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Sustainable household debt: Towards an operational view and framework

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Abstract

From a broad financial stability perspective, sustainable household debt should be evaluated within a steady-state consumption-path approach. We calculate measures for households' steady-state consumption based on average consumption to income ratios for a number of household groups and use a 'counterfactual history approach' to evaluate their debt sustainability. The results show that households within the first-home buyers and second steppers groups, which hold more than half of total household debt in Norway, are vulnerable to an increase in the loan rate.

Key words: Household debt, sustainability, consumption, financial stability

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1 Introduction

For many years, Norges Bank has drawn attention to the development in household debt. This is related to the bank's responsibility for promoting financial stability and keeping inflation low and stable. With higher debt, households are more sensitive to shocks to income, interest rates and house prices. Such shocks may affect households' default on bank loans and consumption, and hence affect both financial stability and price stability. For a discussion of the potential macroeconomic consequences of higher household debt, see, for example, Debelle (2004a, 2004b).

The Ministry of Finance has recently charged Norges Bank with the function of macroprudential policy adviser. This role includes supplying the Ministry with both the information necessary for macroprudential policy decisions and a policy advice. The aim of macroprudential policy is to prevent or mitigate systemic risks within the financial system, for example, Basel Committee on Banking Supervision (2010), Committee on the Global Financial System (2010), the review by Galati and Moessner (2010) and references therein. Macroprudential policy is closely connected to regulating banks' lending behaviour, including lending to households. Norges Bank will therefore monitor household debt even more - rather than less - closely in the future.

In Norges Bank's reports on financial stability, and in speeches by the central bank governors, concerns have been raised about the high and continuously increasing household debt to income ratio.. Norges Bank (2012a) states that "The high household debt burden poses a risk to financial stability" and "... a future interest rate increase or loss of income ... households may be forced to reduce consumption or saving". In the same report, however, it is claimed that "Most households will thus be able to tolerate a substantial increase in the interest burden before they encounter payment problems."

The seemingly conflicting views in one and same report, reflects the complexity of the issue of sustainable or unsustainable household debt. First, the *horizon* for the evaluation of household debt is important. At any point in time, as long as households are capable of servicing their debt, the level of debt may appear sustainable. At the same time, looking into the future or over a longer horizon, both the level of and the rate of growth in household debt may seem unsustainable. Second, the framework, or more explicitly *the model*, applied to evaluate the sustainability of household debt, is important. Evaluation of household debt typically relates the level or growth to what is considered fundamental explanatory variables. In general, the set of explanatory variables includes a measure of household income, the interest rate on debt, and collateral values, i.e. house prices, since most household debt is mortgage debt. However, the choice of fundamentals is not identical across analyses, and the choice may well influence the conclusion. Third, even if one concludes that household debt is in accordance with its fundamental value, the question of potential *fragility* in the fundamental explanatory variables remains and may affect the final conclusion.

The latter, i.e. the potential fragility in explanatory variables, seems particularly relevant in the Norwegian case. The prolonged period of high income growth for Norwegian households can to a large degree be related to high oil prices. A long-lasting fall in oil prices may trigger significant downward pressure on income growth. Furthermore, households may experience a significant increase in the interest rate on loans if banks' funding costs or risk assessment change. Finally, history has taught us that house prices, as most asset prices, vary significantly over time. Hence, a price fall, which reduces the collateral value of private homes, may well occur.[1] If such an unfavourable development in fundamental explanatory variables should occur, household debt may turn out to be at an unsustainable level.

From the discussion above, it is easy to understand that the view on "sustainable household debt" may vary. The potential impact of the framework used for evaluation makes it a difficult and complex issue, and it is tempting to conclude as Paul Ashworth, senior US economist at Capital Economics: "Nobody knows what a sustainable household debt level is supposed to be" (Rampell, 2010).

Despite the challenges, we argue that a policy maker, such as Norges Bank, should have a well defined framework for assessing household debt sustainability, including an operational definition. Information on this should be available to the public. The potential benefits of this approach are, first, that it is likely to promote consistency in the evaluation over time, and second, that it will enable agents to better understand and predict policy decisions. Ideally, banks and households should take expected policy actions into account when making their decisions. In this case, the need for policy actions may be reduced.

In this paper, we put forward an operational definition of household debt-sustainability within a broader financial stability perspective. Data at the household age-group level are used to test debt sustainability within a counterfactual history approach. Since the interest rate is the primary policy instrument of an inflation targeting central bank, and since macroprudential policy is aimed at mitigating systemic risk by smoothing credit growth through the cycle and making the banks more resilient, it is particularly relevant to look at the vulnerability to increases in the interest rate and how close to a maximum manageable debt level households are.

We should add, however, that the analytical approach applied in this paper to address household debt sustainability should be seen merely as a milestone along the road towards a well defined analytical framework.

2 Defining sustainable household debt

We argued above that the central bank should develop a clear framework for evaluating sustainable household debt, which would include an operational, i.e. empirical measurable, definition. In the literature, we have found only two papers that explicitly provide an

[1] See Jurgilas and Lansing (2013) and references therein for resent analyses of Norwegian house prices.

operational definition of household debt sustainability. In addition, there are a few strands in the literature that one can argue are closely related to debt sustainability. In the following, we will first present the relevant approaches before presenting our definition of sustainable household debt.

2.1 Sustainable household debt in the literature

Sustainability may be viewed as a fundamental-value issue. In this case, a sustainable level of household debt is related to a specified prediction model with fundamental explanatory variables or indicators that household debt is held up against. A comparison of actual debt and predicted debt, where the latter defines the fundamental value, will show if debt is above or below its fundamental value. If one assumes that fundamental value bears information on the level of debt that households are able and willing to service, debt above the fundamental value would imply unsustainable debt. For analyses that model household debt and hence develop prediction models, see for example Georgopoulos et al. (2011), Tudela and Young (2005), Papadimitriou et al. (2002, 2006), Jacobsen and Naug (2004) and Barnes and Young (2003). The Barnes and Young (2003) paper defines 'sustainability of household debt' consistently with the fundamental-value perspective: "...the level of debt chosen by a household is sustainable whenever the expectations about income growth, house prices, interest rates and other determinants of borrowing that underlie that choice are not falsified or revised."

An alternative strand in the literature models households' ability and willingness to service their debt directly by modelling households' non-performing loans, see Berge and Boye (2007), Rinaldi and Sanchis-Arellano (2006) and May and Tudela (2005) and references therein. In this case, one would need to define a benchmark value against which predictions of non-performing loans can be compared. If the predicted value of non-performing loans is above the benchmark, this would signal unsustainable debt.

While the first approach, by definition, would predict sustainable debt levels if the model is simulated on a priori specified future paths of the explanatory variables, the second approach does not necessarily do so.

We also refer to the work by Drehmann and Juselius (2012). They look at the usefulness of private sector's debt servicing cost as a predictor, i.e. early warning signal, of banking crises. The intuition is that an increase in the 'debt servicing cost to GDP' ratio reduces private agents' ability and/or willingness to service their debt. Debt servicing costs are defined as interest payments and principal payments and depend on the debt level, the interest rate and the maturity of the debt. As part of their analysis, they look separately at the ratio of household debt servicing costs to disposable income.

The last alternative is given in Barker (2009), who also gives an explicit definition of sustainable household debt. She defines "a weak form" and "a stronger form" of sustainability. According to Barker, the burden of debt is in some sense unsustainable if expected income growth, the likely path of interest rates and maintenance of current spending

patterns imply ever-rising debt levels. This gives her weak form definition. The stronger form of sustainability is related to a level of debt that households want to sustain. She adds that, under plausible assumptions, agents are comfortable with this steady-state level of debt which should not be ever-rising. It is interesting that Barker relates sustainable debt not only to household income and the interest rate, but also to household spending, i.e. consumption, pattern. Furthermore, in her stronger form definition, the statements "level of debt that households want to sustain" and "steady-state level of debt" point to optimising household behaviour and a longer horizon approach.

Our understanding of these alternative strands in the literature described above is that they are very much in conjunction with each other. However, when choosing an operational definition and designing a framework for evaluating households' sustainable debt, we will particularly bear in mind the proposal by Barker. We strongly believe that consumption is important. Debt, or savings, is the instrument for consumption smoothing over time, i.e. for disconnecting the consumption path from the income path.

2.2 Towards an operational definition

We propose a narrow and a wider definition of sustainable household debt that we believe encompass the alternatives described in the previous section. The narrow definition takes a narrow financial stability perspective and is related to household debt servicing capacity and willingness. The wider definition takes a wider financial stability perspective and relates to both direct and indirect consequences of households' debt position. This latter definition reflects the responsibility of the central bank for promoting financial stability and also its role within macroprudential policy.

Banks' credit risk is important for financial stability, and households are important for banks' credit risk. This is true for the credit risk that is directly related to household debt, but also for the credit risk related to firms' debt that can be triggered by household behaviour. Based on previous experience, in cases of a negative event, we expect households in general to give priority to fulfilling their debt contract, even if this means a serious cut in consumption for a period of time. Hence, consumption acts as a buffer against default on debt. A cut in consumption affects firms negatively, however, and may cause default on firms' bank loans and bank losses.

From a central bank perspective, sustainability of household debt should be related both to household debt servicing capacity and to the potential effect on firms from a cut in household consumption in order to fulfil their debt contract.

Narrow definition
Households are able and willing to service their debt.

We address this condition by evaluating households' debt servicing income, i.e. the income available for interest and principal payments. Debt servicing income is defined as income

after tax minus consumption expenses. Our narrow definition is consistent with Barker's definitions in that we are thinking within a consumption-path setting, in addition to being consistent with the other approaches.

Wider definition
The narrow definition holds. In addition, a shock to or return to the equilibrium path of households' debt servicing income or interest rate should not cause a 'below steady state' fall in consumption that threatens financial stability through firms' debt servicing capacity.

In this paper, we evaluate the sustainability of household debt within the wider definition by looking at the vulnerability of households' debt servicing income at their current spending pattern. We assume that the spending pattern reflects households' desired, in the sense optimal, consumption pattern contingent on all relevant factors. The spending pattern is measured by the average consumption to income ratio. Of course, this spending pattern is not necessarily the steady-state consumption pattern if important factors are off their steady-state path. To define the steady-state consumption path, we would need a general model for households' optimising behaviour and the steady-state development of important explanatory variables. This is beyond the scope of this paper.

3 Data and counterfactual analysis

3.1 The data

For this analysis, we use annual data for the years 1987-2009 from Statistics Norway and the National Institute for Consumer Research (Sifo). Primarily, we use data based on household-level information on income, wealth, debt and tax payments from Statistics Norway. The household data available to us are aggregated across 7 age groups to ensure anonymity. The households are sorted in groups according to the age, in years, of the main income earner of the household. The age groups are 0-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75- , in addition to All, which is the overall aggregate. With the exclusion of self-employed, the data include all Norwegian residents living in private households as of 31 December each year.[2] We denote these data the household-group level (HG) data. In addition, from Statistics Norway's website, we use data from the Annual National Account (NA) and the Consumer Expenditure Survey (CES).

The early years of our dataset are influenced by a severe banking crisis in Norway. The common definition of the crisis period is 1988-1992, and the pre-crisis and crisis years show a classic boom and bust cycle in household credit, house prices and consumption.

In the following, we present figures that illustrate the development in household debt over time. The first two figures show the development in the number of households and the share

[2] Self-employed are excluded because we are not able to separate their debt for business purposes from their consumer and mortgage debt, while our primary focus is on consumer and mortgage debt. According to Statistics Norway, the share of self-employed persons of total population 25 years and older is around 10 per cent.

of households with debt respectively. The general picture is that the number of indebted households has increased over time. At the aggregate level, from 1987 to 2009, the number of indebted households has increased from 1.1 million to 1.8 million. However, among age-group 25-34, the number of indebted households has decreased since 2000, see Figure 1.

Figure 1. Number of indebted households across age groups, 1987-2009. In 1000[1]

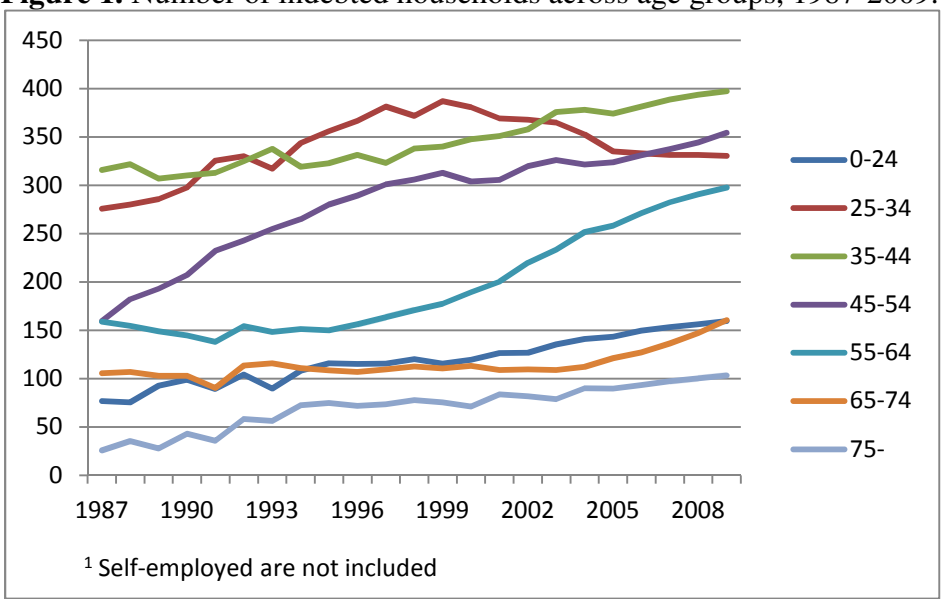
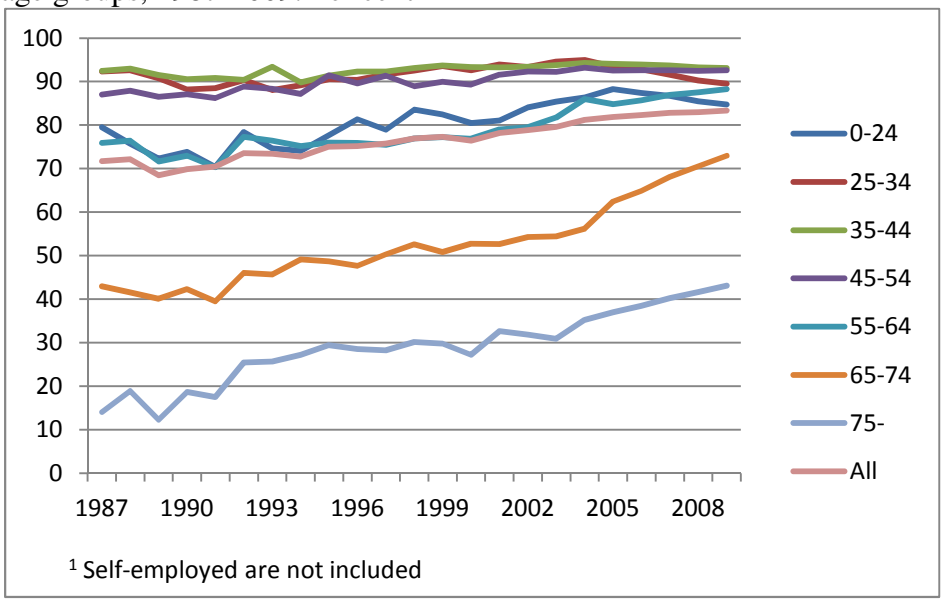


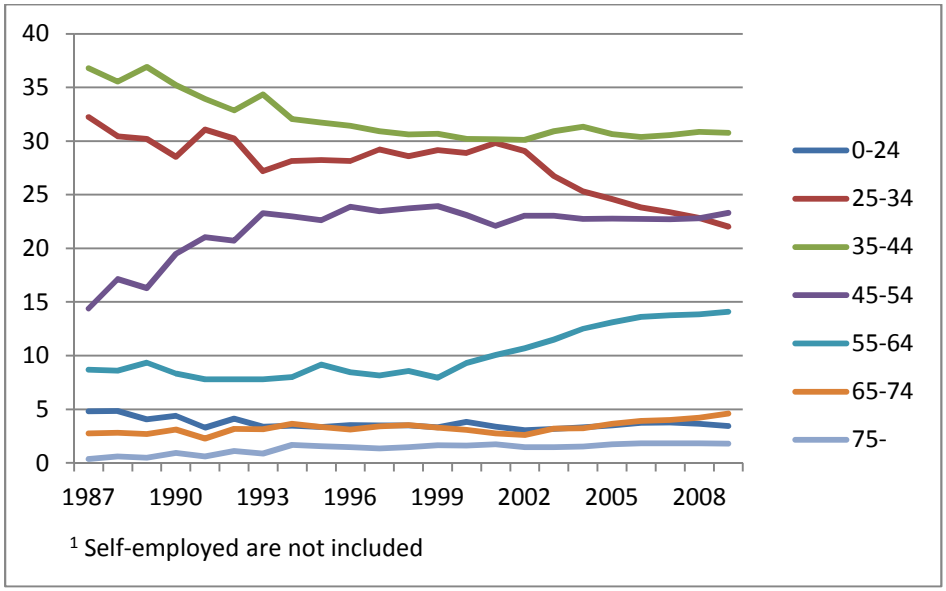
Figure 2 shows that the increase in the number of indebted households can be partly explained by an increase in the share of indebted households. In our data, the aggregate share has increased from 72 to 83 per cent. Looking at the age groups, we find that it is particularly households of age 55 and above that show an increasing share with debt. Hence, over time, it has become more common among older households to hold debt. For younger households, the share has been more stable.

Figure 2. The ratio of number of households with debt to total number of households across age groups, 1987-2009. Per cent[1]



In Figure 3 we show the distribution of total household debt across age groups. While age group 25-34 has reduced its share of total debt significantly after 2000, partly due to the decline in the number of households holding debt in this age group, the opposite is true for age group 55-64. One explanation for this change in the distribution of debt could be parents providing their children with financial support to enter the housing market. As for the remaining groups, after the aftermath of the Norwegian banking crisis, the share of total household debt has been relatively stable.

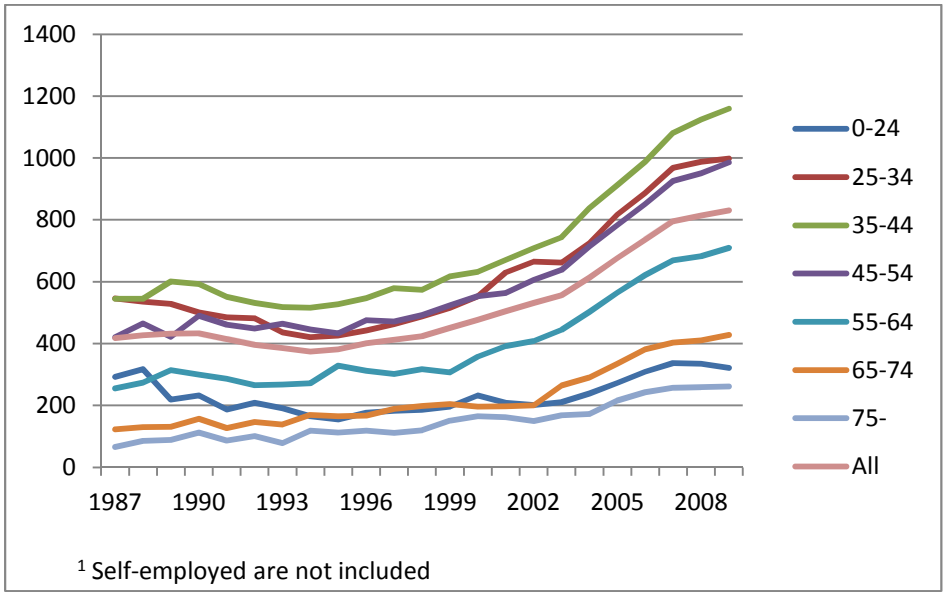
Figure 3. Distribution of total debt across age groups. Indebted households, 1987-2009. Per cent[1]



While the previous figures are unable to disclose information on the robustness or vulnerability of households' debt, we will now present three figures that can help us in that respect. Our data enables us to split households into indebted and non-indebted households, and we will concentrate on indebted households. Figure 4 shows the real debt per household, i.e. nominal debt per household deflated by the consumer price index. Figure 5 shows the ratio of household debt to disposable income, i.e. nominal debt to household income after tax and interest payments. Finally, Figure 6 shows household interest payments to total income after tax.

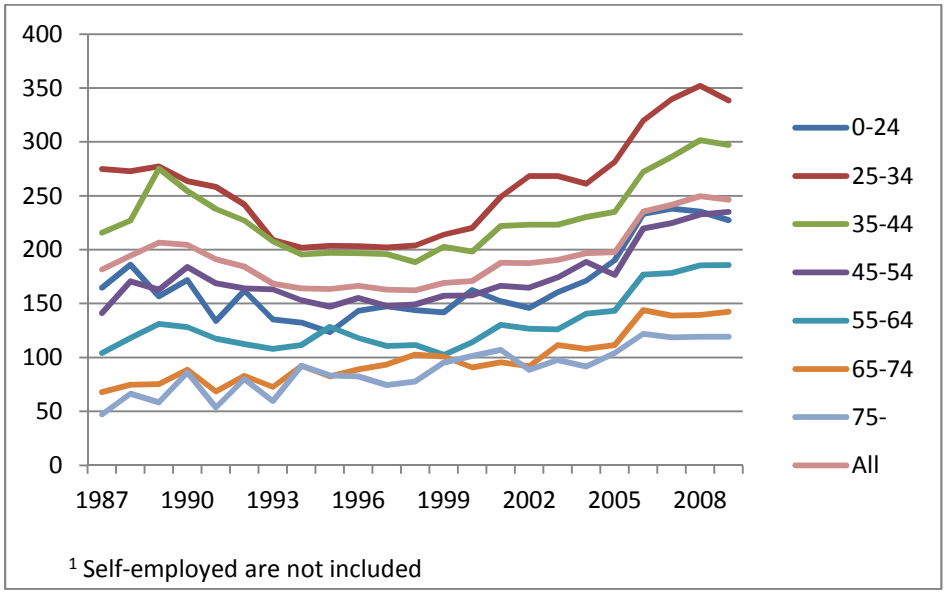
Figure 4 and 5 show that real debt per household and debt to disposable income have increased among households with debt at levels well above those before the Norwegian banking crisis. Households in the primary first-time home-buyers and the second steppers age groups, i.e. households aged 25-44, have a debt to income ratio of 300-350 per cent in 2008-2009. [3] These are peak levels in our data. The youngest age group, i.e. the age group 0-24, has a relatively low level of real debt per household, but due to a low income per household, their debt to income ratio is close to the average.

Figure 4. Real debt per household across age groups. Indebted households, 1987-2009. 1000 1998-NOK[1]



[3] Approximately 80 per cent of household debt is mortgage debt with private homes as collateral.

Figure 5. Debt to disposable income ratio across age groups. Indebted households, 1987-2009. Per cent[1]



Since debt is a way of smoothing consumption over time in accordance with the households' preferences, at first sight, high debt is positive. However, with a high debt to income ratio, even a modest income shortfall or interest rate increase may undermine the consumption path.

Figure 6 shows the interest-payment burden, i.e. interest payment to income after tax, across age groups. As in the case of debt to disposable income ratio, households aged 25-44 have an interest-payment burden above average. Most of Norwegian households' debt consists of floating rate loans.[4] This makes Norwegian households highly exposed to changes in the loan rate, and the interest-payment burden follows closely the fluctuations in the loan rate, see Figure 7. The continuing downward trend in the interest rate after the Norwegian banking crisis has to a large degree offset the effect of the increasing trend in household debt on the interest-payment burden.

[4] Historically, the fixed interest-rate share of Norwegian households' loans has been very low. Although it has increased in later years, it is still only around 10 per cent.

Figure 6. Interest payment to total income after tax across age groups. Indebted households, 1987-2009. Per cent[1]

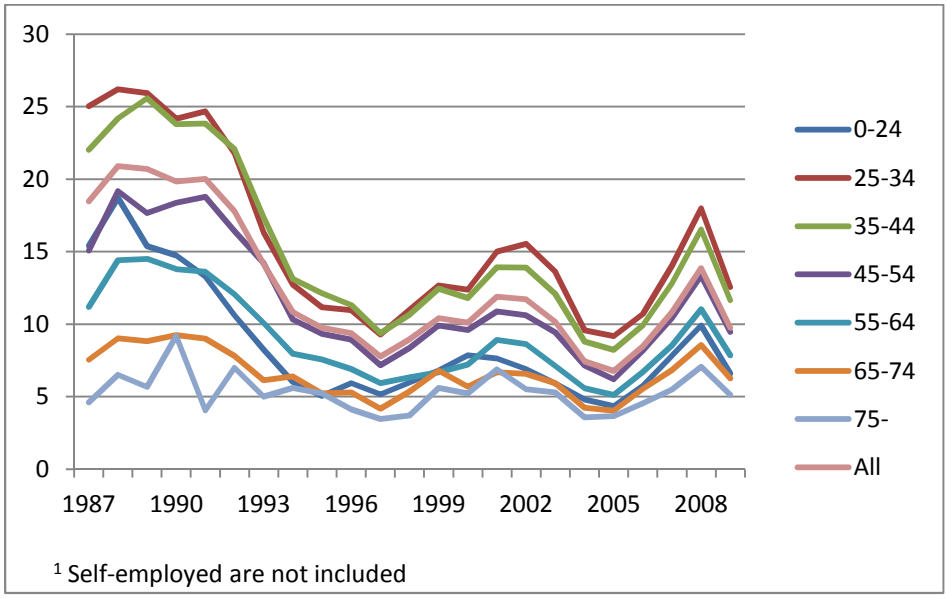
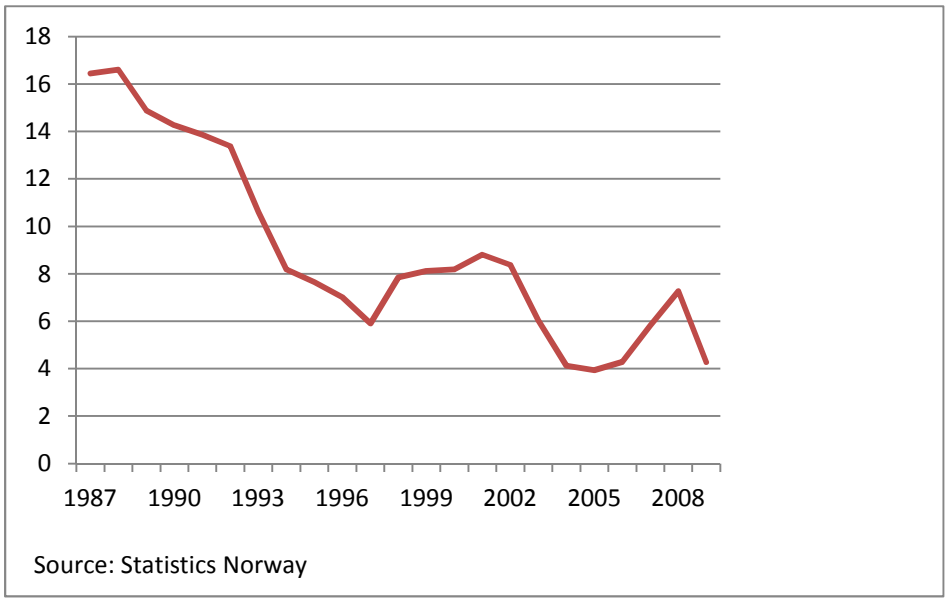


Figure 7. Households' average loan rate in banks and mortgage companies, 1987-2009. Per cent



The figures included in this section show that household debt has increased significantly over time, both in real terms and in relation to household income. On average, household interest payment varies around 10 per cent of total income after tax for households with debt, which, evaluated on its own, may be a sustainable level. However, with later years high and still increasing debt levels, households' interest-payment burden increases significantly with even a modest increase in the interest rate. At present, interest rates are very low.

In our data, households' default on loans has in general been low. Hence, in general, households have been able to service their debt. The exception is during the Norwegian banking crisis, when the default rate was above 9 per cent in 1992. Loss given default was much lower, however. In that difficult period, households cut back significantly on consumption. From 1986 to 1989, as the banking crisis was building up, household consumption fell by almost 4 per cent in real terms. During the present financial crisis, the default rate has stayed below 2 per cent and household consumption has been robust with a decline of less than ¼ per cent in 2009 only.

Still, it is easy to understand that the central bank, as a policy maker, expresses concern. The household debt situation is very much in unknown territory, and we do not know how vulnerable households are or how strong their response will be, in terms of for example consumption, if the present crisis escalates and hits Norwegian households harder than in the past. To evaluate this, we need to calculate and test the robustness of households' debt servicing capacity.

3.2 Calculating debt servicing income

Households' debt servicing capacity is represented by their debt servicing income (DSI), i.e. the income available for interest and principal payment. Households' DSI is defined as total income minus tax and consumption expenditure.[5] Calculating measures of consumption that are in accordance with our definition of sustainable household debt is a major challenge, however.

Using broadly the same household data as this analysis, Vatne (2006, 2007) calculates Norwegian households' DSI based on data on consumption for a number of household categories from the National Institute for Consumer Research (Sifo). The Sifo consumption data are considered to be low and closer to a minimum consumption level than a steady-state consumption level[6]. Over a short-run horizon, households may cut consumption to the Sifo level to be able to fulfil their debt contract. Over a longer-run horizon, we expect the Sifo consumption level to violate our wider definition of sustainable debt. Within this sustainable debt analysis, we therefore attempt to calculate measures of consumption that are closer to households' desired or optimal consumption path.

Our approach when calculating 'desired consumption' rests on the assumption that there exists a stable relationship between this consumption and their disposable income, and that the relationship can be revealed by available historical data.[7] Our measures are based on data

[5] The "debt servicing income" approach has similarities to the "disposable income" approach. The latter calculates the income available for consumption expenditure taking interest payment on debt into account, while the first calculates the income available for debt servicing taking consumption into account.
[6] We should make clear that we are not steady state
[7] Norwegian National Account data show that the household consumption ratio, i.e. consumption relative to disposable income, is 0.93 on average and the median is 0.92 over 1978-2011. The same is true over 1987-2009. The consumption ratio varies between 88 per cent (in 2005) and 100 per cent (in 1986). The ADF test (with a constant) for unit root rejects the H_0 of non-stationarity at the 5 per cent level. Although this supports our

from Statistics Norway on consumption and income from the Annual National Account (NA) in combination with data on consumption from the Consumer Expenditure Survey (CES). Due to coverage and data quality, we use NA consumption data as a benchmark. We develop two alternative 'desired consumption', and hence DSI, measures.

When calculating the DSI measures, we need to take into account that the NA consumption data include an estimated value of homeowners' rent as part of homeowners housing consumption. This rent does not include pecuniary expenditure, and we need to scale down the NA benchmark consumption data accordingly to obtain the preferred consumer expenditure measure.

Our *first measure* uses NA data over 1978-2011 to calculate the overall average consumption to income ratio for households and the average consumption share of total housing rent. Based on information from CES over 1997-2009, we calculate homeowners' share of total housing rent. This allows us to downscale consumption and identify the consumption-expenditure ratio as argued above. Our first measure applies a common consumption and consumption-expenditure ratio for all age groups in all years.[8]

In our *second measure*, we calculate household-group specific average consumption-expenditure ratios over 1997-2009 by combining data from the Consumer Expenditure Survey (CES), NA data and household-group (HG) data. Rental cost data from NA and CES are applied to calculate household group-specific data on homeowners rent. This enables us to develop the preferred household group-specific data on consumption were housing consumption for homeowners is excluded.

Table 1 shows the consumption-expenditure ratios, CER1 and CER2, which enter the calculation of two alternative debt servicing income measures DSI1 and DSI2 respectively. The third alternative, CER3, is the implicit consumption-expenditure ratio that is derived from the Sifo-based calculations. These are included in the table for comparative purposes. Both CER2 and CER3 have the expected life-cycle pattern across age-groups, i.e. consumption is relatively high compared to disposable income among young and old households. The income pattern shows the opposite (concave) shape across the age groups. See the Appendix for a more detailed presentation of the calculation of the CER data.

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assumption of a stable steady state relationship between consumption and income, we should add that there is evidence of a collateral value effect from housing on consumption in Norway, i.e. a financial accelerator effect, see for example Erlandsen and Nymoen (2008). With strong growth in real housing values and financial innovations in Norway that have enabled more mortgage equity withdrawal, one might have expected to find an increasing consumption-to-income ratio as in the UK and the US, see Aron et al. (2011).

[8] A common consumption to income ratio across age groups may seem to be in conflict with the general life-cycle assumption of a convex consumption propensity over the life span. However, we would need cohort data rather than the age group data to be fully consistent with a life-cycle approach.

Table 1. Average household-group specific consumption-expenditure ratio (CER). Per cent

	Age group							
	0-24	25-34	35-44	45-54	55-64	65-74	75-	All
CER1[1]	82	82	82	82	82	82	82	82
CER2[2]	131	89	85	74	66	73	93	82
CER3[3]	95	69	65	53	51	64	82	63

[1] Based on data on consumption and disposable income from Statistics Norway, NA and CES.
[2] Based on data on consumption from Statistics Norway (NA and CES) and disposable income from Statistics Norway (NA and HG).
[3] Implicit CER calculated using Sifo consumption data.

We use the average consumption-expenditure ratios in Table 1 in combination with information on income, tax and disposable income from our household-group data to calculate time series for DSI. We do that for all households (excl. self-employed) and for indebted households (excl. self-employed).[9] Table 2 and Figure 8 show the average DSI per household for different age groups over 1987-2009.

Table 2. Debt servicing income (DSI) per household for different age groups with three alternative consumption measures. All households and indebted households. Average 1987-2009. 1000 NOK

	Age group							
	0-24	25-34	35-44	45-54	55-64	65-74	75-	All
DSI1[1] All	32	72	90	90	71	46	30	67
DSI1[1] Indebted	35	76	94	95	78	53	38	77
DSI2[2] All	-32	54	80	113	114	65	12	66
DSI2[2] Indebted	-29	54	77	113	123	81	33	76
DSI3[3] All	15	106	149	191	168	90	36	119
DSI3[3] Indebted	22	113	155	199	181	107	56	138

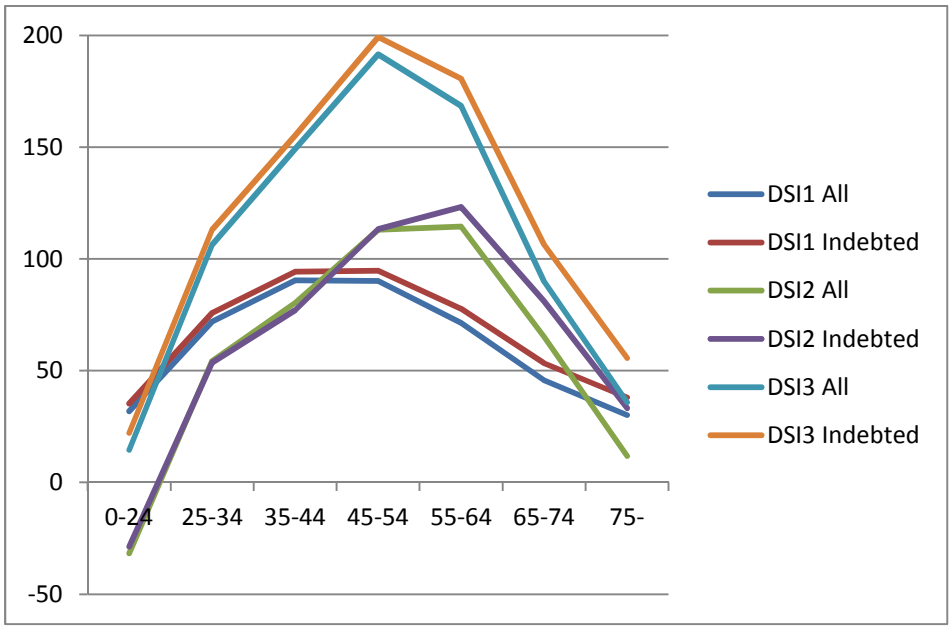
[1] DSI1 = Income – Tax – CER1 * Disposable income; CER1 = 0.82
[2] DSI2 = Income – Tax – CER2 * Disposable income; CER2 = [0.66 – 1.13]
[3] DSI3 = Income – Tax – Sifo consumption

The DSI is higher per indebted household than the average. This reflects that income of indebted households in general is higher than that of non-indebted households. All the three DSI alternatives show a concave pattern across age groups. As expected, DSI3, the Sifo consumption-based measure, predicts the highest debt servicing income. The discrepancy across the DSI alternatives is particularly large for middle-aged households, which is due to a

[9] This approach ensures that, for each group and the aggregate, total consumption withdrawal in DSI over time equals the sum of calculated consumption over time. We assume that the overall level of consumption is in accordance with optimising household behaviour contingent on the development in all factors of relevance.

relatively large difference between these households' average consumption and the Sifo minimum consumption level. The shape of DSI1 shows that assuming a common consumption-expenditure ratio for all age groups flattens the DSI curve across age groups. We expect the true consumption ratio to have a convex pattern across age groups. This is consistent with the findings in Erlandsen and Nymoen (2008) on Norwegian data. Hence, the DSI2 alternative stands out as particularly interesting.

Figure 8. Debt servicing income (DSI) per household for different age groups with three alternative consumption measures. All households and indebted households. Average 1987-2009. 1000 NOK



In the next section, we will present counterfactual analyses that can help cast light on the sustainability of Norwegian household debt over time on the basis of our DSI measures.

3.3 Counterfactual analysis

The purpose of the counterfactual analyses in this section is to increase our understanding of the vulnerability, i.e. sustainability, of household debt. We do that by asking "how close to the edge", i.e. how close to not being able to service their debt and maintain a desired consumption level, households are. We are interested in households' position over time to see if there are any clear patterns in their willingness to push boundaries.

The approach we take is to find the maximum interest rate and the maximum debt level that households could have handled in our sample and compare these with the actual levels. The comparison is done year by year over 1987-2009. We do this for the DSI1 and DSI2 measures defined in the previous section. The results obtained when using the third debt servicing income measure, DSI3, are presented in Appendix 2. We concentrate on indebted households and ask the following questions: i) what is the maximum interest rate that households could

have faced given the actual debt levels, income and a priori defined consumption path, and ii) what is the maximum debt level that households could have serviced given actual interest rates, income and a priori defined consumption path. We use data per household for each of our age groups.

We assume that households use all their available debt servicing income (DSI) to pay interest and principal. Hence, there are no other savings than principal payments. Given this assumption, we can define the following simple relationship between debt servicing income (*DSI*), the loan interest rate (*i*), the tax rate (*T*), the down payment of the stock of debt in per cent (α) and *debt* at any point in time denoted by subscript *t*.[10]

$$(1)\ DSI_t = [i_t(1-T) + \alpha] \cdot debt_t$$

This relationship may be rewritten with the interest rate and debt as the left-hand side variable. We use this to define the maximum loan rate and debt respectively in equations (2) and (3). Both the maximum interest rate and the maximum debt level increase with higher DSI, reduced down-payment of the principal and increased tax deduction of interest payment. The maximum interest rate decreases with a higher debt level, and the maximum debt level decreases with a higher interest rate.

$$(2)\ i_t^{max} = \frac{\frac{DSI_t}{debt_t} - \alpha}{1-T}$$

$$(3)\ debt_t^{max} = \frac{DSI_t}{[i_t \cdot (1-T) + \alpha]}$$

Within our simple static approach, it is difficult to interpret the results when the consumption to income ratio exceeds one.[11] When presenting the results from DSI2, we therefore exclude household groups 0-24. The share of total household debt held by this age group is small, below 4 per cent on average, see Figure 3.

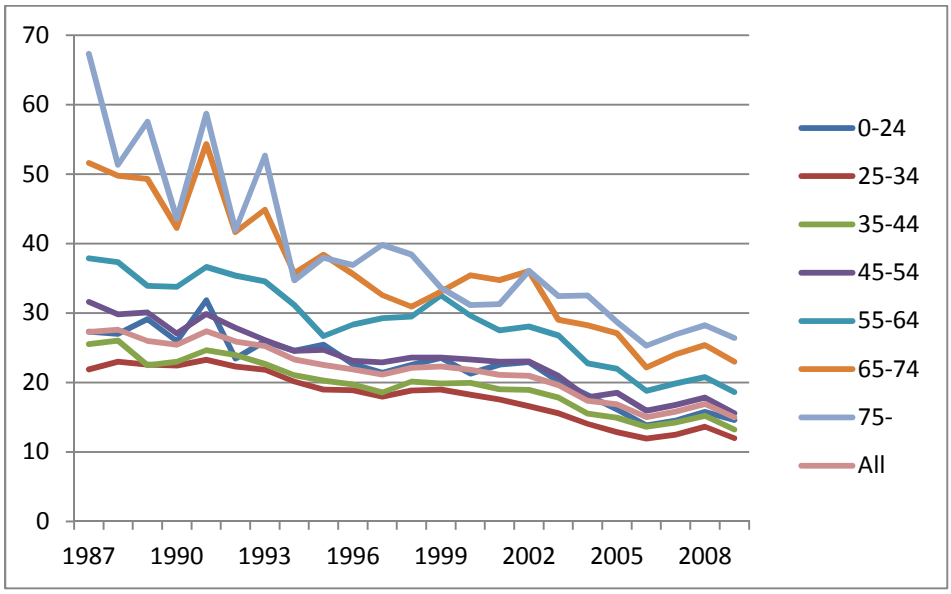
We look at two cases: i) We assume no principal payment or interest-only loans so that $\alpha \cdot debt_t = 0$. Hence, DSI is fully used for interest payment. ii) We assume $\alpha = 0.05$.[12]

We first calculate the maximum loan rate when using equation (2). The results are given in Figure 9-12 below.[13] We put most weight on the results based on DSI2.

[10] Since 1992, the tax rate is 0.28. Prior to 1992, the tax system was different, and we use the average marginal tax rate on wage earners capital income.
[11] To fully take into account a convex structure of the consumption-expenditure propensity of households, we would need to do a more comprehensive life-cycle type of analysis.
[12] A down payment of 5 per cent of outstanding debt each year is similar to assuming that, for all years, the maturity of the stock of debt is 20 years within a serial loan context. Kredittilsynet (2008) reports that average maturity on mortgage loans has increased in later years and is above 20 years. Today, it is not uncommon to obtain a mortgage loan with a 25-30 year repayment period. On the other hand, Vatne (2008) concludes that in 2006, the repayment period was 6¼ years for existing household debt and 12 years for new debt. According to Drehmann and Juselius (2012), the average maturity of Norwegian households' stock of debt is 14 years.

Using DSI1 and DSI2, we find that the maximum loan rate has declined over time for all age groups. This reflects the increasing debt-to-income ratios. A maximum loan rate below 6-7 per cent is low when compared to the normal money market rate and margin on household loans in Norway. These are assumed to be about 4-5 per cent and 1-1 ½ percentage point, respectively.[14] From this perspective, households in the primary first-time home-buyer and the second steppers age groups, i.e. households of age 25-44, are vulnerable to even a return to normal interest rates and margins when a 5 per cent down payment of the stock of debt each year is assumed, see Figure 11-12. These households may not be able to maintain their wanted consumption path. This is particularly true for the DSI2 calculations, but also to some degree for the DSI1 calculations. Assuming no principal payment, as would be with interest only loans, Figure 9-10, the situation is much less fragile.

Figure 9. The maximum loan rate (DSI1). No principal payment. Indebted households, 1987-2009. Per cent



[13] Deposit rates are unchained and we do not adjust for the households' fixed rate loans, since the share is relatively small and we do not have information on the distribution across age groups.
[14] The normal level of Norges Bank's key policy rate and money market margin are assumed to be around 4 per cent and 0.35 percentage point respectively, Norges Bank (2012b). On top of that a bank lending margin must be added.

Figure 10. The maximum loan rate (DSI2). No principal payment. Indebted households, 1987-2009. Per cent

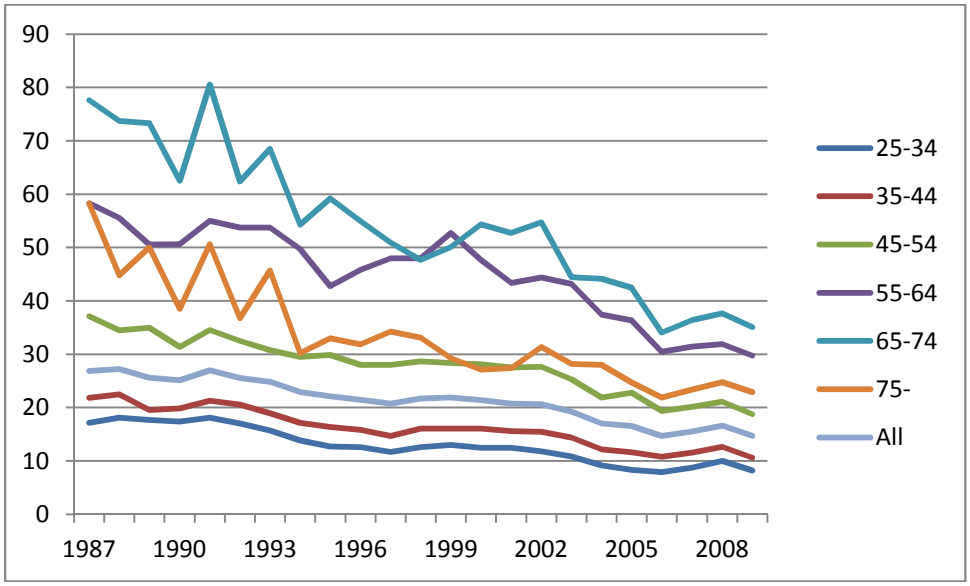


Figure 11. The maximum loan rate (DSI1). With principal payment. Indebted households, 1987-2009. Per cent

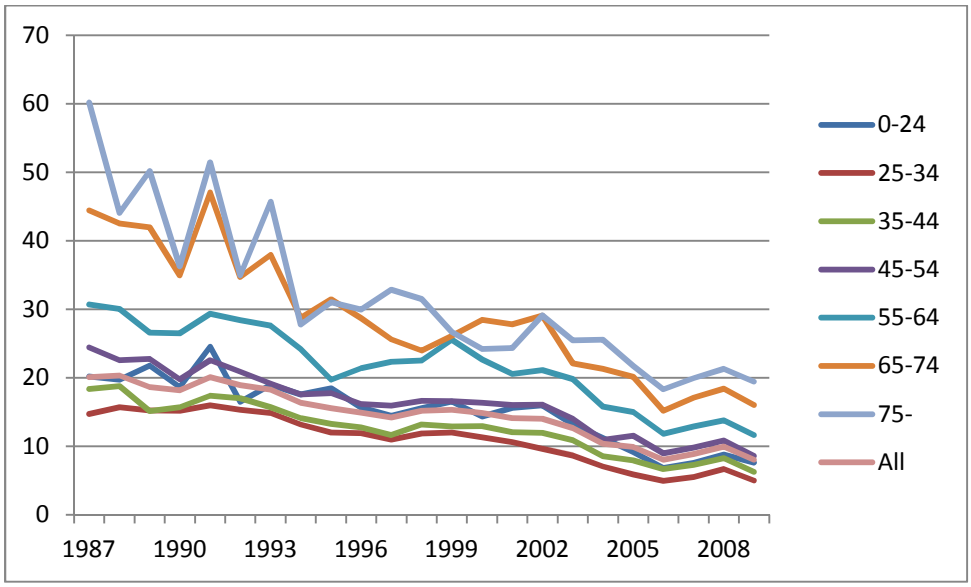
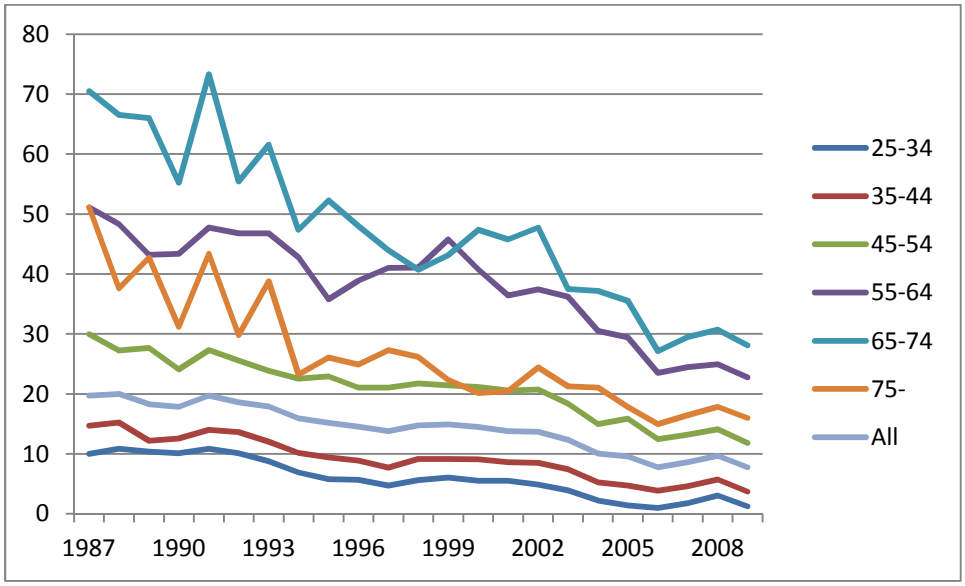


Figure 12. The maximum loan rate (DSI2). With principal payment. Indebted households, 1987-2009. Per cent



To better understand the vulnerability of the household sector with respect to an increase in the loan rate, we compute the maximum loan rate minus the imputed loan rate for each age group. The imputed rate is calculated as households' actual interest payment (excluding tax deduction) divided by their debt. The results are presented in Figure 13-16.

Figure 13. The maximum loan rate minus imputed loan rate (DSI1), 1987-2009. No principal payment. Indebted households. Percentage points

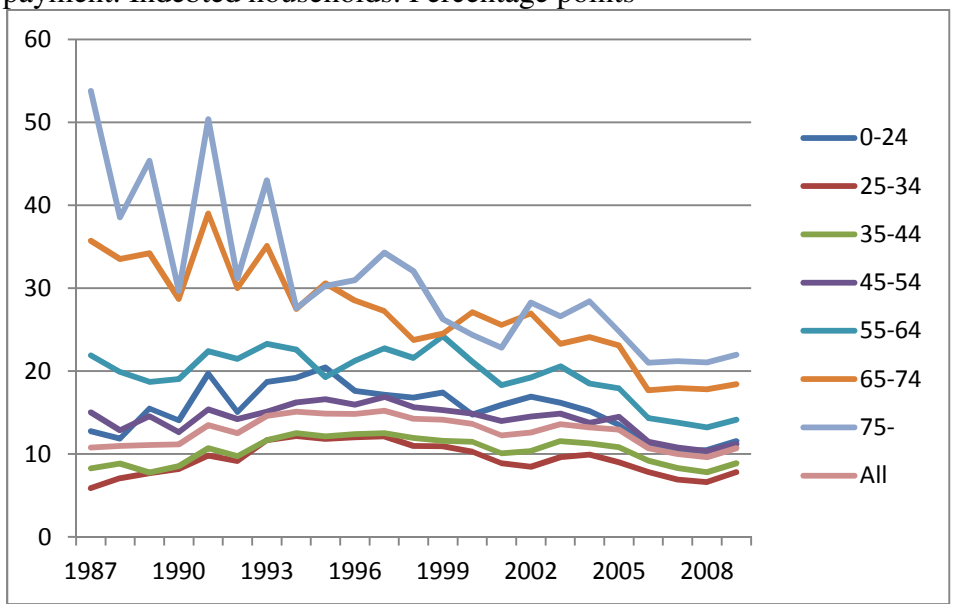


Figure 14. The maximum loan rate minus imputed loan rate (DSI2), 1987-2009. No principal payment. Indebted households. Percentage points

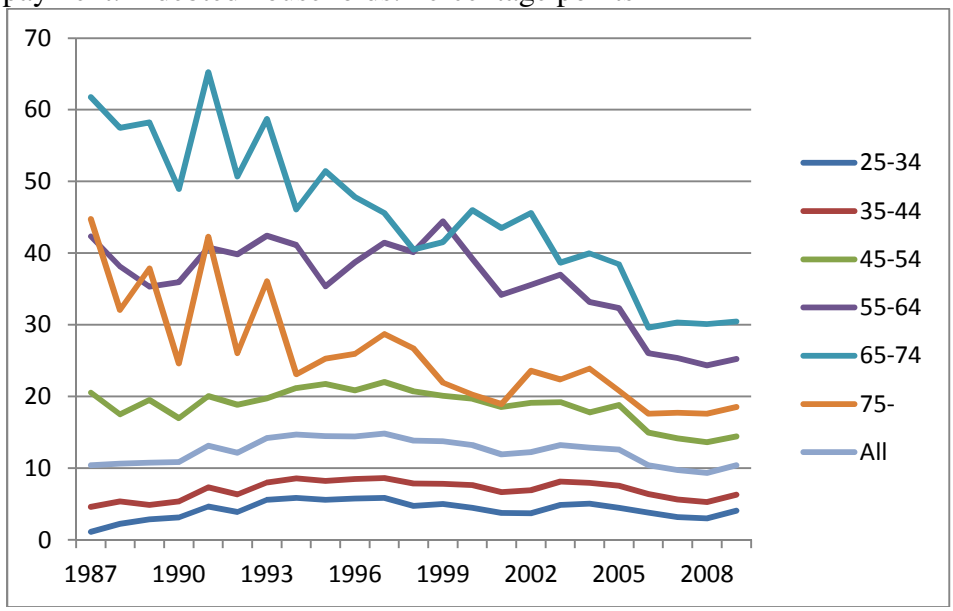


Figure 15. The maximum loan rate minus imputed loan rate (DSI1), 1987-2009. With principal payment. Indebted households. Percentage points

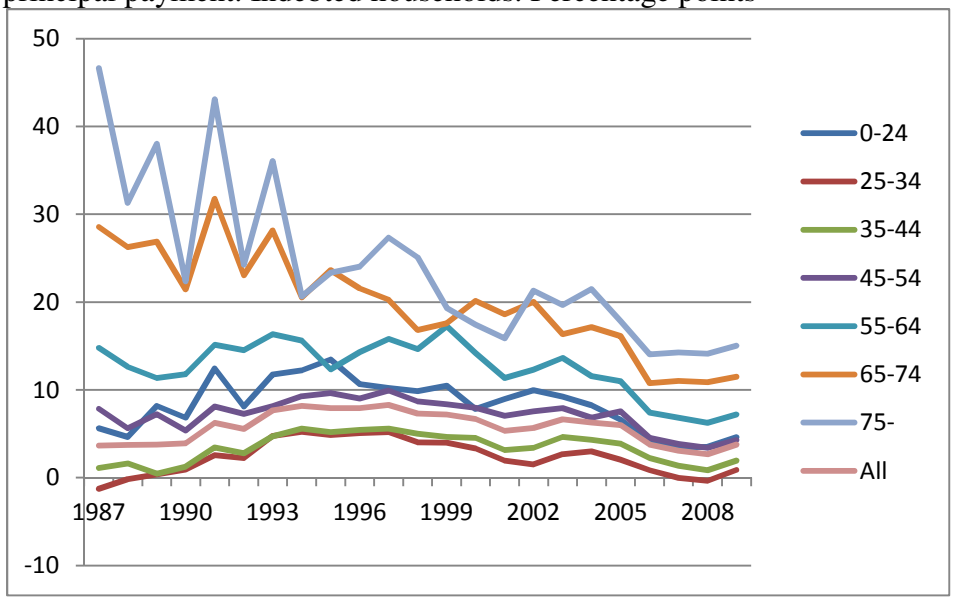
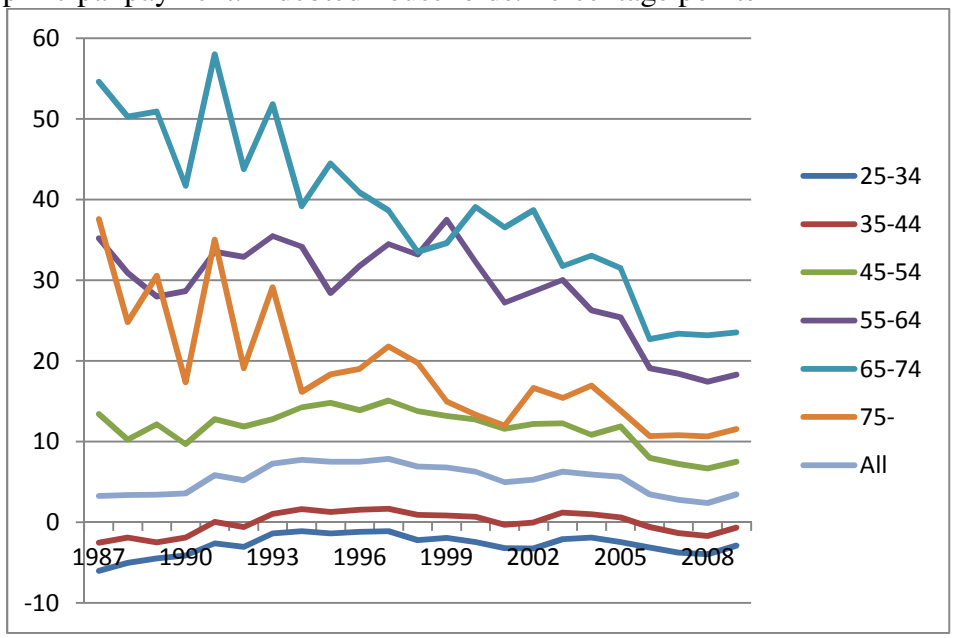


Figure 16. The maximum loan rate minus imputed loan rate (DSI2), 1987-2009. With principal payment. Indebted households. Percentage points



According to Figure 15-16, the average household, the All-line, would tolerate an increase in the loan rate of only 3-4 percentage points from the low 2009-level if, simultaneously, they are to maintain 'desired consumption', repay 5 per cent of the principal and pay interest. Hence, an increase in the loan rate of more than 3-4 percentage points is likely to force these households to cut their consumption to below the desired path as defined by the historical consumption pattern. If we assume that firms have developed contingent on this historical consumption pattern, a fall below this path is likely to affect firms' debt servicing ability negatively. Producers that depend on domestic consumption may have to cut production below their long-run path. Without principal payment on households' debt, see Figure 13-14, the corresponding manageable increase in the loan rate is 10-11 percentage points.

As expected from the maximum loan-rate results, households aged 25-44 are the most vulnerable with respect to an increase in the loan rate. In the 'with principal payment' case, in later years, these households would have been able to manage a 1-2 percentage point higher loan rate according to DSI1. The DSI2 results show that these households either have not made a down payment of 5 per cent of the principal in later years, or their consumption has been below the desired level. The latter is the case for 2006-2008, but not for 2009 according to our calculations. If, instead of 5 per cent, we assume an annual repayment of 2½ and 4 per cent of the stock of debt for the age group 25-34 and 35-44 respectively, they would be able to maintain 'desired consumption'.

In our data, households aged 25-44 hold 60 per cent of total household debt on average and are of major importance to banks' credit risk on household lending. In addition, these households' share of the household sector's total consumption is around a third. Hence, a

reduction in consumption to increase their debt servicing capacity may trigger a significant increase in the credit risk on firms' debt.

For the other age groups, the situation is more robust, although the manageable increase in the loan rate in general has fallen over time.

Interestingly, our results show that the important age groups 25-44 probably have been close to the edge in many of the years 1987-2009. Our interpretation is that, contingent on the loan rate at the time and their preferences with respect to consumption, the most active households in the housing market borrow close to the maximum of what they are able to service. Hence, a significant share of household debt is vulnerable to an increase in the loan rate according to our Blaker-inspired definition, and this has been the situation in many years. The important difference between later and earlier years is the low interest rate in later years, see Figure 7.

We will now present the counterfactual calculations of the maximum debt level using equation (3). To facilitate the interpretation of the results, we show the maximum debt levels relative to actual debt levels. The results are presented in Figure 17-20.

Figure 17. Maximum debt to actual debt (DSI1). No principal payment. Indebted households, 1987-2009. Per cent

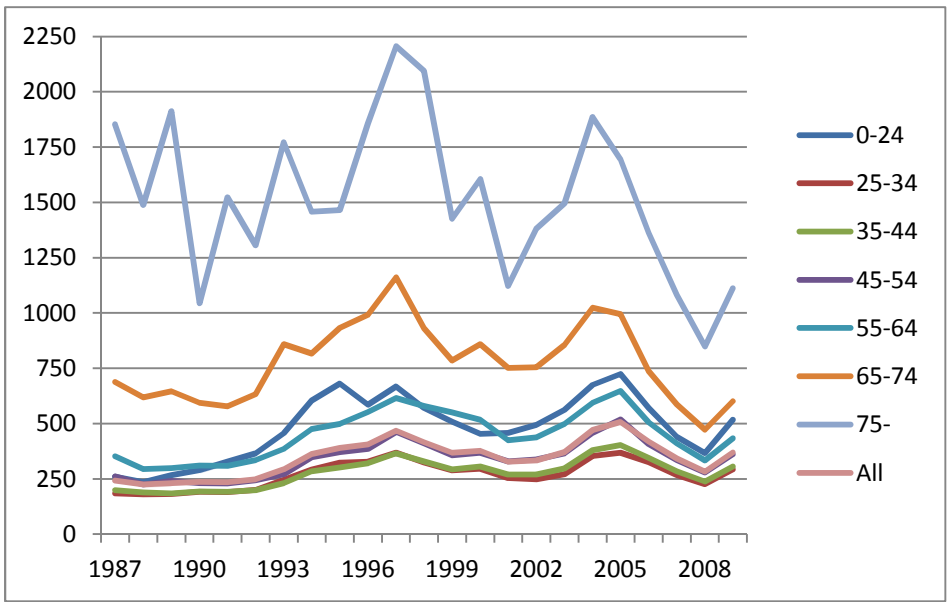


Figure 18. Maximum debt to actual debt (DSI2). No principal payment. Indebted households, 1987-2009. Per cent

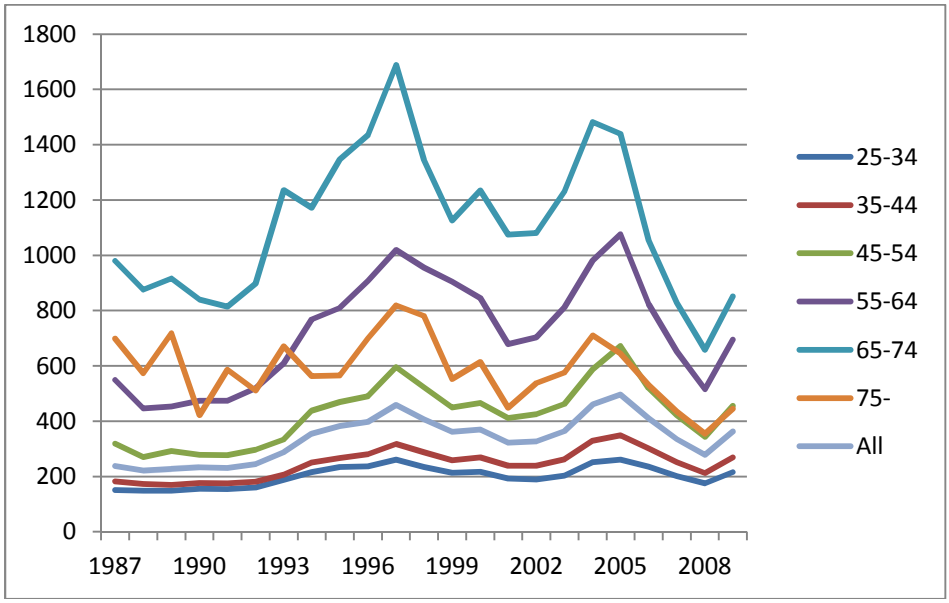


Figure 19. Maximum debt to actual debt (DSI1). With principal payment. Indebted households with debt, 1987-2009. Per cent

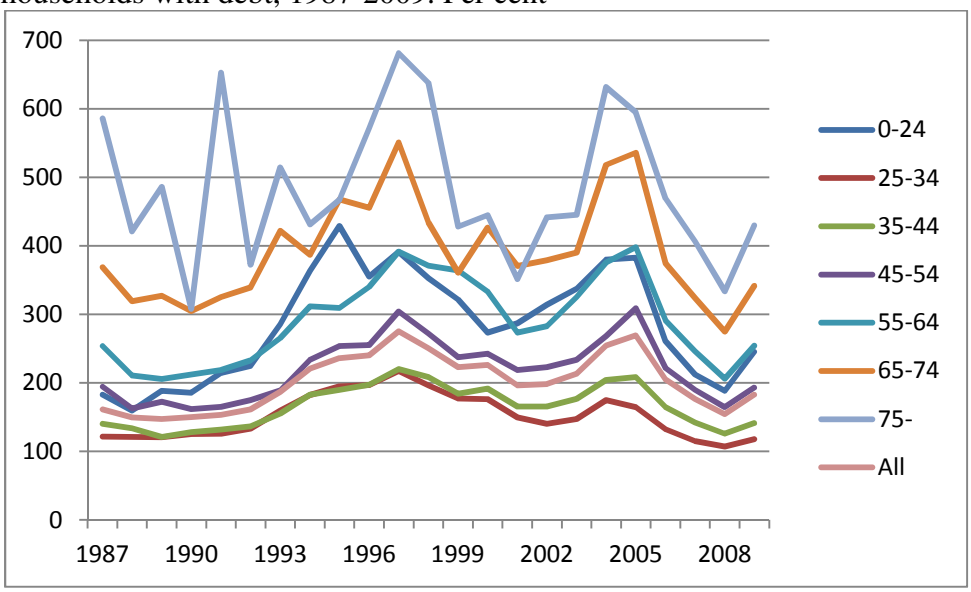
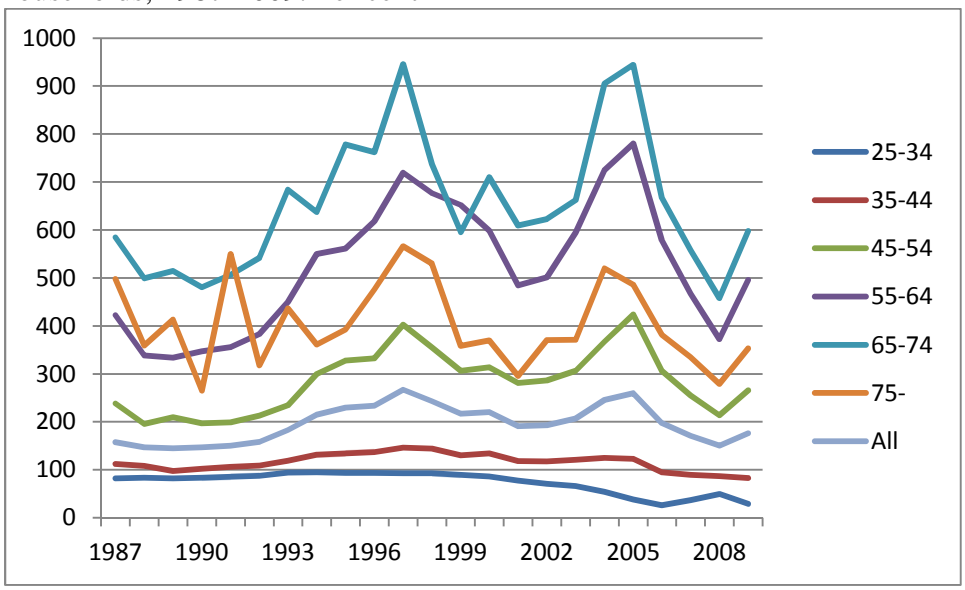


Figure 20. Maximum debt to actual debt (DSI2). With principal payment. Indebted households, 1987-2009. Per cent



Concentrating on the with principal-payment case, Figure 19 and 20 show that the maximum manageable debt relative to actual debt varies widely across the age groups. Furthermore, after the Norwegian banking crisis, we can see two clear waves in the maximum debt to actual debt ratio. Since 2005, the ratio has fallen, implying that actual debt has climbed towards the maximum debt level. The 2009-data show a reversal for many age groups, however.

Again, it is the age groups 25-44 that stand out as potentially fragile. According to the DSI2 results in Figure 20, these households have debt levels above their maximum manageable level. This is in line with that expected based on the maximum interest rate calculations. These households either consume below 'desired consumption' or do not repay five per cent of their stock of debt, or both. At the relatively low consumption-expenditure to income ratios in the DSI1 calculations, the household group aged 25-34 could have managed 18 per cent higher debt in 2009, while the household group aged 35-44 could have managed 41 per cent higher debt in 2009. A longer repayment period than 20 years also changes the rather dramatic picture of the age group aged 25-44.

4 Concluding remarks

In this paper, we evaluate the sustainability of household debt by looking at households' debt servicing income, i.e. the income available for paying interest and principal. Debt servicing income is calculated as income minus tax and consumption.

Within a narrow definition of sustainable household debt, one can relate sustainability to households' ability and willingness to service debt contingent on a minimum consumption level. In difficult times, households may cut consumption to a minimum to prioritise servicing their debt. However, a large and lasting cut in consumption will affect firms' profit and their

ability to service debt. Consistent with a broader financial stability perspective that takes this into account, we define the sustainability of household debt as the debt households are able to service contingent on the historical consumption to income pattern.

Household income, debt and consumption vary systematically over the life-cycle, and this may influence their ability to service debt over the life-cycle. We take this into account by looking at the debt position of seven household age groups. Consumption data are not available to us for these households groups, however. By combining different data sources, we are able to calculate age group-specific consumption, and we use this to identify the historical consumption to income pattern. We expect firms to have developed in accordance to this historical pattern, and hence, consumption consistent with this pattern should not trigger firms' credit risk.

To evaluate the sustainability of household debt, we calculate the maximum loan rate and debt levels that households would have managed over 1987-2009. We condition the counterfactual analysis on the historical consumption to income pattern.

Assuming that 5 per cent of the stock of debt is repaid each year, which is consistent with a 20 year maturity, we find that households in the primary first-time home-buyer and the second steppers age groups, i.e. households aged 25-44, are vulnerable to even a return to normal interest rates and lending margins from today's very low levels. In fact, the results show that for some years, these households' loan rates are above the calculated maximum rates. This can partly be explained by actual consumption being below the consumption level predicted by the historical consumption to income pattern. In addition, households have taken advantage of new types of debt contracts available to them, such as interest-only loans and credit lines secured on dwellings. The use of more flexible debt contracts has increased rapidly in later years and such contracts are likely to have increased the repayment period. More flexibility enables households to hold higher debt and at the same time maintain a high level of consumption.

Irrespectively, households aged 25-44 seem to be "close to the edge" and may not be able to maintain their historical consumption to income path if loan rates increase. The results also show that these households have been vulnerable to even relatively small increases in their loan rate in large parts of the sample. Our interpretation is that, contingent on the loan rate at the time and their preferences with respect to consumption, the most active households in the housing market follow a simple strategy and borrow close to the maximum of what they are able to service. This may, however, turn out to be a riskier strategy to follow in today's situation compared with earlier due to the potential fragility in households' future income path, the interest rate and house prices. These variables have all developed in a favourable way for a long time, but adverse shocks could reverse this. For example, the oil price may fall affecting households' income growth negatively, banks' funding costs and lending margin may increase, the latter due to a change in banks' risk assessment, and finally, collateral values may deteriorate if house prices enter a period of downward correction.

Drehmann and Juselius (2012) find that increasing debt servicing costs, i.e. interest and principal payments, is a relatively clear signal of financial instability in the near future. Furthermore, around banking crises, sharp changes in debt servicing costs are mainly driven by changing interest rates. From a financial stability perspective, the high vulnerability to interest rate changes of the age groups 25-44, who hold 60 per cent of household debt, is therefore of concern. It seems particularly important to reduce household vulnerability to interest rate increases. This can be achieved by limiting the loan-to-income ratio of floating-rate loans in particular.

Even if adverse shocks do not occur, due to the low interest rates at present, we do not expect households' loan rates to continue to fall in the future. Hence, without new instruments that enable households to take on more debt, or increasing financial support by their parent generation, we expect debt for the younger age groups to fall back and follow their growth in income more closely.

If households should experience an increase in loan rates or other changes that significantly affects their debt servicing capacity as measured by their debt servicing income, they would probably re-optimise their consumption as well as debt paths. To address this, we need to adopt a more complicated life-cycle based analysis. That could help us understand how different shocks affect households and the associated direct and indirect effects on banks and financial stability.

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Appendix 1. The consumption data

We calculate the 'wanted consumption-expenditure to income' ratio as the average over time of consumption minus home owners' calculated rent divided by disposable income.

All data are from Statistics Norway. We use annual national account (NA) data (1978-2011), Consumer Expenditure Survey (CES) data (1997-2009) and Household Group (HG) data (1987-2009). [15]

1) A common 'desired consumption-expenditure to income' ratio across age groups (CER1)

Our first consumption-expenditure to income measure applies the assumption that this ratio is equal across age groups, or more generally, across all types of households.

$$CER1 = \frac{1}{34}\sum_{t=1978}^{2011}\left[(Consumption_t^{NA} - Housing\ rent_t^{NA} * \frac{1}{13}\sum_{t=1997}^{2009}\frac{Home\ owners'\ rent_t^{CES,All}}{Housing\ rent_t^{CES,All}})/Disposable\ income_t^{NA}\right]$$

Consumption^{NA} = Total consumption, incl. housing consumption
Housing rent^{NA} = Total housing rent (for both renters and home owners)
Housing rent^{CES} = The sum of per household housing rent for renters and home owners multiplied by the number of households
Home owners' rent^{CES} = Calculated by Statistics Norway on the basis of observed market rents for renters on corresponding dwellings with respect to an a priori defined list of characteristics. Per household data are multiplied by the number of households
Disposable income^{NA} = Total wage and capital income + net transfers – tax– interest payment

The *CER1* is used when calculating the debt servicing income measure *DSI1*.

2) Age group specific 'desired consumption-expenditure to income' ratio (CER2)

In this alternative, we calculate age group specific consumption-expenditure to income ratios. From NA we use total consumption, disposable income and total housing rent. From CES we use the ratio of different household groups' consumption relative to the average household consumption and homeowners rent as a share of total housing rent across age groups. From the HG data we use the number of households and disposable income in different age groups.

[15] The original CES data are given as 3-year overlapping averages. In addition, the age groups differ somewhat from the age groups in our household data. Calculations were done to transfer the CES format to our annual age group format. First, we take the average across the 3-year data that include the year of interest to obtain year specific data. Second, we split and aggregate the age group consumption information in CES in accordance with the number of years the CES groups cover of our age groups. The CES variables included in the equations in this appendix take the transformed format.

Step 1: We take NA data on consumption and housing rent as a benchmark at the aggregate level, i.e. across all households. Since our HG data exclude self-employed households, we start by scaling down these NA data accordingly. As a scaling factor, we use the NA data on household disposable income relative to the disposable income of the households included in the HG data. This approach implicitly applies the assumption that the propensity to consume is similar across the included and excluded households.

$$Consumption_t^{HG,All} = \frac{Disposable\ income_t^{HG,All}}{Disposable\ income_t^{NA}} \cdot Consumption_t^{NA}$$

$$Housing\ rent_t^{HG,All} = \frac{Disposable\ income_t^{HG,All}}{Disposable\ income_t^{NA}} \cdot Housing\ rent_t^{NA}$$

Consumption^{HG} = Total consumption, incl. housing consumption
Disposable income^{HG} = Total wage and capital income + net transfers – tax– interest payment
Housing rent^{HG} = Total housing rent (for both renters and homeowners)

Step 2: We now proceed to calculate consumption at the household-group level by using information from CES on per household consumption in different age groups relative to the aggregate per household consumption.

$$Consumption_t^{HG,j} = CES\ consumption\ per\ household_t^{HG} \cdot \left(\frac{Consumption_t^{HG,All}}{Number\ of\ households_t^{HG,All}}\right) \cdot Number\ of\ households_t^{HG,j}$$

j = 0-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75-

Step 3: We now calculate home owners rental cost across the household groups.

First, we calculate data on total housing rent across the household groups.

$$Housing\ rent_t^{HG,j} = [CES\ rent\ for\ renters\ per\ household + CES\ rent\ for\ home\ owners\ per\ household]_t^{HG,j} \cdot \left(\frac{Housing\ rent_t^{HG,All}}{Number\ of\ households_t^{HG,All}}\right) \cdot Number\ of\ households_t^{HG,j}$$

j = 0-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75-

Second, we calculate home owners' rent across age groups as housing rent multiplied by the share of home owners' share of total rent in the CES data.

$$Home\ owners'rent_t^{HG} = \left[\frac{CES\ \ rent\ for\ home\ owners\ per\ houshold}{CES\ rent\ for\ home\ owners\ per\ houshold + CES\ housing\ rent\ for\ renters\ per\ houshold}\right]_t^{HG} \cdot Housing\ rent_t^{HG}$$

Having established consumption data at the household-group level, we combine these with the HG data on disposable income and calculate household-group specific consumption-expenditure to income ratios.

$$CER2^{HG,j} = \frac{1}{23}\sum_{t=1987}^{2009}(Consumption - Home\ owners'rent)_t^{HG} / Disposable\ income_t^{HG}$$

j = 0-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75-, All

When calculating DSI3, we use this household-group specific consumption-expenditure to income data.

3) Sifo consumption

National Institute for Consumer Research (Sifo) produces consumption-data from regular surveys for a number of household categories. Necessary accommodation is done by Norges Bank to obtain consumption data consistent with our household groups. In addition, heating and housing maintenance costs are added to the original data by Norges Bank.

$$CER3^j = \frac{1}{23}\sum_{t=1987}^{2009}\left(\frac{Sifo\ consumption}{Disposable\ income}\right)_t^j$$

j = 0-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75-, All

Appendix 2. Results when using the DSI3 measure

With DSI3, the maximum loan rate is, as expected, in general higher than with DSI1 and DSI, and there is a less clear downward trend. The explanation to the latter is a declining consumption to income ratio when using the Sifo consumption measure, while the other two measures are based on constant average propensity to consume over time.

Figure A1. The maximum loan rate (DSI3). No principal payment. Indebted households, 1987-2009. Per cent

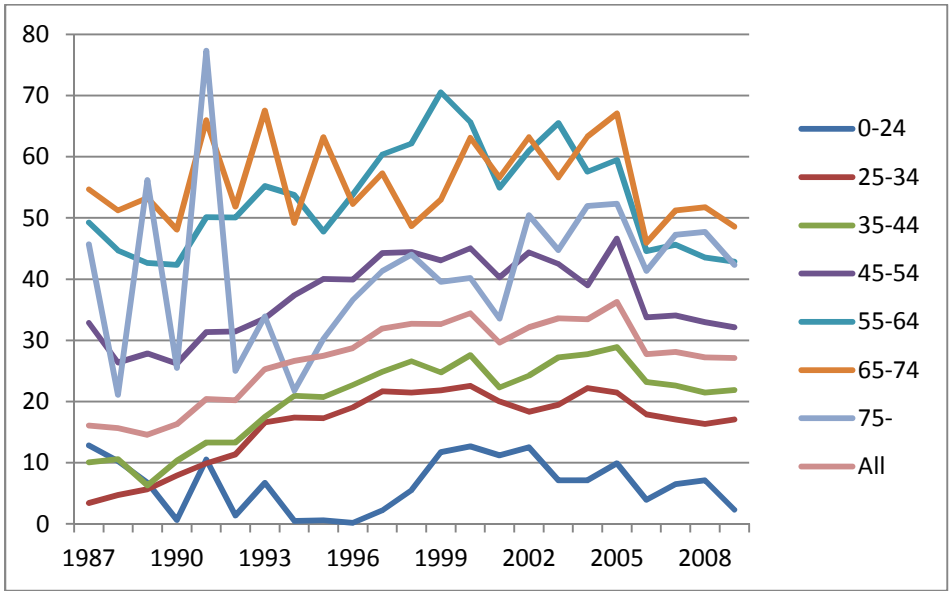
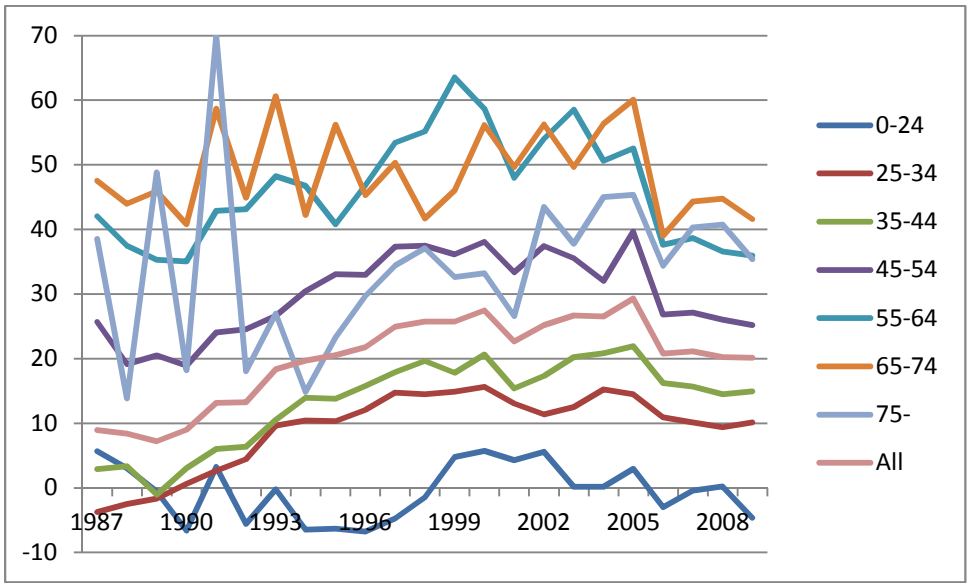


Figure A2. The maximum loan rate (DSI3). With principal payment. Indebted households, 1987-2009. Per cent



Due to a the relatively high consumption-expenditure to income ratio, see Table 1, the youngest households, i.e. the age group 0-24, are vulnerable to an increase in the interest rate according to this DSI measure.

When calculating the manageable interest increase using DSI3, we find that, with the exception of the very youngest age group, since the Norwegian banking crisis, households have been robust to significant increases in the loan rate. See Figure A3-A4.

Figure A3. The maximum loan rate minus imputed loan rate (DSI3), 1987-2009. No principal payment. Indebted households. Percentage points

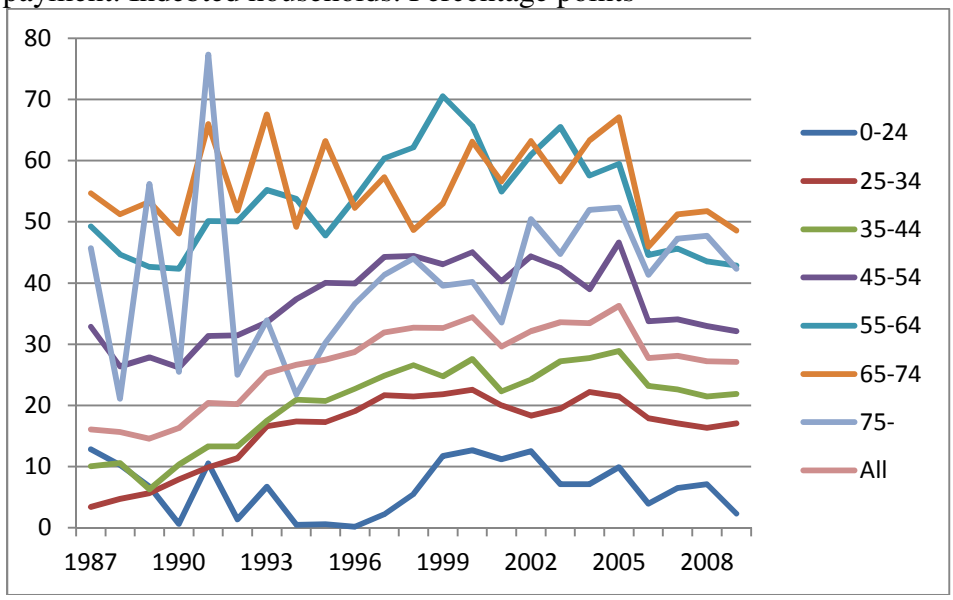
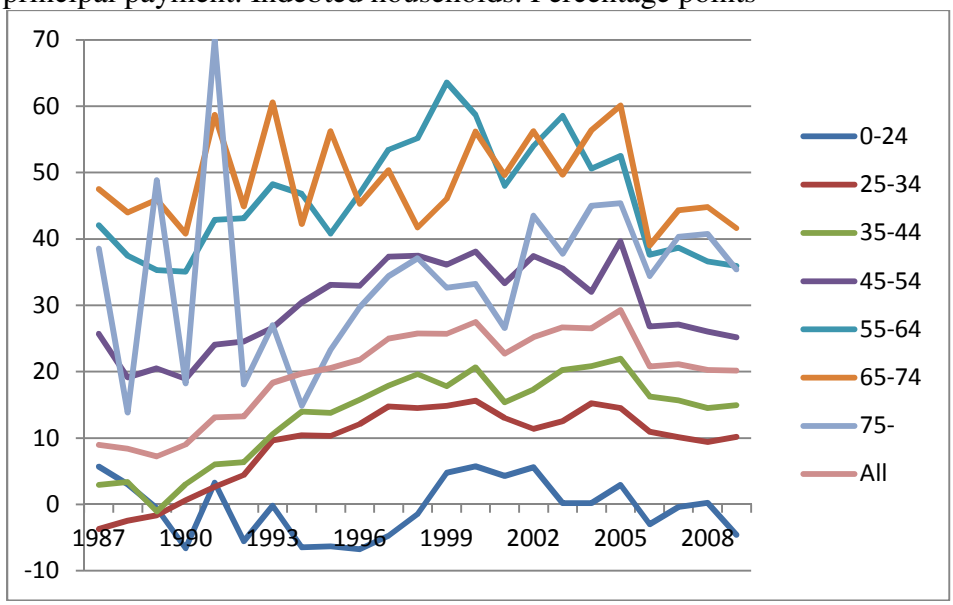


Figure A4. The maximum loan rate minus imputed loan rate (DSI3), 1987-2009. With principal payment. Indebted households. Percentage points



We now look at the maximum manageable debt to actual debt using DSI3. Again, the results are in general very different from the DSI1 and DSI2 results. At the minimum consumption level, most households would have been able to service debt many times above the actual historical levels. The very youngest age group, 0-24, are closer to their limit, however.

Figure A5. Maximum debt to actual debt (DSI3), 1987-2009. No principal payment. Indebted households. Per cent