expected immediate increase in banks' loan impairment charges on lending to private households of approximately 1 per cent of total lending. The corresponding figure for scenario 2 is 1.2 per cent. Judging from these estimates, the consequences for banks will be considerably greater than for mortgage banks.

9. FROM DEFAULT TO MAINTENANCE – WHO MANAGE TO RESOLVE THEIR ARREARS?

Among the families included in our analyses, approximately 2,300 were 105 days behind on payments exceeding kr. 1,000 for the June instalment of 2010, but not on payments for the June instalment of 2009. Just under half of them were still mortgage customers at the end of 2011, and in 668 cases, the financial difficulties seemed to have been resolved as the family was not in arrears by 105 days on the June instalment of 2011. In contrast, 371 families had serious financial difficulties again in 2011, while 1,271 families were no longer mortgage customers at the end of the following year.

Why do some families manage to resolve their financial difficulties, while others do not? One obvious explanation could be that the difficulties were initially less serious for the former group. Indeed, this appears to be the case, since the average arrears amounts in 2010 were lower for the families with no arrears on the June instalment of 2011 than for the other families, cf. Table 11. For a larger proportion of the former families, the problems also appear to have been of short dur-

ARREARS STATUS IN 2011, INCOME DEVELOPMENT AND STRUCTURE OF DEBT FOR FAMILIES IN ARREARS ON THE JUNE INSTALMENT OF 2010 Table 11

	Families with mortgage loans at end-2011, not in arrears in June 2011	Families with mortgage loans at end-2011, in arrears in June 2011	Families with no mortgage loans at end-2011
Number of families	668	371	1,271
Avg. amount of arrears in June 2010, kr.	17,446	21,454	18,755
Share in arrears by 45 days on the September instalment of 2010, per cent	68.7	85.4	93.9
Avg. income after tax in 2009, kr.[1]	338,520	333,083	264,852
Avg. income after tax in 2011, kr.[1]	363,298	349,725	257,008
Share with adjustable rates on min. 50 per cent of mortgage debt at end-2009, per cent[1]	50.5	47.6	38.8
Share with adjustable rates on min. 50 per cent of mortgage debt at end-2011, per cent[1]	56.4	47.6	-
Share with deferred amortisation on min. 50 per cent of mortgage debt at end-2009, per cent[1]	44.6	54.3	55.3
Share with deferred amortisation on min. 50 per cent of mortgage debt at end-2011, per cent[1]	48.9	52.4	-

Note: Only families in arrears by 105 days on payments exceeding kr. 1,000 for the June instalment of 2010 are included. This is also conditional on the family being a mortgage customer at the end of 2009, and that it was not 105 days behind on its payments for the June instalment of that year. Families with members who are self-employed or not liable to tax are not included. The same applies to families with an annual income after tax of less than kr. 25,000 in 2010.

Source: Own calculations based on data from mortgage banks and from Statistics Denmark.

[1] Only families in which the composition of adult members is the same in 2009 and 2011 are included.

ation: 31 per cent of the families in this group were not in arrears by 45 days on the September instalment of 2010, even though they were more than three and a half months behind with the June mortgage payments in the same year. Among the remaining families, this only applied to around 15 per cent of the families who were still mortgage customers at end-2011, and only to around 6 per cent of the families who no longer had mortgage loans.

Another possible explanation is changes in the family's income. A comparison of income after tax in 2009 (i.e. the year *before* the family fell into arrears) with income after tax in 2011 (i.e. the year *after* the family fell into arrears) shows clear differences between the three groups of families in arrears. The families who managed to resolve their problems experienced an *increase* in their average income after tax of 7.3 per cent. For the families who found themselves in serious financial difficulties again in 2011, the average income increased by 5 per cent, while the families who were no longer mortgage customers at end-2011 experienced a *fall* in their average income after tax of 3 per cent.

Finally, there are indications that converting mortgage debt to other loan types may make a difference in terms of whether a family is able to resolve its financial difficulties. This can be seen e.g. by considering how large a share of the families in each of the three groups had adjustable-rate loans for more than half of their mortgage debt in 2011 compared with the corresponding share in 2009. Among the families who reverted to making their payments on time, this share rose from 51 per cent to 56 per cent over the two-year period. Among the families who continued to have payment problems, the share with adjustable-rate loans for more than half of their mortgage debt did not increase, however.

A similar difference applies to the use of deferred-amortisation loans. The share of families with deferred-amortisation loans for at least half of their debt increased considerably in the group who managed to resolve their problems, while the share was more or less unchanged for families with continued payment problems. Part of the explanation is that the use of deferred-amortisation loans was already more widespread in the latter group than in the former group in 2009, i.e. *before* the payment problems arose. Hence, the differences between the two groups indicate that the option of deferred amortisation may very well contribute to resolving sudden difficulties in servicing their mortgage loans – but only if the family did not fully exploit this option before the problems occurred.

10. LITERATURE

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APPENDIX

PARAMETER ESTIMATES IN PROBIT MODEL — Table A.1

	2009 and 2010	2009	2010
Disposable amount per adult, kr. 10,000			
x liquid assets plus positive home equity under kr. 50,000	-0.017*** (0.001)	-0.021*** (0.002)	-0.013*** (0.002)
x liquid assets plus positive home equity between kr. 50,000 and kr. 100,000	-0.020*** (0.002)	-0.023*** (0.003)	-0.019*** (0.003)
x liquid assets plus positive home equity between kr. 100,000 and kr. 250,000	-0.013*** (0.002)	-0.015*** (0.002)	-0.012*** (0.002)
x liquid assets plus positive home equity between kr. 250,000 and kr. 500,000	-0.015*** (0.002)	-0.018*** (0.003)	-0.013*** (0.002)
x liquid assets plus positive home equity between kr. 500,000 and kr. 1,000,000	-0.014*** (0.002)	-0.019*** (0.003)	-0.010*** (0.002)
x liquid assets plus positive home equity over kr. 1,000,000	-0.008*** (0.002)	-0.010*** (0.002)	-0.006*** (0.002)
Decrease in income after tax and interest between 0 and 10 per cent	0.001 (0.015)	-0.007 (0.021)	0.023 (0.022)
Decrease in income after tax and interest between 10 and 25 per cent	0.100*** (0.016)	0.101*** (0.021)	0.115*** (0.024)
Decrease in income after tax and interest between 25 and 50 per cent	0.314*** (0.017)	0.284*** (0.023)	0.364*** (0.025)
Decrease in income after tax and interest over 50 per cent	0.557*** (0.021)	0.518*** (0.029)	0.601*** (0.031)
Liquid assets plus positive home equity between kr. 50,000 and kr. 100,000	-0.177*** (0.039)	-0.221*** (0.054)	-0.108* (0.056)
Liquid assets plus positive home equity between kr. 100,000 and kr. 250,000	-0.324*** (0.031)	-0.365*** (0.045)	-0.278*** (0.045)
Liquid assets plus positive home equity between kr. 250,000 and kr. 500,000	-0.408*** (0.033)	-0.420*** (0.045)	-0.388*** (0.048)
Liquid assets plus positive home equity between kr. 500,000 and kr. 1,000,000	-0.542*** (0.033)	-0.533*** (0.047)	-0.539*** (0.048)
Liquid assets plus positive home equity over kr. 1,000,000	-0.792*** (0.035)	-0.784*** (0.049)	-0.802*** (0.051)
Pension wealth after tax between kr. 50,000 and kr. 100,000	-0.015 (0.022)	-0.008 (0.029)	-0.018 (0.033)
Pension wealth after tax between kr. 100,000 and kr. 250,000	-0.057*** (0.018)	-0.076*** (0.024)	-0.028 (0.027)
Pension wealth after tax between kr. 250,000 and kr. 500,000	-0.145*** (0.019)	-0.164*** (0.026)	-0.115*** (0.028)
Pension wealth after tax between kr. 500,000 and kr. 1,000,000	-0.265*** (0.022)	-0.266*** (0.030)	-0.259*** (0.032)
Pension wealth after tax over kr. 1,000,000	-0.328*** (0.027)	-0.345*** (0.038)	-0.307*** (0.038)
Debt service ratio, per cent	0.003*** (0.000)	0.002*** (0.000)	0.003*** (0.000)
Homeowner	-0.388*** (0.013)	-0.407*** (0.018)	-0.375*** (0.020)
Two adults in the family	-0.195*** (0.012)	-0.226*** (0.017)	-0.159*** (0.018)

CONTINUED Table A.1

	2009 and 2010	2009	2010
Age of eldest family member	0.008***	0.008***	0.009***
	(0.000)	(0.001)	(0.001)
Number of children	0.121***	0.122***	0.122***
	(0.005)	(0.007)	(0.008)
Higher education in the family	-0.206***	-0.201***	-0.209***
	(0.012)	(0.017)	(0.017)
Number of years since taking up residence	-0.004***	-0.005***	-0.004***
	(0.001)	(0.001)	(0.001)
Prolonged unemployment	0.048***	0.041*	0.045*
	(0.017)	(0.024)	(0.024)
Divorce or the death of a spouse	0.233***	0.198***	0.270***
	(0.023)	(0.032)	(0.032)
Admission to hospital	0.142***	0.149***	0.133***
	(0.013)	(0.018)	(0.018)
Disbursement of sickness benefits	0.120***	0.129***	0.111***
	(0.012)	(0.017)	(0.018)
Copenhagen's environs	0.085***	0.054	0.125***
	(0.027)	(0.036)	(0.039)
North Zealand	0.101***	0.075**	0.136***
	(0.026)	(0.035)	(0.038)
East Zealand	-0.008	-0.036	0.025
	(0.054)	(0.076)	(0.077)
West and South Zealand	0.216***	0.210***	0.228***
	(0.028)	(0.038)	(0.042)
Bornholm	0.291***	0.273***	0.316***
	(0.022)	(0.030)	(0.034)
Funen	0.018	-0.035	0.077**
	(0.026)	(0.035)	(0.039)
South Jutland	0.013	0.012	0.020
	(0.025)	(0.034)	(0.037)
East Jutland	0.011	0.000	0.027
	(0.024)	(0.033)	(0.036)
West Jutland	-0.031	-0.057	0.001
	(0.028)	(0.039)	(0.042)
North Jutland	0.065***	0.050	0.086**
	(0.025)	(0.034)	(0.037)
Constant	-2.248***	-2.087***	-2.438***
	(0.041)	(0.056)	(0.060)
Estimation method	Pooled probit	Probit	Probit
Year, explanatory variables	2009-10	2009	2010
Year, dependent variable	2010-11	2010	2011
Number of observations	1,871,562	928,865	942,697

Note: The table indicates the coefficient estimates in the probit model described in section 7. Standard errors are denoted in parenthesis. *, ** and *** indicate levels of statistical significance of 10, 5 and 1 per cent, respectively.

Source: Own calculations based on data from mortgage banks and from Statistics Denmark.